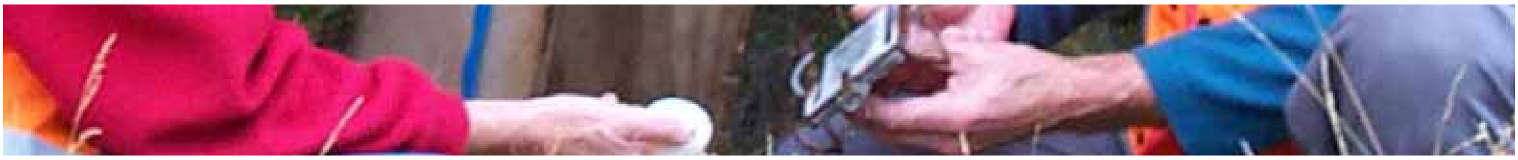


Rotoiti Nature Recovery Project Annual Report July 2005 - June 2006

St Arnaud's Mainland Island Nelson Lakes National Park

August 2007

Department of Conservation
Te Papa Atawhai

Rotoiti Nature Recovery Project Annual Report July 2005 – June 2006

ST ARNAUD'S MAINLAND ISLAND, NELSON LAKES NATIONAL PARK

Compiled by:

Paton B.R.; Maitland, M.J.; Bruce, T.A.; Wotherspoon, J.A.; Brow, A.K.; Leggett, S.A.; Chisnall, D.T.

August 2007

Published by:
Department of Conservation
Nelson/Marlborough Conservancy
Private Bag 5
NELSON

S:\RNRP Annual Report

Occasional Publication No. 71

December 2006, Department of Conservation

ISSN 0113-3853
ISBN 0-478-14155-6

Cover photo: Friends of Rotoiti members Bryce & Carol Buckland

CONTENTS

Figures

Tables

Graphs

Summary

KEY RESULTS

Possum Control – Vegetation Response

Possum numbers were maintained at very low levels in the treatment area with no browse observed on the sensitive plant species monitored. Monitoring with waxed chew sticks confirmed this result. Kill trapping continued in RNRP, and a continued presence of neighbouring Animal Health Board maintenance operations may have affected local possum activity.

Rodent Control

Rat tracking indices demonstrated that the trapping regime had produced a significant difference between the treatment and non-treatment area however tracking tunnel rates peaked at 39% in the treatment area indicating a serious failure to meet the target figure during a heavy beech masting event using snap trapping alone. A trap trial comparing Victor snap traps with Thomas traps was also carried out The 2006 seedfall can just be described as a full mast event. It was also energetically high due to dominance of red beech seed. This seedfall event ranks second in both number and energetic contribution of all seedfall events recorded at this site (from 1997).

Mustelid Control

Another moderate mustelid year was experienced based upon capture records. Again, tracking tunnel data demonstrated a significant difference in presence between the non-treatment site and the treated site. A similar but slightly higher result was recorded in the Wairau Valley indicating the Friends of Rotoiti mustelid control is effective at reducing mustelid activity.

Wasp Control

An area of 1100 hectares was again treated with a non-preferred toxin, Finitron as opposed to the toxin of choice which had been Fipronil. The 2005-06 season was a high wasp season. Poisoning achieved a reduction in wasp numbers but failed to reduce wasps below the Ecological Damage Threshold (EDT). No assessment of invertebrate response was undertaken.

Response of Native Fauna

The kaka project's objective to monitor 30 nesting attempts in RNRP was achieved this year concluding the study.

Twelve females were monitored this year, nine of which attempted to breed. From eleven nesting attempts six nests were successful, producing a total of 16 chicks, seven of which were female; a much higher percentage than in previous years. An effort was also made to retrieve transmitters by mist netting outside nests.

For the first time since the extended stoat control regime was put in place, two adult females were predated on nests within RNRP, both by stoats. The mean mustelid track rate per line in the RNRP was held within the 5% threshold recommended by Greene et. al. (2004), as providing most benefit to kaka populations.

This year saw an increase in the number of robins holding territories within the survey this year. In July 2005 rodent trapping intensities were doubled in the surveyed area/Loop track which appears to have made a considerable difference to the robin population. However rodent tracking rates are still far above the 5% target.

Five-minute bird counts were characterised by high counts for several species in May. Five minute bird counts were continued but were not subjected to any substantial analysis.

Great-Spotted Kiwi

Of the nine original kiwi one has been lost and one was found dead presumed drowned. Of the seven remaining six were recaptured and the health checks indicated body conditions ranging from good to excellent. Four nesting attempts were monitored with breeding confirmed in three after the discovery of one chick and two with egg shell fragments. The Technical Report on the first phase was published. Seven further kiwi were translocated from Gouland Downs and all remain in the project area.

Advocacy and Education

The presence of kiwi has maintained high public interest and support for the wider project. Local media have been active in pursuing the birds' progress with particular focus on the transfer of a further seven bird's to the project area in May and the discovery of the chick Rito during the annual health checks. Evening talks at the Rotoiti Lodge and walks on the Honeydew Walk, predominantly for school groups, have largely maintained their popularity. Revive Rotoiti, was published twice during the year.

Volunteers and Friends of Rotoiti

Casual volunteers, predominantly from New Zealand, continue to be an important resource to support the mainland island effort with 195 days of effort. The Friends of Rotoiti attracted new members and continued a solid effort in both rat and stoat trapping. The group set up a new stoat trapping line in September which runs from the start of the Lakeside Track on the western shore of Lake Rotoiti to Whisky Falls.

Research

Landcare continue to use the project area as a research site. Three reports were received for work on malaise sample analysis, beech scale insect distribution and bellbird nesting success. Two research proposals on introduced bird competition and fuschia recruitment were also received.

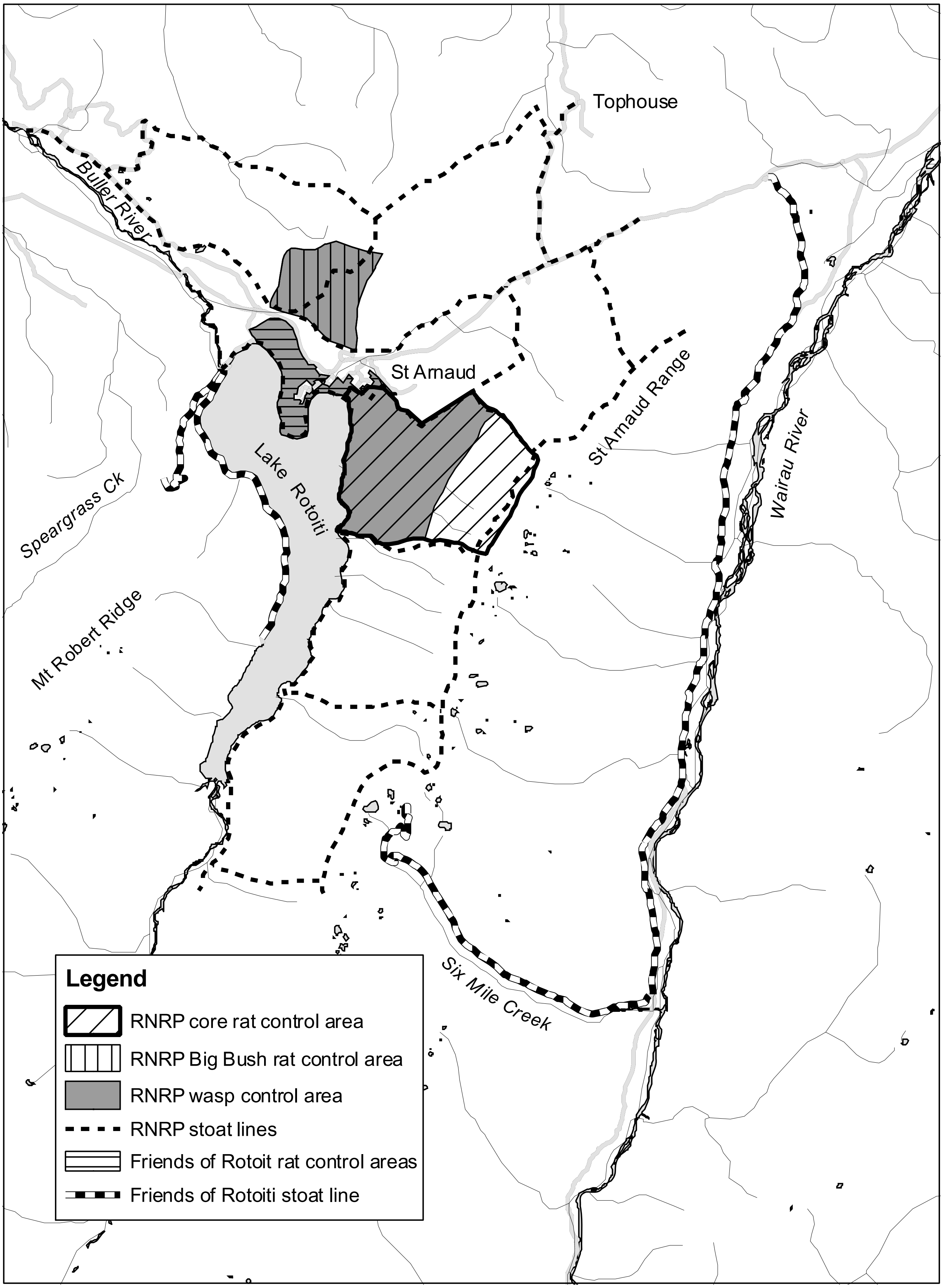
1. Introduction

The Rotoiti Nature Recovery Project (RNRP) is the name given to the mainland island project. It is based on beech forest containing honeydew, and is one of six such projects, two in the South Island and four in the North Island. The project area was extended in 2002 from the original 825 hectares on the slopes of the St Arnaud Range, Nelson Lakes National Park, to take in further forest in the Park to the north and south and part of Big Bush Conservation Area which made the total area managed 5,000 hectares. Figure 1 shows different parts of the extended area are targeted for different pests and that some of the trapping is conducted by the Friends of Rotoiti community group. The overall site was chosen as representative of a habitat type that occupies about 1 million hectares or 15% of New Zealand's indigenous forests (Beggs 2001) particularly in the northern South Island, at a location accessible to visitors. It is crossed by three popular walking tracks adjacent to St Arnaud, the main gateway into Nelson Lakes National Park.

The same two non-treatment sites were used as in previous years at Lakehead (Figure 2), situated at the head of Lake Rotoiti about five kilometres from the treatment area covering similar aspect and altitudinal range, and Rotoroa or Mt Misery (Figure 3) situated at Lake Rotoroa 18 kilometres to the west of Lake Rotoiti, which extends to lower altitude.

This annual report presents its results within the project's three objectives (Section 2.0 below). Readers are referred to the Strategic Plan (Butler 1998) for the thinking behind these objectives and their translation into a long-term programme of scientifically based activities. More detail on methods or past results can be found in the Appendices.

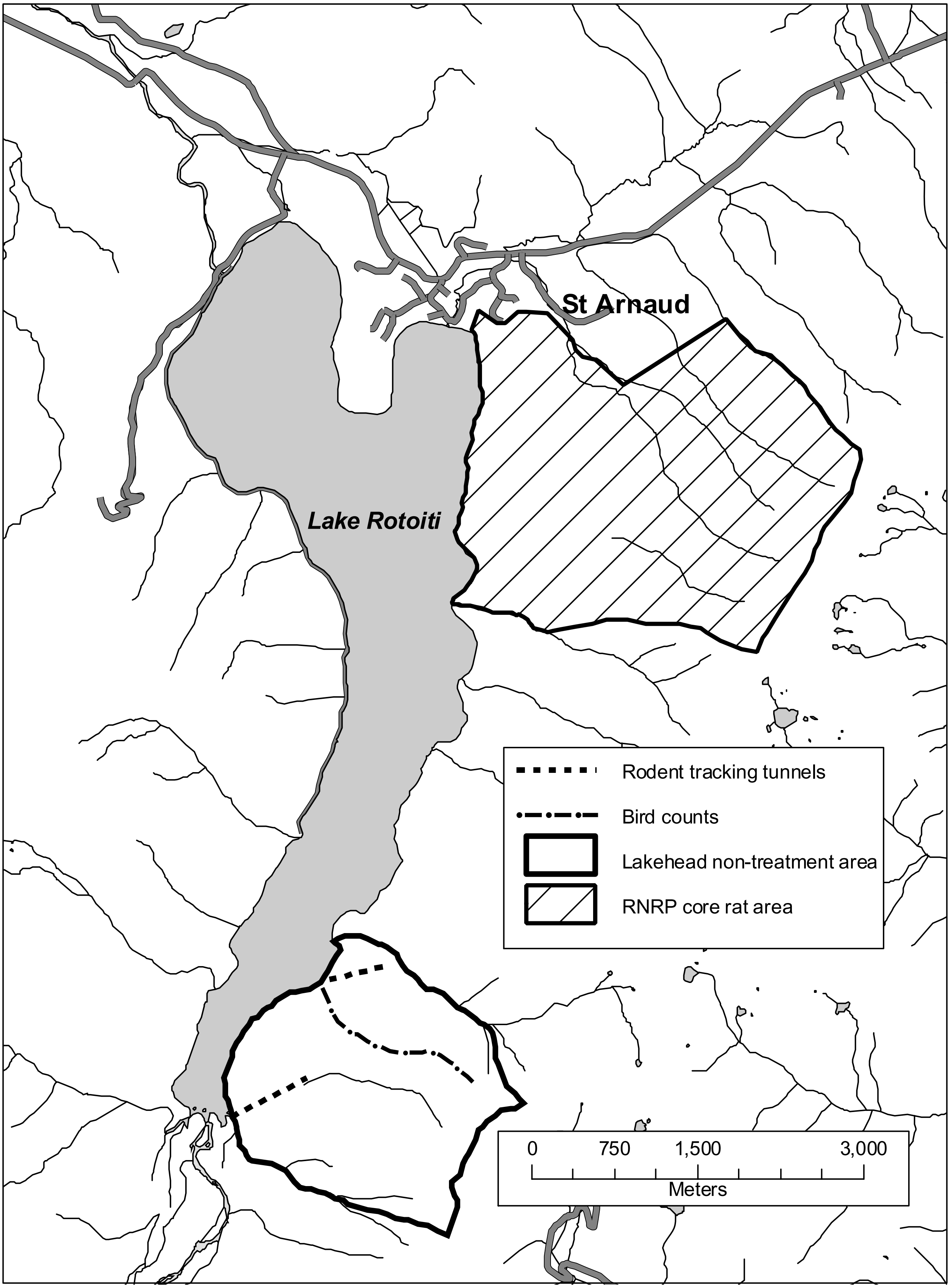
Figure 1 Pest control Areas RNRP



Compiled by IMU, Business Services, Nelson/Marlborough Conservancy

G/Projects/nelson lakes/rnrp annual report 2006/fig 1 pest control area rnrp

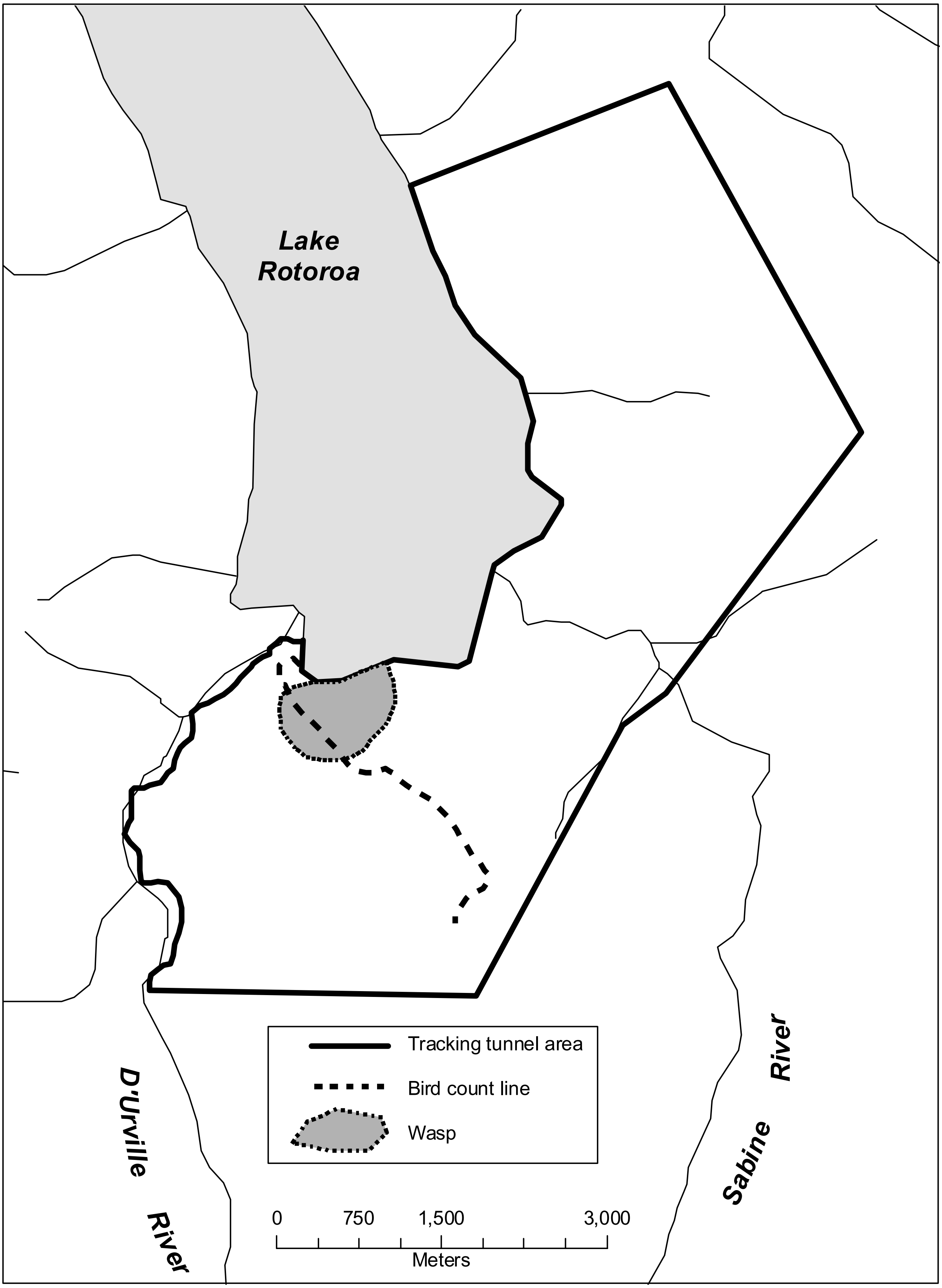
Figure 2 Lakehead non-treatment site



Compiled by IMU, Business Services, Nelson/Marlborough Conservancy

G/Projects/nelson lakes/rnrp annual report 2006/fig 2 non treatment area

Figure 3 Rotoroa (Mt Misery) non treatment site



Compiled by IMU, Business Services, Nelson/Marlborough Conservancy

G/Projects/nelson lakes/rnrp annual report 2006/fig 3 rotoroa non treatment areas

2. Project Goal and Objectives

GOAL

Restoration of a beech forest community with emphasis on the honeydew cycle.

Objectives

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

3. Results – Pest Control and Monitoring

3.1 POSSUM (TRICHOSURUS VULPECULA) CONTROL AND MONITORING

Objectives

- To maintain possum numbers long term within the RNRP at a level that:
  - Preferred browse species show increased growth/productivity and further plants re-establish.
  - Impacts on land snails are reduced to a level that is insignificant compared to other mortality factors.
  - Nesting success of kaka is maintained at a level allowing population growth.

Performance Measures

Operational

- Maintain existing kill traps and check in conjunction with mustelid Fenn™ trap lines as described in the RNRP Draft Operational Plan 2005-06.
- Plan future approach to possum control in the RNRP for inclusion in the 2006-07 Operational Plan.
- Maintain dialogue with biodiversity personnel undertaking liaison with Animal Health Board contractors as described in the RNRP Draft Operational Plan 2005-06.

Result

- Possum densities maintained at low levels within the RNRP core as assessed by the standard national possum control agencies (NPCA) Wax-tag monitoring protocol (conducted every 2-3 years).

Outcome

- Foliar browse indexing (FBI) monitoring shows an improvement in indicators within the treatment area.
- Impacts on kaka through nesting failure due to possums are reduced to a level that is insignificant compared to other mortality factors.

Methods

Refer to the RNRP 2004-05 Annual Report and RNRP 2005-06 Draft Operational Plan for detail on methods (olddm-623991).

Control

Kill trapping along the 'Borlase Boundary', 'German Village', 'Snail Boundary', 'Grunt Boundary' and 'MOR' Fenn™ trap lines as in the 2004-05 year. This work focuses on buffering the old Mainland Island core area only. During 2004-05 two rat traps were placed at each trap site along the German Village line in an attempt to reduce rat interference of possum lures. This rat trapping effort was designed to tie into a trial to investigate ways of reducing mouse interference of rat traps (see section 3.2, rodent control).

Results

TABLE 1: TRAPPING OPERATION: NUMBER OF POSSUM KILLS

MONTH	BORLASE BOUNDARY	GERMAN VILLAGE	SNAIL BOUNDARY	GRUNT BOUNDARY	MOR
July	2	0	0	2	1
August	1	1	0	0	0
September	0	1	0	0	0
October	0	0	0	2	1
November	0	0	0	1	2
December	0	0	0	1	3
January	1	0	0	1	2
February	1	1	1	3	3
March	0	1	0	4	3
April	0	1	1	2	1
May	0	0	2	2	4
June	0	0	1	0	1
Total	4	5	5	18	21
# traps	60	23	10	10	12
Capture/trap*	0.06	0.21	0.50	1.80	1.75

*Not corrected for sprung traps

TABLE 2: TRAPPING OPERATION: NUMBER OF NON TARGET KILLS

LINE	SHIP RAT
Borlase Boundary	10
German Village	0
Grunt Boundary	0
Snail Boundary	0
MOR	0

Wax-tag monitoring

A Wax-tag monitor was undertaken in May 2006 using the NPCA Wax-tag monitoring protocol. Two sites were monitored, one within the RNRP core as the treatment site and the second a 500ha site at Lakehead as the non-treatment site. The indices of abundance were 2.5 and 19.5 respectively which showed that possum densities have been maintained at low levels within the RNRP Core. Full results refer to DOCDM-88344

Chew-stick monitoring

As in previous years, possum interference with wax chew sticks (designed by Pest Control Research as precursor to Wax-Tag®) was measured on four occasions. The chew sticks are placed next to each tracking tunnel in the core area in association with the rodent and mustelid monitoring. Chew sticks are placed on a raised rodent proof platform and are left out for one night and then for a further three nights.

TABLE 3: CHEW STICK RESULTS

	% STICKS CHEWED (+/- ONE STANDARD DEVIATION)			
	AUGUST	NOVEMBER	FEBRUARY	MAY
One night	0 (0)	1 (1)	0 (0)	2 (2)
Three night	1 (1)	0 (0)	1 (1)	0 (0)

There are some unresolved issues of independence between sample units in this data. A single possum could chew consecutive chew sticks. Since completion of this work protocols for the use of wax chew sticks as a result monitoring tool have been approved (National Possum Control Agencies, 2005).

Neighbouring operations

Neighbouring possum control operations for TB vector control were contracted out by the Animal Health Board and undertaken by Southern Pest Management. As in previous years, a 3km buffer, excluding toxins such as Sodium fluoroacetate (1080) with secondary poisoning potential, has been maintained around the RNRP. It is acknowledged that neighbouring operations may impact the number of possums dispersing into the RNRP.

Tophouse Operation, 23 September 2005 – 31 January 2006 (File ref: NHT-02-16-143).

Subcontractor: Target Pest Contracting.

Raised leg-hold & kill trapping. Hand-laid toxins: 1080 Exterminator paste in bait bags, hand broadcast 1080 pellets and cyanide paste in pre-feed KK bait stations.

Overall Actual RTC achieved: 0.20%.

Upper Motueka Operation, 26 October 2004 – 24 December 2005 (File ref: NHT-02-16-142).

Subcontractor: EcoFX.

Raised set leg-hold & Kill trapping.

Overall Actual RTC achieved: 0.4%.

Discussion

In the past monitoring possum densities has been undertaken using the Residual trap catch (RTC) method with a RTC target of less than 2%. The preferred method has now changed to Wax-tag monitoring which is measured using the Possum activity Index (PAI). A target PAI needs be decided on (further research is needed to find out the relativity between RTC & PAI). The results of the Wax-tag monitor indicated significantly reduced possum numbers in the RNRP core. Wax-tag chew sticks also indicate similar or lower possum activity in the RNRP core as in the 2003-04 year. This suggests that the current level of control is adequate for protecting the old core area. Quarterly 'quick checks' using wax tags is a useful tool for quickly evaluating possum densities in the RNRP in all seasons. Outcome monitoring of *Raukawa simplex* by FBI recorded no observable possum browse indicating possum control to be effective for protecting floral values (Section 4.4.3).

Raw capture data suggests higher numbers of possums caught on the southern boundary (MOR). The next highest catching line was the southern boundary of the core (Grunt Boundary). This pattern is not surprising as no possum control exists south of MOR, while German Village, Borlase Boundary and Snail Boundary lines all border AHB control areas. It is possible that RNRP possum control efforts have been assisted by AHB activities. Bait take, presumably from rat activity, along the German Village line has remained within acceptable levels since 18 February 2005. Rat traps will be maintained as long as rats are caught along this line.

During the 2005-06 kaka breeding season, two nesting females were killed on nests within the RNRP area by stoats and one nesting female kaka was killed on a nest outside of the treatment area in Big Bush /Rainy River by a possum. It needs to be considered that although possums are not the main predator for kaka they are a factor to regard.

It is possible that possums may interfere with nesting great spotted kiwi and this may be a subject for investigation in the future.

Most possum control is dovetailed in with other activities, requiring only a slight increase in operational cost.

Recommendations

- Continue trapping of possums along existing possum trap lines.
- Add a line of 10 Warrior traps on the most southern Fenn line (Clearwater).
- Continue using the WaxTag® protocol for future possum population monitoring (every 2-3 years).
- Continue quarterly WaxTag® 'quick checks' in conjunction with tracking tunnels.
- Continue with vegetation outcome monitoring.

3.2 RODENT CONTROL, MONITORING AND RESEARCH

3.2.1 Ship Rats (*Rattus rattus*)

Objectives

To reduce rat numbers to levels at which:

- Predation of nesting birds (see section 4.1 bird monitoring);
- Predation of ground dwelling invertebrates;

- Inhibition of plant regeneration (through eating of fruit, seed);
- are insignificant alongside other mortality factors affecting these groups.

Performance Measures

Operational

- Trap density effectiveness will be examined at the end of the financial year, with indicative analyses done prior to business planning.
- Traps will be checked in accordance with prescribed frequency (see methods below).
- Trap entrance height will be examined against captures.
- 'Thomas' trap will be trialled against Victor Professional™.

Biological

- The biological response to rodent control will be measured; by means of tracking tunnels (result) and robin territory mapping (outcome measure).

Method

Rat control

Control was undertaken in 2005-06 by trapping as in previous years using one Victor Professional™/hectare serviced fortnightly (see 2003-04 Annual Report). Rodents are also captured as non-target species during both possum and mustelid control.

Results

Trapping effort

The prescribed operational performance measure was for fortnightly servicing of all traps was achieved with the exception of upper 'G' and 'H' lines which are serviced on an as required basis (see Paton *et al.,* 2004). A mean interval of 15.3 (±s.e. 0.1) days (range 0-66 days) was achieved. Examination of the database records suggests some dates have been entered incorrectly, or some entries omitted which may explain the large range.

Targeted trapping

Despite 183 additional traps and three rapid knockdown trap sessions in the lower core area at the beginning of the year 23 percent fewer rats and 90 percent fewer mice were caught in the core area in rat traps this year compared with the last. This is expressed in Table 4 below as a ratio.

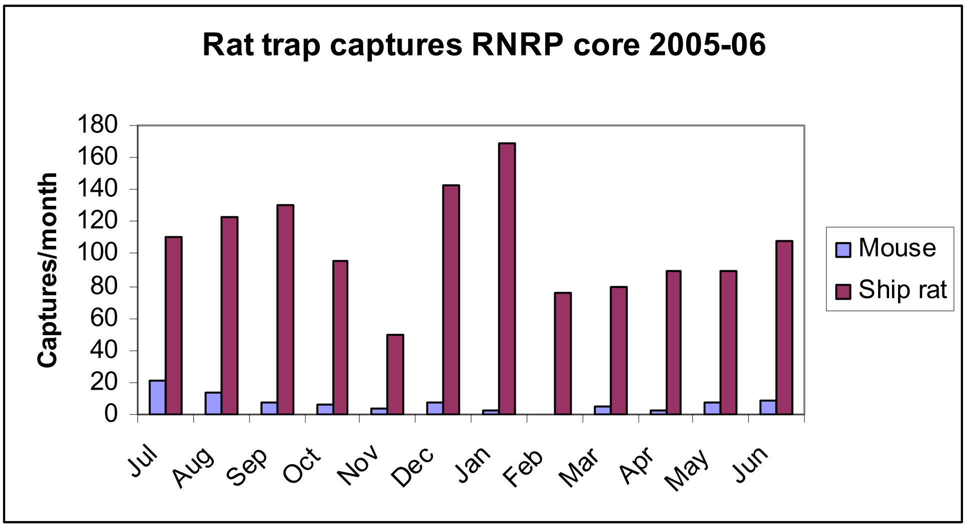
TABLE 4: TOTAL CAPTURES FROM RNRP CORE RAT TRAPS BY YEAR

	RAT	MICE	STOAT	WEASEL	TOTAL
2004-05	1660	833	9	4	2508
2005-06[1]	1271	89	3[2]	3	1366[1]
Ratio 2004-05: 2005-06	1.3:1	9.3:1	3:1	1.25:1	1.8:1

[1]Includes captures from an additional 183 traps
[2] One capture recorded as stonefly in database assumed to be stoat.

Captures by sex cannot be reported as records exist for only 40% of ship rat captures. This is due to the decayed nature of the carcass in the trap, unwillingness of observers to perform this task.

GRAPH 1: RAT TRAP CAPTURES BY MONTH, RNRP CORE



Note: Captures are recorded against date trap checked. Number of trap checks per month not always equal.

Non-targeted captures

Three bird captures were recorded this year, two SI robins in Big Bush, and one rifleman at PF13 in RNRP core. The two robins were caught in traps that had not had their entrances reduced to 40mm x 40mm. Mammalian non-target captures include three stoats, four weasels, and five hedgehogs. One weta was also caught (not identified to species). This data covers all rat trapping operational areas and trials.

Non-targeted trapping

Rats were caught in both RNRP and Friends of Rotoiti Fenn™ trapping programmes targeting mustelids, and in RNRP possum control trapping operations. See respective sections of this report. Only some parts of the RNRP possum and Fenn™ operations overlap with rat control operations. The by-catch rate of rats from these operations is considered insignificant to impact upon the targeted operations.

Friends of Rotoiti trapping

The Friends of Rotoiti community group maintain and check a network of 238 victor snap traps in coreflute tunnels around the village of St Arnaud. Three weasels and 3 house sparrows were caught in rat traps during 2005-06. This low incidence of non-target captures suggests that the modifications made last season to reduce tunnel entrance size may have been sufficient to ensure that robins are not caught.

TABLE 5: FRIENDS OF ROTOITI RAT TRAP CAPTURES

	RAT	MOUSE	HEDGEHOG	STOAT	BIRD	WEASEL
2005-06	180	282	0	0	3	3

Method

Rat monitoring

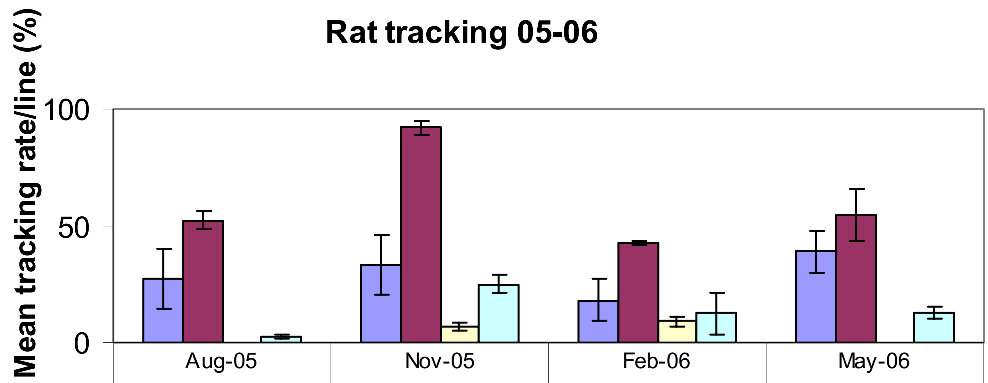
Four 'standard' tracking surveys were achieved this year at all sites with the exception of Rotoroa in August and May (poor weather). All tunnels for rodent monitoring are centrally-baited with peanut butter, as opposed to end-baited as per the Department's Standard Operating Procedure (SOP) (Gillies and Williams 2002[a]), to retain continuity with the method previously used at this site.

Ten additional tracking tunnel surveys were undertaken in the Lower RNRP core area for the trap space trial. These surveys were timed to coincide with similar moon phase at each survey (late 1st quarter to full).

Rodent monitoring using the Wairau Valley/Eastern St Arnaud Range tracking tunnel network was discontinued with the last monitor being May 2005. It had proved logistically infeasible to achieve this monitor using students from the Nelson Marlborough Institute of Technology Trainee Ranger class and accommodate the operational requirement of a fine night.

Results

GRAPH 2: RAT TRACKING 2005-06



	Aug-05	Nov-05	Feb-06	May-06
RNRP	27.16	33.2	18	39.18
Lakehead	52.5	91.96	43	54.79
Rotoroa		6.85	9.17	
Big Bush	2.5	25	12.5	12.5

Tracking indices for treated areas are different from those of the local non-treatment site at Lakehead, with the possible exception of the May survey. The Rotoroa non-treatment site has tracked very low numbers of rats over the previous few seasons. Data presented above aggregates all tracking line data in RNRP as mean tracking rate per line and includes the trap density trial areas.

Rodents were tracked when tracking tunnel surveys were run targeting mustelids. This data is not presented as it represents a 'by-catch'. However data from these surveys should be assessed at some stage for correlation with rodent targeted surveys.

Discussion

Rats continue to be present only at low levels at the Rotoroa non-treatment site. Data from this site has not been used for analysis; rather the focus has been placed upon the local non-treatment site of Lakehead. It must be acknowledged that this site is now encompassed within the expanded mustelid control regime.

The 2005 beech seed fall was similar in volume to the events of 1999 and 2002. The energetic contribution was similar to 1999, but three times greater than that of 2002. The energetic contribution of the 2005 seedfall can be considered minor and it is unlikely that this event is the cause of moderate rat activity in the RNRP and Lakehead sites through the early months of this reporting period. The 2006 seedfall event was huge and is comparable in both volume and energetic contribution to that of 2000. This event probably had a significant effect upon rat activity at these sites. (refer section 4.4.4).

The increase in rats both caught in traps and recorded in tracking tunnels in November can probably be attributed to the large beech flowering event that occurred at that time. An increase in both rats caught in traps and tracked in monitoring tunnels also occurred steadily from February through to June. This is probably attributable to the beech seedfall over this period. A sharp decline in rat activity from trap and tunnel measures was observed between November/December and February. This may relate to a scarcity of food resource between beech flowerfall and seedfall. If this is true this would indicate a probable point at which ‘prey switching’ would occur. The ability to predict and respond prior to these floral events that contribute substantial energy to the rodent population offers the greatest opportunity for circumventing a rat population irruption. Manager preparedness and flexibility are critical to this.

The potential positive outcomes of rat control are discussed under bird monitoring (Section 4.1).

Method

Rat Control Research – “Thomas” vs Victor Professional™ trap trial

A new style of trap was tested for efficacy at excluding house mice; for efficacy at killing ship rat; and to assess for attractiveness to ship rat when compared against current best practice trap (Victor Professional™).

The ‘Thomas’ trap has a similar kill mechanism to the Victor Professional ™, but has a novel trigger mechanism. See Paton *et al* 2005.

‘Strike location’ for captures was recorded to test the null hypothesis that the “Thomas trap” will have no significant difference in kill type for ship rat than the Victor Professional ™. The justification for this was that the “Thomas trap” is in development and has not been tested for ‘humane kill’, but it has a similar killing action to the approved Victor Professional™ trap and is therefore assumed to be ‘unlikely to be inhumane’. Strike location were recorded as 1= head in front of ears; 2 = head behind ears and base of neck; 3 = forelimbs; 4 = torso; 5 = hind limbs; 6 = tail. Strike locations of ‘1’ and ‘2’ are considered most likely to deliver a ‘humane kill’.

Following the paired trial at 'Weka Bush' in 2004/05 (Ibid) and subsequent data analysis the second stage of the trial was incorporated within the Big Bush rat control area. This phase involved three trap types (Steel Thomas, Aluminium Thomas, and Victor™) being set alternately at each trapping station and checked fortnightly in accordance with targeted trapping methodology. The Aluminium Thomas was not used in the pilot trial, but was very similar to the Steel Thomas with the principal differences being manufacturing material and lack of 'lip' at front edge. All Steel Thomas and Victor™ traps used in the trial had previously been used, with the Victor™. All Aluminium Thomas traps were previously unused. The trial period was 15 April 2005 to 24 May 2006, with 26 checks achieved.

Results

Twenty-six trap checks were achieved. This report includes three checks delivered in the 2004/05 year. A decision was made in November by the Area Manager to discontinue rat trapping in Big Bush as an attempt to alleviate staff pressures identified by the Biodiversity team capability and capacity review and resultant staffing instability.

TABLE 6: CAPTURES PER TRAP BY TRAP TYPE, BIG BUSH

	ALUMINIUM 'THOMAS'	STEEL 'THOMAS'	VICTOR PROFESSIONAL™
n traps	83	46	93
Ship rat captures (captures/ trap)	66 (0.795181)	40 (0.869565)	154 (1.655914)
Mouse captures (captures/ trap)	7 (0.084337)	3 (0.065217)	9 (0.096774)
Sprung empty (sprung empty / trap)	9 (0.108434)	15 (0.326087)	23 (0.247312)
Trap success (% activity = target)	90.41%	93.02%	91.12%

Only the Victor ™ trap had non-target captures other than mice: 3 hedgehogs, 1 weasel, and 2 robins.

The low numbers of mouse captures preclude the ability to adequately test the ability of 'Thomas' style traps to exclude mice. All three trap types experienced >90% of all activity being captures of target animal (ship rat).

'Trap success' is defined as proportion of total trap activity resulting in capture of target species (ship rat). For the preferred baiting method (wire coil bait filled with peanut butter placed horizontally under trigger in "Thomas" trap) this was 92% against 48% for the Victor ™ trap baited with peanut butter during the pilot trial in Weka Bush (2004/05). The 8% and 52% of trap activity for each trap type respectively represents 'sprung empty' and mouse captures combined. This allowed the 'Thomas' traps to capture more ship rats than Victor™ traps from equal numbers of trap sets (72 vs. 55 or 1.3:1).

The low mouse tracking rates in Big Bush (0-5%, see section 3.2.2) during the trial period suggests that the low incidence of mouse capture over all traps is a function of low mouse abundance and not an indication of the ability of any trap type to exclude this species.

Strike location was poorly reported by field staff (41% of all captures). Where records were taken observations were similar across traps for ship rats, with values of 85% of 'Steel Thomas', 92% of 'Aluminium Thomas' and 94% of Victor Professional™ traps achieving a type '1' or '2' strike (head and neck area). Such a strike is considered likely to be an 'humane kill' as the nature of the kill is similar to that inflicted by the Victor Professional™ trap on Norway rats (*Rattus norvegicus*) when tested for humane kill under NAWAC guidelines (B. Warburton pers. comm.). The paucity of mouse captures allows little analysis of strike location for this species; however data from this trial confirm findings from the pilot trial (Paton *et* al, 2005) whereby mice are struck across all parts of the body.

Discussion

The Victor™ professional rat trap appears able to deliver more target captures/trap than the current Thomas trap if disturbance effect can be minimised. Previous experience at this site show that in high seed years mouse captures can exceed rat captures by almost 2:1 (Butler *et al.* 2003). Where rat trapping activity can potentially be compromised by the presence (trap interference) of non-target species, or trapping may compromise non-target values (by-kill) the Thomas trap shows real potential to mitigate or eliminate these effects. It is reasonable to assume that this ability to withstand interference may extend to species other than mice, e.g. crabs, reptiles, and small mammals interfering with trap, and large mammals knocking stations. These scenarios should also be tested.

Operational scale trials of the Thomas trap should be undertaken in environments where trap disturbance or non-target activity is expected to be high.

Commentary received from trapping staff indicate that once comfortable with the operation of the Thomas trap it is favourable to the Victor™ trap due to it's manufacturing materials making it easier to clean, the pre-made bait is less fiddly, and the trap when set is safer to handle as it is more able to withstand knocks and bumps and the trigger can not slip. This manager's perspective is that there is an increased confidence that all trap sets will be similar (if not equal) as there is almost no scope for individual operator style (e.g. fine or hard set, quantity of bait). This aspect is most important when rat traps are used as monitoring or indexing tools. Additionally the stability of the trap set allows for unconventional trap placement.

Method

Effect of tunnel entrance height

Rat trap tunnel entrance height continued to be examined both for efficacy in reducing mouse by-catch and comparative attractiveness to target animals (ship rats). Standard rat trap tunnels had been set previously at the base of 23 possum kill traps on the German Village line to reduce rat interference with the possum traps. A paired trial of tunnels with low entrances (ground level) and high entrances (at top of tunnel = 60mm above ground level) began in October 2004. 10 checks in conjunction with possum trap maintenance were achieved.

Results

TABLE 7: TUNNEL ENTRANCE HEIGHT TRIAL

YEAR	ENTRANCE STYLE	SHIP RAT	MOUSE
2004/05	High	11 (19.6%)	0
	low	45 (80.4%)	5
2005/06	high	6 (15.4%)	0
	low	33 (84.6%)	0
Total	**high**	**17 (17.9%)**	**0**
	low	**78 (82.1%)**	**5**

Twenty checks of 23 paired tunnels were made. Trap tunnels with low entrances appear to be favoured by ship rats over those with high entrances. Of the 17 ship rats caught in tunnels with high entrances, only 5 (29.4 %) were caught when the low entrance tunnel adjacent was unoccupied. Analysis can not be made as to which tunnel was occupied first in this situation, but observer anecdote suggests those animals found in high entrance tunnels are fresher (less decayed). A single stoat was caught in a high entrance tunnel.

Method

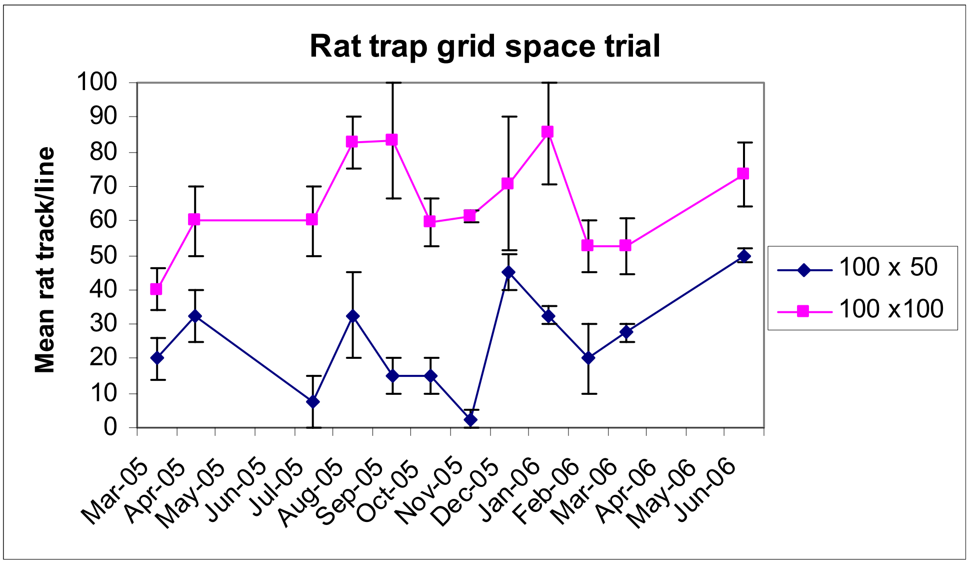
Effect of trap density

The lower RNRP rat control area was the venue for a rat trap density trial in the 2005-06 year, testing the relative efficacy of a 100m x 50m grid against the 'standard' of 100m x 100m grid. All traps and tracking tunnels had between three and six months 'weathering' on site to mitigate possible neophobic effect at commencement of trial (1 July 2005). Three rapid knockdown trap checks commenced the trial, with the intention to service all traps equally until a drop in catch rate was observed. The interval between these checks was less than one week, as close temporally as could be managed by the field staff. All traps were then serviced fortnightly for the remainder of the year.

Results

Rat capture records from the grid space trial have not been analysed for captures/trap or captures/unit area for comparison by treatment. Tracking tunnel indices are presented in Graph 2. March and April 05 indices represent pre-treatment data. The curves have been interpolated between data points where greater than planned monthly sample intervals occur. Indices in both treatments follow a generally similar pattern throughout the year except over the periods April to July and August to November. The difference between indices prior to treatment appears to re-assert itself in December and become the pattern for the rest of the trial period.

GRAPH 3: RAT TRACKING RATE BY MONTH, TRAP DENSITY TRIAL



Discussion

The rapid knockdown checks at the commencement of the trial (1 July 2005) were continued until the capture rate dropped off noticeably. This drop in capture rate is reflected in a sharp decline in tracking indices in the 100m x 50m treatment, but is not evident in the 100m x 100m treatment where tracking indices remained steady. This apparent greater treatment effect from the rapid trap checks (knockdown) in the denser grid can probably be attributed to the fact that half of all trap sites were operative in areas that had not previously had active traps, although the traps and stations had been weathered on site for many months. This suggests the weathering of stations overcame any neophobic response to these apparatus, but perhaps a neophilic response occurred to the change in state of these (i.e. the presence of bait). It would be interesting to test what effect may occur if the trial included a treatment of introducing novel trap stations at commencement of control. Previous experience at this site in the presence of moderate rat densities (August 2000) saw an immediate catch rate in traps that were set as they were laid out in the grid (Butler 2003).

Any difference achieved by the increased density of traps in this trial appeared to be lost in December, at which point the tracking index patterns between sites became similar, although difference in value was maintained. This may reflect the input of beech flower into the ecosystem. Aggregate tracking indices for the RNRP core (of which this trial was only part) and indices for the Lakehead non treatment site both showed a sharp increase at the November survey.

3.2.2 Mice (*Mus musculus*)

Since July 2000 mice have not been targeted for any control but they have been caught as a significant by-catch during rat trapping. It is noted that although mice were targeted prior to August 2000 via brodifacoum poisoning it was shown to be ineffective at reaching target indices (Butler, 2003; Ecosystems Consultants, 2000). Monitoring was carried out using tracking tunnels as for rats.

Monitoring Methods

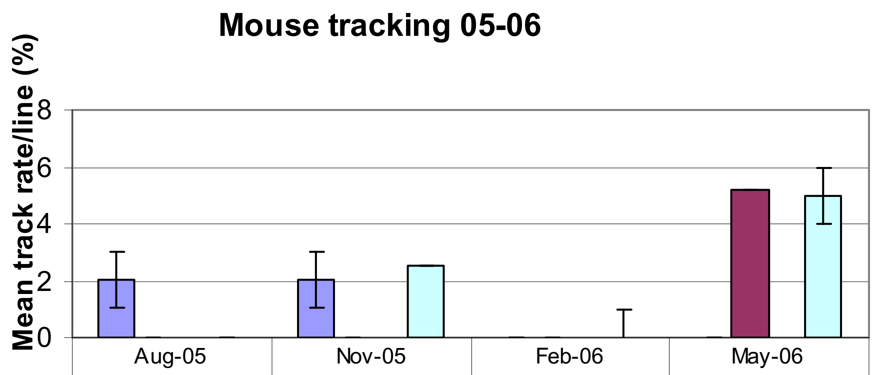
Mouse activity indices are derived from rodent tracking tunnel monitoring at RNRP, Lakehead, Big Bush and Rotoroa. Mouse activity indices are also generated from mustelid tracking tunnel monitoring at the above sites. This data is not presented as it represents a 'by-catch'.

Mice are also caught as by-catch from rat trapping operations (Section 3.2.1).

Monitoring Results

Four tracking surveys were achieved this year at all sites with the exception of Rotoroa in August and May (poor weather). The graphed results do not include the extra tracking lines put in for the trap density trial.

GRAPH 4: MOUSE TRACKING 2005-06



	Aug-05	Nov-05	Feb-06	May-06
RNRP	2.05	2.05	0	0
Lakehead	0	0	0	5.2
Rotoroa		0	0	
Big Bush	0	2.5	0	5

Rat traps in RNRP core caught 89 mice as by-catch, and 19 from Big Bush. These numbers are very low compared to previous years.

Discussion

From tracking tunnel results mice were present in low numbers at all sites throughout the year. This is corroborated by captures from targeted rat trapping. Both effectively targeting mice, and removing the negative influence of mice upon targeted rat control, remain areas of concern for this programme.

Research commissioned from Ecological Networks Ltd 2000 in 1999 to examine the optimum spacing for bait stations for control of house mice during mast seeding in a beech forest has until now not been published, but has been referred to by this project and cited as Ecological Networks Ltd 2000. David Butler was contracted under the Science Advice Fund to edit this report. This was submitted to DOC Science Publishing in 2006 and declared to require too much work to meet DOC Science standards. This would not be done as the work was not funded by RD&I. This report is now as finished as it will ever be, and is stored in Department of Conservation internal electronic files as (docdm-9520) and as Appendix 4 of this report

3.3 MUSTELID (STOAT, FERRET AND WEASEL) CONTROL AND MONITORING

Objectives

- To maintain mustelid numbers long term within the recovery area at a level that allows local recovery of populations of resident birds (particularly kaka) and re-introduction of species vulnerable to mustelid predation (e.g. mohua, tieke).
- To monitor 30 kaka nesting attempts and during this period develop a target mustelid tracking index related to kaka nesting success.
- To refine and maximise efficiency of mustelid control in the RNRP.

Performance Targets

Operational

Check and maintain all Fenn™ sets and manage carcasses as described in the 2004-2005 RNRP Draft Operational Plan, and the RNRP Operational Field Manual (Appendix 2).

Liaise with and support the Friends of Rotoiti community trapping group and national mustelid research project leaders as required.

Obtain quarterly 'relative activity' indices for mustelids at treatment and non-treatment sites as result monitoring of mustelid control and forward tracking tunnel data to national survey coordinator.

Result

No result targets have been set as of yet. Mustelids were monitored for the fourth time this year using tracking tunnels in accordance with the National Tracking Tunnel standard operational procedure (SOP Gillies and Williams, 2002[a]). Over the next year tracking tunnel indices for mustelids will be correlated with kaka nesting success to guide development of a target tracking index for future operations.

Outcome

Maintain an increasing kaka population in the RNRP (see the 2005-2006 RNRP Draft Operational Plan, and Moorhouse, (1998)).

Increase the numbers and/or range of bird species recorded in 5-minute bird counts, compared with historical data and non-treatment areas.

Contribute to national understanding of mustelid activity and the effects of control.

Control Methods

Stoats are the primary target for mustelid control. Ferrets and weasels are caught as well but may not be optimally targeted by this system. Both the RNRP and Friends of Rotoiti continued kill trapping following the same methodology as in the 2004-05 year (refer to the RNRP 2004-05 Annual Report for detail).

Liaison with the Friends of Rotoiti trapping group continued throughout the 2005-06 financial year.

Neighbouring pest control operations

Neighbouring possum control operations for Tb vector control were contracted out by the Animal Health Board. As in previous years, a 3km buffer, excluding toxins with secondary poisoning potential, has been maintained around the RNRP. However, it is acknowledged that the wider Tb vector control may still have some impact on numbers of mustelids invading the RNRP. (Refer section 3.3.1)

Monitoring methods

As in the 2004-05 year, tracking tunnels were run in the RNRP, the Rotoroa non-treatment site and within the Friends of Rotoiti trapping network in the Wairau Valley (see the RNRP 2004-05 Annual Report and the RNRP Operational Field Manual for methodology, maps and further detail).

As no target tracking tunnel index has been set, data cannot be used to assess achievement of result targets. The primary use of this data is to record the effect upon the mustelid population of trapping according to the operational performance target. Mean tracking rate per tracking tunnel line is the figure used to assess control effect.

Results

Stoats

TABLE 8: TOTAL STOAT CAPTURES 2005-06

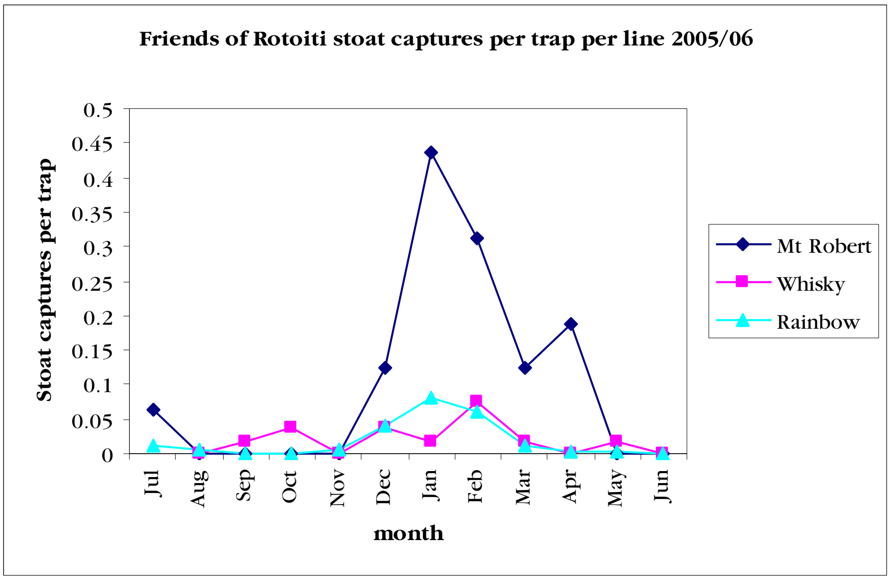
MONTH	ST. ARNAUD RANGE	BIG BUSH	RNRP TOTAL*	RAINBOW VALLEY	MT ROBERT	WHISKY FALLS
July	3	3	6	2	1	
August	8	5	13	1	0	
September	2	12	14	0	0	1
October	7	2	9	0	0	2
November	4	2	6	1	0	0
December	22	4	26	10	2	2
January	43	32	75	20	7	1
February	28	35	63	15	5	4
March	14	8	22	3	2	1
April	4	6	10	1	3	0
May	3	7	10	1	0	1
June	3	4	7	0	0	0
Total	141	120	261	54	20	12

*St Arnaud Range, Big Bush, Peninsula Nature walk and Anglers' walk combined

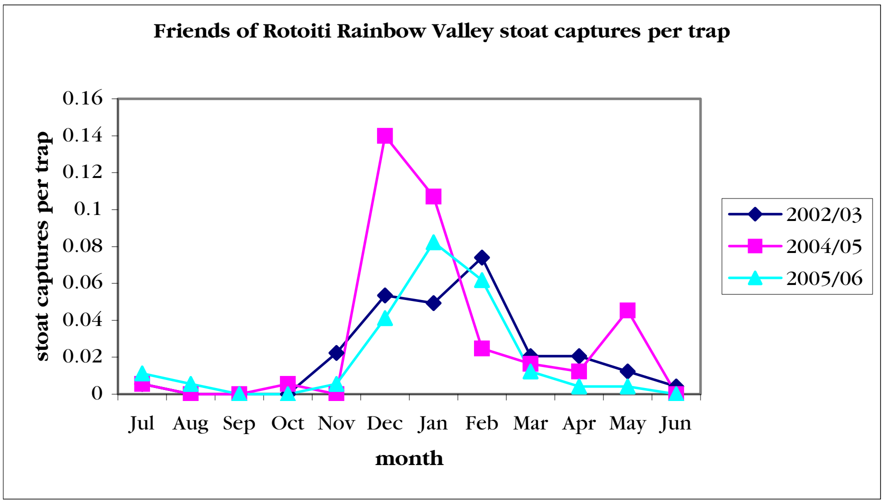
The Friends of Rotoiti set up a stoat trapping line in September which runs from the start of the Lakeside Track on the western shore of Lake Rotoiti to Whisky Falls. The trapping line consists of 24 DOC 200 traps and 30 Fenn™ traps in DOC current best practice tunnels at 100 metre spacing. Due to the start of this line being several metres away from the middle of the Mt Robert line, traps 10 to 14 on the Mt Robert line were closed.

The line will act as a buffer to the RNRP and it is hoped that the line will be extended to Coldwater Hut in the future. The Fenn™ traps on this line will be replaced with DOC 200 traps as and when Fenn™ traps are needed on other Friends of Rotoiti lines.

GRAPH 5: FRIENDS OF ROTOITI STOAT CAPTURES PER LINE – 2005/06

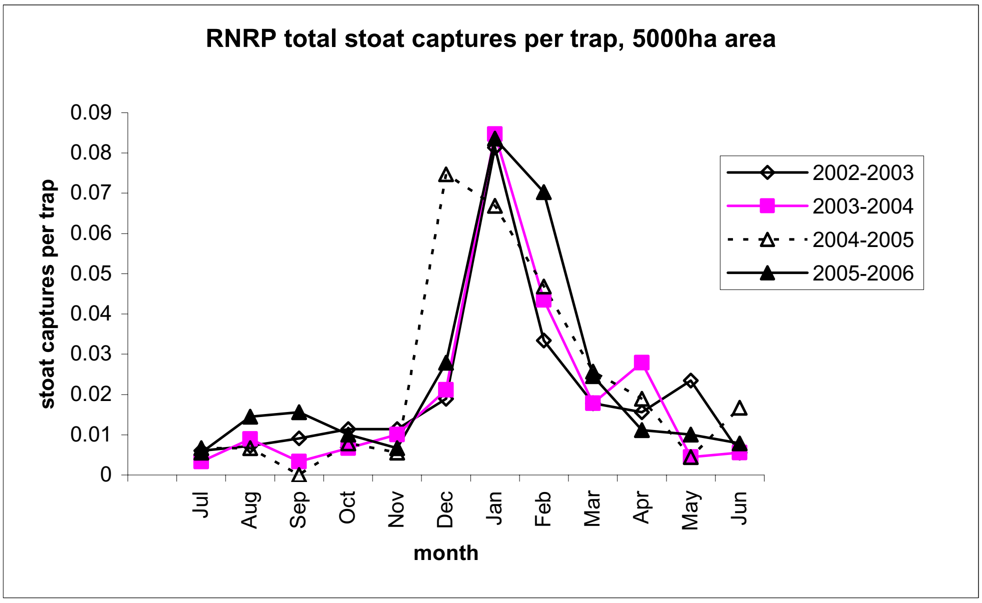


GRAPH 6: FRIENDS OF ROTOITI RAINBOW VALLEY STOAT CAPTURES PER TRAP

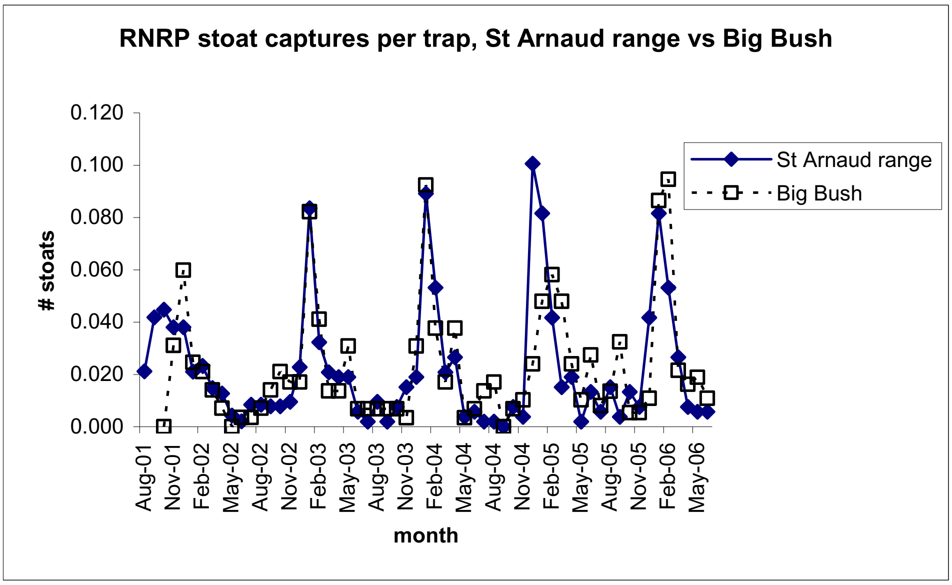


Note: Capture rates for 2002/03, (lowest capture rates per year) and 2004/05, (highest capture rates per year) are shown as a comparison to this year's capture rates which have lowered considerably from the previous year.

GRAPH 7: RNRP TOTAL STOAT CAPTURES PER TRAP: 5000HA OPERATIONAL AREA



GRAPH 8: STOAT CAPTURES PER TRAP, ST ARNAUD RANGE VERSUS BIG BUSH



Overall stoat captures in the St Arnaud range area exceeded the numbers caught in Big Bush, however this was this reversed during the months September 2005, February, April, May and June 2006.

An unknown number of mustelids were killed in the AHB Tophouse and Upper Motueka possum operations. Eight ferrets were killed in the Wairau TB survey. All captures in the Rainbow Ferret Survey and total stoat captures overall (about five at the most (Dave Grueber, Marlborough District Council, pers. comm.) were too remote to consider as impacting on RNRP and FOR trapping operations.

TABLE 9: TOTAL FERRET AND WEASEL CAPTURES, RNRP AND FRIENDS OF ROTOITI FENN™ TRAP LINES

	FERRET		WEASEL
MONTH	RNRP	FOR[1]	RNRP
July	2	0	1
August	0	0	3
September	1	0	2
October	1	1	3
November	1	0	0
December	0	0	2
January	2	0	0
February	7	1	4
March	0	1	1
April	1	1	5
May	0	0	1
June	0	0	4

[1] Rainbow Valley Fenn™ and Whisky Falls lines only, no ferrets recorded as caught on the Mt Robert Road line
[2] No weasels were recorded as caught on the Friends of Rotoiti Rainbow Valley, Whisky Falls or Mt Robert Road Fenn™ trap lines

Non-target captures

TABLE 10: FENN™ TRAP NON-TARGET CAPTURES 2005-06

SPECIES	RNR P	MT ROBERT ROAD	RAINBOW VALLEY	WHISKY FALLS
Cat	15	0	0	0
Ship rat	466	12	65	16
Hedgehog	186	2	126	0
Possum	5	0	10	2
Rabbit	64	1	17	0
Bird	0	0	0	0

By-catch in rat trapping

Three stoats and three weasels were caught in the RNRP core area rat traps in 2005-06. No mustelids were caught in the Big Bush rat trapping area. Three weasels were caught in the Friends of Rotoiti rat trapping operation, 1 in February and 2 in April 2005 on the Peninsula Nature Walk, Black Valley and Black Hill rat trap lines.

Monitoring - tracking tunnel

Tracking surveys were achieved all quarters at Rotoiti, and all except May at Rotoroa due to weather and other operational constraints.

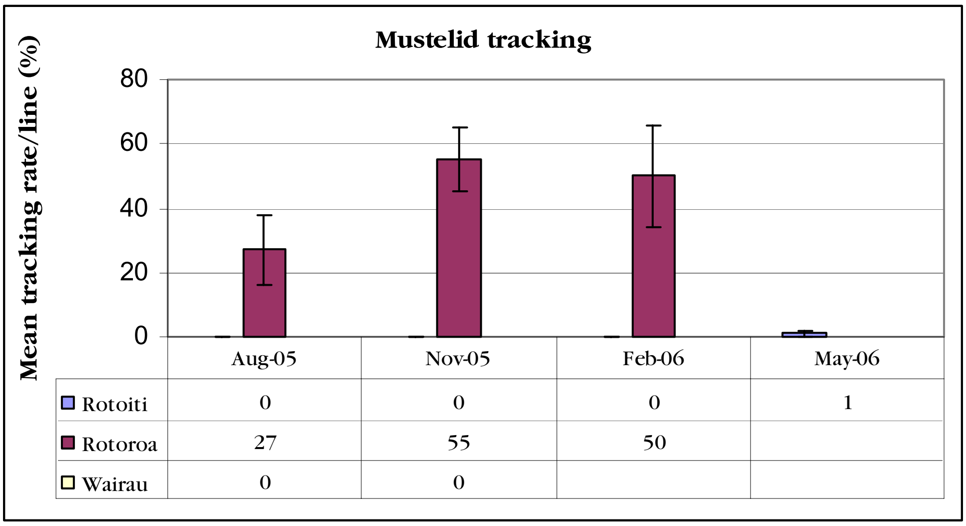
Wairau tracking tunnels were operated with the Nelson Marlborough Institute of Technology Trainee Ranger class, and volunteers (mostly Friends of Rotoiti) in November when students are on summer placement. One line has been abandoned as it was 'lost', and subsequently found but removed due to difficult terrain. Wairau tracking data can potentially be stratified for proximity to trap line but has not been done. This year data from the November and May monitors has not been interpreted and analysed by the Trainee Ranger responsible. The February data was unusable as the mustelid monitor was run for three nights using peanut butter instead of rabbit meat as bait. The November monitor had one incident of a volunteer operator setting tunnels sponge-paper-sponge rather than paper-sponge-paper. These issues highlight some of the potential pitfalls on being reliant upon inexperienced and volunteer staff to coordinate and deliver such programmes. Quality direction and supervision is essential.

TABLE 11: MUSTELID TRACKING INDICES 2005-06

		AUGUST	NOVEMBER	FEBRUARY	MAY
Rotoiti (treatment)	Lines tracked (%) n=15	0	0	0	7
	Mean track rate/ line (% (standard error))	0	0	0	1(1)
	Tunnels tracked (%) n=75	0	0	0	1
Rotoroa (non treatment)	Lines tracked (%) n=11	45	82	55	*
	Mean track rate/ line (% (standard error))	27(11)	55(10)	50(16)	*
	Tunnels tracked (%) n=55	27	47	35	*
Wairau (FOR treatment)	Lines tracked (%) n=11	15	**	***	**
	Mean track rate/ line (% (standard error))	3 (2)	**	***	**

* No survey due weather.
** Survey undertaken but data unable to be found.
*** Survey undertaken incorrectly, data unusable.

GRAPH 9: MUSTELID TRACKING INDICES 2005-06



Source graph =olddm-62353 sheet.

Hedgehogs were not tracked at either Rotoiti or Rotoroa over all surveys.

Rat and mouse indices from mustelid tracking surveys are ignored as better quality data is derived from rodent tracking surveys run immediately prior.

Discussion

Mustelid tracking indices for Rotoiti are assumed to be significantly different to Rotoroa as the values and patterns are similar to previous data which was tested and found to be true. The same is likely for the limited Wairau Valley data available.

Effects of control on mustelid numbers

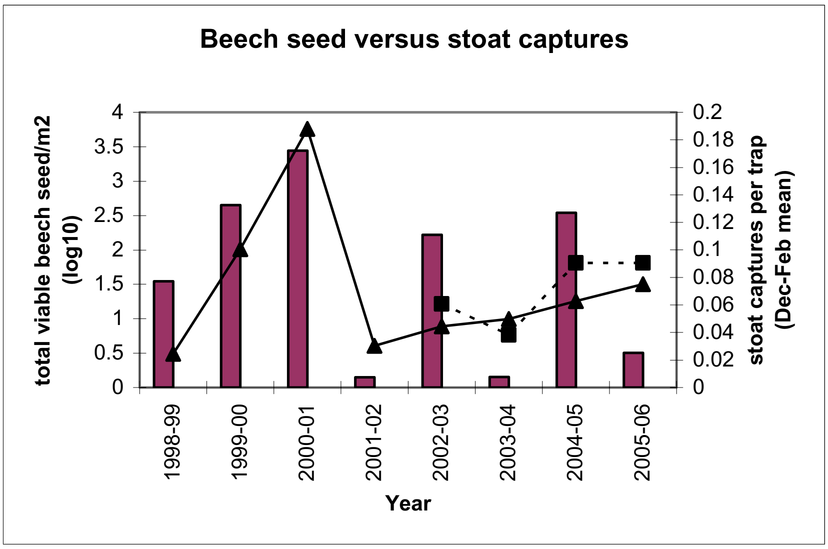
While it cannot be assumed that without predator management the number of mustelids in the environment at Rotoiti would be the same as at Rotoroa, data collected nationally suggests that without treatment, tracking indices at Rotoiti would be more similar to those collected at Rotoroa (after Maddigan, 2004). Thus results suggest that trapping in the RNRP is having a significant impact. Since inception of mustelid tracking tunnel monitoring (December 2002) the mean track rate per line in the RNRP was held within the 5% threshold recommended by Greene et. al. (2004), as providing the most benefit to kaka populations. Capture trends indicate that the 2005-06 year was moderate in terms of stoat numbers in the environment. The regime now needs to be tested in the presence of high numbers of stoats, as seen during the 1999-2000 and 2000-2001 years.

Stoat capture trends and beech mast response

All trapping operations showed a typical summer peak in captures, tailing off slowly to typical low winter captures. Stoat capture figures were similar on all lines during the 2005-2006 year, with the typical January peak. Again Wairau Valley stoat captures per trap during December, January and February were higher than RNRP stoat captures, but it is not known if this difference is significant. Overall stoat captures in the Wairau Valley were down from last year.

From 1998-99 to 2001-02 there was a strong relationship between beech mast events and stoat captures in the RNRP, with more animals caught in response to heavier beech seeding (see section 4.4.4 for yearly beech seed fall results). Since 2001-02 this response has been less clear. The reason for this is unknown, but may be influenced by the type of beech seed produced during different mast events or a data bias caused by the different trapping layout since 2001-02 with a higher ratio of internal/external trap lines than previously. Analysis of this data in a national context would be worthwhile to tease out cause and effect.

GRAPH 10: BEECH SEEDING AND STOAT CAPTURES, RNRP & RAINBOW VALLEY



Key: Column = total viable beech seed/m2 (log 10)
Solid line = stoat captures per trap, RNRP
Dotted line = stoat captures per trap, Rainbow Valley

Note: only summer peak stoat capture data is used (Dec-Feb mean). Stoat data is plotted against beech seed data from the autumn preceding the summer peak stoat data.

Recommendations

- Continue to foster the relationship between AHB contractors and DOC St Arnaud, focussing on provision of technical information regarding surrounding AHB control operations.
- A large amount of data has been collected over the years, and the opportunity exists for detailed temporal and spatial analysis of capture trends, which should be pursued.

3.4 FERAL CAT CONTROL & MONITORING

Objectives

- To reduce feral cat numbers within the Recovery Area to benefit resident native bird populations and allow re-introduction of species vulnerable to cat predation (e.g. tieke, kiwi).
- To eventually reduce to zero the number of pet cats in St Arnaud, with support of the local community.

Performance Target

Operational

Run and maintain cat trapping regime as described in the 2005-06 RNRP Draft Operational Plan. Investigate alternative cat control methods to improve our current regime.

Find or design a 'result monitor'.

Provide information and support to advocacy team as required.

Result

No result targets have been set, due to the absence of a good method to monitor cats. Captures in Fenn™ traps may act as an index of cat activity in the area, as well as cat sightings and sign however cats are not targeted with the Fenn™ trapping network.

Outcome

No result monitoring is available for cat control at present. Survival of great-spotted kiwi chicks may be used as an indicator in the future.

Methods

Fourteen 'Steve Allan Conibear™ style' kill traps operated this year. Traps were set as in the 2003-04 year (refer to the RNRP Operational Field Manual for trap set design).

Kill traps were generally checked in conjunction with other work, mainly Fenn™ trapping and rodent trapping. The checking and re-baiting periods are uneven for each trap. Generally halved rats were used as bait; however, possum and rabbit were also used. As always, problems with bait life occurred during the summer when wasps remove all protein bait within a few hours.

One Friends of Rotoiti member regularly ran one live trap at the water tank between St Arnaud and Rotoiti.

No active advocacy work was done to discourage St Arnaud residents from keeping pet cats; however discussions were held with owners on a casual basis when the opportunity arose.

Results

A total of 5050 kill trap nights (uncorrected) were run.

Two cats and one possum were caught in the Steve Allan modified Conibear™ traps (one cat was caught in April the other in June). A chimney style ground set Timms™ trap was trialled in an area of cat sign for six weeks and was successful within the third week catching one male cat.

Two cats were caught during May and July by a FOR member in live-traps set at the water tank.

Fifteen cats were caught in RNRP Fenn™ traps during the 2005-2006 year (cf. 25 in 2004-05, 11 in 2003-04 and 2002-03 and 8 in 2001-02).

Discussion

As in previous years, bait life was a major issue in the RNRP, as wasps remove bait in a few hours during the day. A long-life cat lure that is unattractive to wasps is needed.

Cat control was not a high priority for work in the RNRP in the 2005-06 year; however with the reintroduction of great-spotted kiwi importance of this work should rise. The current regime is currently ineffective and continuation of this programme needs to be discussed with the Technical Advisory Group at the 2007 meeting. It is evident from RNRP work that Fenn™ trap sets catch far more cats (proportionally) than the Steve Allan Conibears in the honeydew beech forest environment. Ground sets are apparently better at targeting cats than raised sets (Darren Peters and Scott Theobold, pers. comm.). Options for ground set cat traps need to be explored as resources allow.

In May 2006 the chimney styled ground set Timms cat trap we trialled was successful within weeks of being put out into the field. This trap is our only “roving” cat trap and is set where cat sign is detected, although it is reasonably portable the design could be improved, and bait life is still an issue.

Recommendations

- Continue targeted cat trapping as the best tool available for cat control.
- Develop a strategy for future cat control and monitoring that reflects the importance of cat control in the presence of a breeding population of great spotted kiwi.
- Support development of a ‘wasp proof’ cat attractant if the opportunity arises.
- Support the advocacy team to establish a programme to encourage responsible ownership of pet cats resident in St Arnaud, and discourage acquisition of new cats by St Arnaud residents.

3.5 WASP CONTROL AND MONITORING

Common wasps (*Vespula vulgaris*) build up to high densities in these forests in summer when they reduce the levels of honeydew, which is a significant food source for native fauna, and take large numbers of native invertebrates.

Objectives

General objectives were:

- to reduce the removal of honeydew by wasps;
- to reduce predation by wasps on native invertebrates and bird nestlings (Moller, 1990) so that the impacts of wasps are insignificant alongside other mortality factors affecting these groups;

to improve the public's experience visiting the beech forest in late summer.

Performance Targets

The performance measure was based on the Ecological Damage Threshold (EDT) (Beggs & Rees, 1999) used in previous years, to maintain wasp activity levels below 2.7 captures per Malaise trap per day.

Methods

Wasp control

Control was undertaken using the toxin Finitron™ (sulfluramid, 0.5%) in sardine cat food based bait, applied in KK™ bait stations. The preferred toxin Fipronil™ used at this site 1999-2003 was undergoing assessment by the Environmental Risk Management Authority of New Zealand (ERMANZ) during the planning stages of this operation. As the outcome regarding decision and subsequent production of poison in time was uncertain a decision to proceed with Finitron™ was made.

The 2005 operation covered the same area treated since 2002 (lower slopes RNRP core, Duckpond Stream, Brunner Peninsula, and St Arnaud Village) giving a total treated area of approximately 1100 hectares (Figure 1). Bait stations were spaced throughout the core area on a grid of 100 x 50 m. In Duckpond, village and Peninsula areas a delivery spacing approximating 200 x 50 metres was used, reflecting existing infrastructure.

Poisoning was planned for week 9-13 January in accordance with the Wasp Poisoning Decision Maker flowchart prepared by Landcare Research (refer Appendix 3). Rain defeated this plan and poisoning was postponed to 19 January.

114 kg of bait was prepared on 18 January using the accredited laboratory facilities of Landcare Research, Nelson. Bait needed to be prepared as close as possible to the date of application as once mixed it has a short shelf life. Thirty two person hours were used for bait preparation. (For Finitron™ bait preparation prescription, refer to Appendix 3). Bait was stored overnight in refrigerators.

Previous operations have identified the high labour demand of this operation, and the subsequent pressure on the team to deliver toxin to all stations in one day. As a result the operational area was split, receiving treatment over two subsequent days. On 19 January 80 grams of bait was applied per KK™ bait station giving a loading of 0.08 kilogram bait/ha in the core area, and less in other operational areas (minimum 0.04kg/ha.) on 20 January. Any remaining bait was removed on 26 and 31 January respectively. Fourteen person days of labour was used to apply bait

An Assessment of Environmental Effect (AEE) for Control of Common Wasps was prepared in December 2006 (refer Appendix 3). There were no significant outstanding issues following consultation and risk assessment.

Wasp monitoring

Malaise traps are used for result monitoring of wasp activity. Twenty traps at the Rotoiti treatment site and ten and six respectively at Lakehead and Rotoroa non-treatment sites were open from November to May and samples collected fortnightly. Wasps were counted and removed and the remainder of the sample stored in 70% ethanol. These samples are also used for outcome monitoring as covered in Section 4.2.

No wasp nest monitoring utilising the strip plots of previous seasons was undertaken.

Landcare Research provided wasp nest density and activity data they collected from strip plots at Mt Misery (Rotoroa) and Rotoiti Lakeside (near Lakehead) in March.

Wasp foraging activity for protein is assessed by monitoring non-toxic bait take (ref Appendix 3). An average of one wasp per bait is required to indicate sufficient attraction of wasps to protein for poisoning to be effective, and is the trigger point used when following the Wasp Poison Decision Maker. Non-toxic bait take assessment is usually undertaken when malaise wasp indices approach the Ecological Damage Threshold.

Results

Non-toxic bait take

Malaise trapping indices in RNRP were first observed to exceed the EDT on 28 December. This provided the trigger for non-toxic bait take assessment.

The non-toxic bait take protocol followed that described in Paton *et al*, 2005.

Last year it was recommended that triggers for poison application be tested and met across the altitudinal and habitat spectrum of the control area. This was met in part with non-toxic bait take measured in the Big Bush operational area as well as the traditional monitored site in the RNRP core. However an altitudinal spread over the RNRP core was not achieved.

Bait used was sardine cat food in aspic, the same protein medium used in the toxic bait.

Non toxic bait activity in the RNRP core area on 11 January averaged 2.3 wasps/bait. Non toxic bait activity in the Big Bush area on 17 January averaged 3.8 wasps/bait. Both values exceed the 'trigger for go' value of an average of 1 wasp/bait.

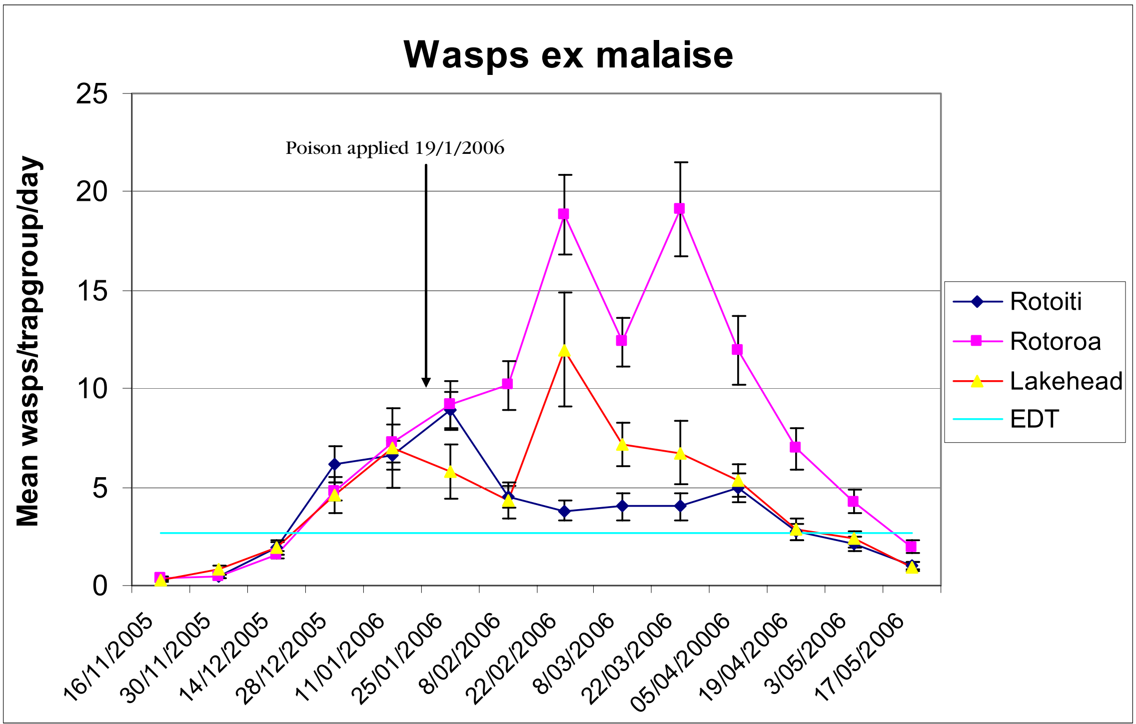
Bait take

An assessment of bait take was made by staff removing unconsumed baits on 26 and 31 January. All bait was consumed in the Big Bush/village area, and only 2kg of 74kg bait applied remained and was removed from the RNRP core area.

Wasp monitoring - malaise trapping

Malaise trapping was undertaken as planned with fortnightly collections at all sites between November and May. All sites follow a similar curve up to 11 January and Lakehead and Rotoiti sites follow a similar curve from 5 April.

GRAPH 11: COUNTS OF WASPS CAUGHT IN MALAISE TRAPS, 2005-06 (± 1 STANDARD ERROR)



Graph from OLDDM-625533 sheet 'summary means.

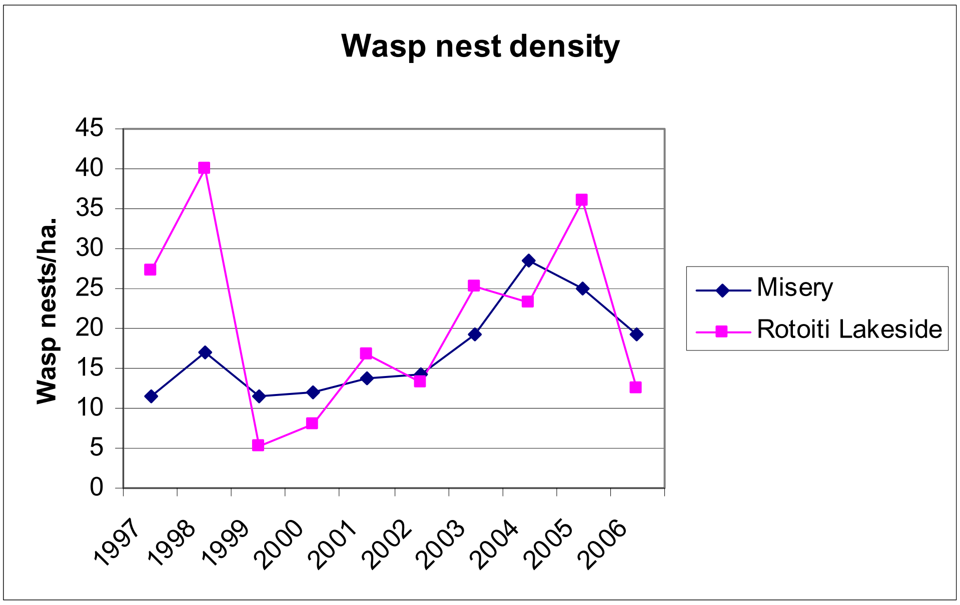
January to March weather was slightly (12.5%) drier than average (total rainfall 309.2mm, 1933-2003 average 353.4mm) with mean maximum temperatures close to the average. Wasp numbers from malaise traps at point of poisoning were approximately eight wasps/trap group/day, which is a similar value to previous seasons at this point.

Peaks of >25 wasps/trap group/day from malaise data are typical of 'good' seasons, a figure not reached at any of the three monitored sites. Lakehead peaked at 11.99 (22/2) and Rotoroa 19.11 (22/3). The disparity between peak indices across sites is noted.

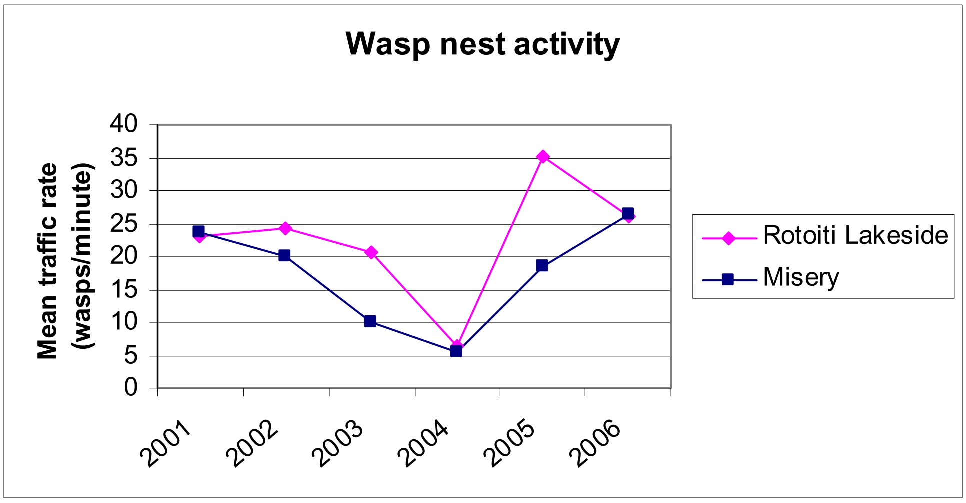
Wasp nest activity

Wasp nest transects monitored by Landcare Research at Mt Misery (Rotoroa) and Rotoiti Lakeside (near Lakehead malaise site) in March showed disparate nest densities and comparable activity rates at each site (Rees, unpublished data, 2006)(Figures 12 & 13). Nest densities are low for Rotoiti and slightly above the 1997-2006 average for Misery.

GRAPH 12: WASP NEST DENSITY (after Rees, unpublished data, 2006)



GRAPH 13: WASP NEST ACTIVITY (AFTER REES, UNPUBLISHED DATA, 2006)



Above graphs source data docdm-79584

Honeydew

The honeydew resource was not monitored this year as a clear link between wasp reduction and honeydew recovery has been demonstrated from previous operations. Honeydew quality was to be inferred from wasp reduction (see discussion).

Non-target impacts

Monitoring of non-target invertebrates was not undertaken as advice received was that we were unlikely to find anything new as past seasons had yielded similar information across years. No vertebrates were observed feeding on baits or found dead following the operation.

Discussion

The 2006-07 season was a moderate wasp season, as illustrated by mid-season wasp transects measured by Landcare Research. The unequal nest density between monitored sites is noted. It is considered probable that the Rotoiti treatment area would be more similar to the Lakehead (Rotoiti Lakeside) non-treatment area than Mt Misery due to its geographic proximity. Differences in density indices for reference sites are not unusual, and the scale of the difference this year is not significantly greater than other years.

Poisoning did not achieve a reduction in wasp numbers to values below the EDT. An average 4.5 wasps/trap group/day index was achieved during the period 8 February to 5 April. Maximum differential between RNRP and Lakehead malaise figures (22 February) suggest a 68% reduction. This is better than values observed for similar 'windows of toxic effect' using Finitron™ in past years (e.g. average 9.5 wasps/trap group/day and 45% reduction at point of maximum differential in 2004/05).

Performance measures specified in the Strategic Plan (Butler, 1998) and used during the earlier years of wasp control at this site before adoption of the easier to measure EDT specify a reduction of wasp nest density (or equivalent wasp reduction) to 2/ha. (after Thomas et al., 1998), or a 92% reduction in wasps to avoid reduction of standing honeydew crop below 2500 J/m² (after Moller et al., 1996). It is unlikely that wasp nest density was reduced to 2/ha. If the pre-poisoning density was 12/ha as recorded at the nearby lakeside site (Figure 13), it would have required an 83% reduction in nest numbers to achieve 2/ha post-poisoning. Similarly wasp numbers were apparently not reduced enough to maintain honeydew above the target.

Achieving the EDT, or the earlier performance measures, gave confidence that wasp control achieved the desired benefits: mitigating the predation pressure on highly vulnerable invertebrates or maintaining honeydew availability to non-wasps. When these targets are not met the question of what the wasp control achieved is more difficult to answer. Comparison between counts in the treatment and non-treatment areas can be used to turn the question around and ask what would have happened had wasps not been controlled?

This comparison suggests that a reduction in wasp activity was achieved in the RNRP through poisoning. Malaise trap figures show similar values and rate of increase at all sites in the early season. Trajectories of the two non-treatment sites are positive whereas the treated site trajectory turns negative from 8 February, 20 days post-poison. Such a delayed impact of poisoning was seen in previous years in which Finitron was used. By 5 April there is overlap in Lakehead and RNRP values and any effect of poisoning has passed (superseded by natural events). The Misery values show no overlap with either Rotoiti or Lakehead for the remainder of monitoring (to 17 May) although do demonstrate a similar rate of decline (as demonstrated by shape of curve) from 5 April. The application of toxic baits to the treatment area seems the only explanation for these results.

Recommendations

- That X-stinguish™ (active ingredient Fipronil™) is used as best practice wasp control tool at this and other sites.
- That a 'Best Practice' for wasp control document be written to guide other projects in effective wasp control prior to 2006/07 summer season.
- That the 2006/07 wasp control programme incorporate experimental management of wasps.
- That strip plot monitoring be the principal result monitoring tool in 'operational areas' as it provides the most cost-effective way of assessing a control operation. Malaise traps provide more precise and longer time series information and should be used in experimental areas.

Community Led Wasp Control Programme

The St Arnaud Community Association has not undertaken any poison baiting of wasps for several years. Several individuals from the community did undertake individual nest destruction using Permex ™ (a pyrethroid powder) killing 350 nests, principally in the village and peninsula area before, during and after toxic baiting. This compares with 348 nests treated last season for similar effort, and 160. 65, 90 and 150 in the previous four years (Buckland, pers. comm.). The voluntary effort of these individuals is greatly appreciated by the project, and presumably by the local and visiting public.

3.6 DEER (*CERVUS ELAPHUS*) AND CHAMOIS (*RUPICAPRA RUPICAPRA*) CONTROL AND MONITORING

Objective

- The target of hunting is red deer but any chamois encountered are to be shot too. Hunting is primarily focussed upon gathering stomach samples to assess diet to guide outcome monitoring relating to deer impacts.

Results

Sightings/incidental encounters

Only sightings of animals are reported on here. Incidental records of pellets, prints, and feed sign are recorded in field diaries. These are treated as an unreliable index as not all observers will record sign, multiple recording of same sign can not be discounted, and assignation of sign to species can not be guaranteed.

Deer and chamois

There was a single encounter of deer in the Big Bush area: two animals seen on the Black Sheep Gully Fenn line in January. No chamois encounters were recorded, although the Field Coordinator recalls mention of sighting(s) on the St Arnaud Range Fenn line from project staff.

Hunting

No hunting effort was undertaken by project staff this year.

Recreational hunting effort is unknown, although much of the site, excluding Big Bush is a closed hunting area due to presence of field staff, past history of toxin use, and potential conflict with other park users.

Discussion

Deer and chamois numbers continue to be at low levels. Outcome monitoring of deer impacts/control still remains to be designed and implemented, as do outcome targets.

3.7 PIG (*SUS SCROFA*) CONTROL AND MONITORING

Objective

- Most of the project area is historically free of pigs. The northern St Arnaud Range and Big Bush hold resident pig populations, and incursions south into the remainder of the project area are occasional. Such incursions or expansion in range to new areas are to be prevented, principally as a biosecurity measure.

Method

Infrequent operation and monitoring of one pig live capture trap.

No other pig control work was planned this year, although the capacity to respond in a reactive manner to pig interference with management tools or expansions in range was allowed for.

Results

Pig trapping

One pig live capture trap is located in the National Park bordering the Beech Hill subdivision, an area frequented by pigs, especially during times of 'range expansion'.

The trap has been baited with either commercial pig nuts or goat carcasses on an intermittent basis. This has been infrequent as the trap is a live capture trap requiring daily checking it is very time consuming, and the remote monitoring device is considered too unreliable to negate this requirement.

No captures were recorded.

Sightings/incidental encounters

Only sightings of pigs are reported on here. Incidental records of pellets, prints, and feed sign are recorded in field diaries. These are treated as an unreliable index as not all observers will record sign, multiple recording of same sign can not be discounted, and assignation of sign to species can not be guaranteed.

A single staff encounter of four piglets and one sow (SRN Fenn line, December) was recorded. This area is historically well utilised by pigs, and thus no hunting response was initiated.

An additional report was received from a local resident of a mob of eight pigs seen on the private land/National Park boundary near the SH63/Tophouse Korere Rd intersection.

Ground hunting

No hunting of pigs by project staff was planned this year. Again one keen staff member was permitted to carry a firearm when undertaking trapping activities in areas utilised by pigs. Nil return recorded from this. No record of hunting effort kept as this was an incidental activity.

Recreational pig hunters are restricted in their activities in the RNRP as approximately two thirds of the area falls within the boundaries of Nelson Lakes National Park, from which dogs are excluded. Additionally within this area is a permanently closed area due to presence of field staff, past history of toxin use, and potential conflict with other park users. The remaining third of the RNRP falls largely within Big Bush Conservation Area where hunting (with dogs) is allowable subject to conditions of hunting permit and Pesticide Use Summaries.

Discussion

The staff encounter rate with pigs is consistent with numbers indicating a 'low pig year' from previous seasons. The efficacy of pig trapping will continue to be monitored, including through a 'high pig year'. Costs, trap types, baits, and remote monitoring tools should all be investigated.

3.8 HEDGEHOG (*ERINACEUS EUROPAEUS*) CONTROL AND MONITORING

This year Fenn™ traps caught 186 hedgehogs within RNRP, most between October and April. Friends of Rotoiti caught an additional 126 on their lines, all of them in the Wairau Valley. Five hedgehogs were caught in rat traps in the big Bush rat trapping area between mid January and early March.

Hedgehog prints were not recorded incidentally through the tracking tunnel programme.

3.9 HARE (LUPUS EUROPAEUS) AND RABBIT (ORYCTOLAGUS CUNIULUS) CONTROL AND MONITORING

No planned control or monitoring was undertaken for hares or rabbits.

3.10 WEED CONTROL AND MONITORING

Weed control within the mainland island falls under the Area Office weed programmes. Weed sightings are reported by RNRP staff, and small incidental encounters of weeds are often treated manually at the time of encounter (e.g. rowan, cotoneaster and Douglas fir). This is an area of poor record keeping, particularly with respect observations/encounters, and no records exist for the 2005/06 year.

4. Results – Monitoring of Native Species and Systems

4.1 BIRD MONITORING

Objectives

- Programme objective: to increase bird numbers through the reduction of predation and competition by pest species.
- Monitoring objective: to document changes in bird populations and determine those that relate to pest control programmes.

4.1.1 Multi-Species Bird Monitoring – 5-Minute Counts

Objective

- To document changes in bird populations and determine those that relate to pest control programmes.

Methods

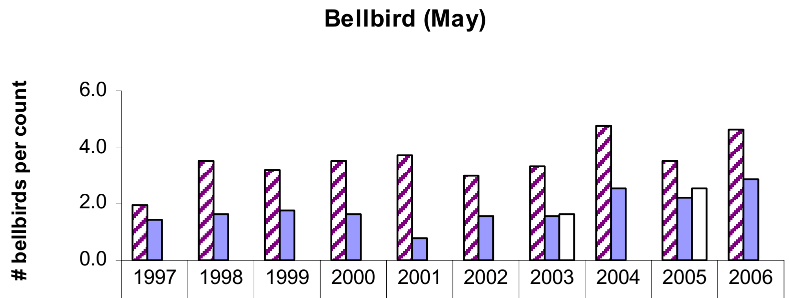
Five-minute counts were undertaken on the same transect lines within the project area ('St Arnaud') and at Lakehead ('Lakehead') and in the non-treatment area ('Rotoroa') as in previous years. Full November, May and February counts were carried out at the St Arnaud and Lakehead sites. There were two counts carried out for February at Rotoroa. Counts were again done to a standard technique based on Dawson & Bull (1975) (see RNRP Annual Report 2003-04 for further detail).

Results

Graphs 14-24 summarise the results for a range of native and introduced species at the St Arnaud, Lakehead and Rotoroa sites. No counts were done at Rotoroa during May 2002, May 2004 and May 2006. No counts were done at the Rotoiti sites in November 1998. Heavy snowfall following the first May 2005 count at the St Arnaud and Lakehead sites impacted replication of these counts and in the absence of further analysis only one days data from this time period has been presented.

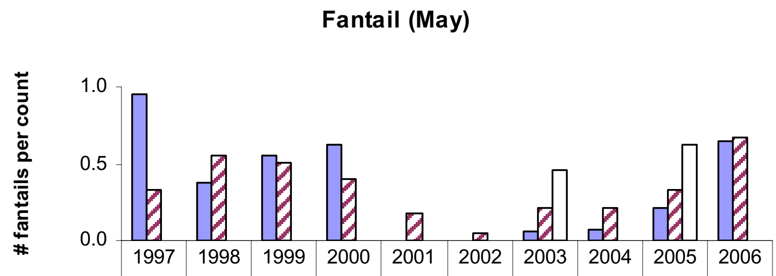
May data only is presented, as this is thought to represent most accurately numbers of birds recruited into the local populations following breeding. May counts are thus not influenced so much by breeding behaviour or differences in breeding season (for example longer breeding/late breeding, etc), with the possible exception of yellow-crowned parakeets which are capable of breeding all winter during a beech mast.

GRAPH14: BELLBIRDS (MAY)



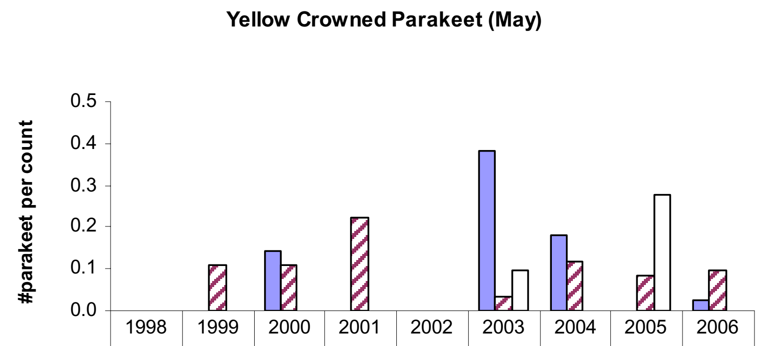
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
St Arnaud	1.937	3.492	3.175	3.524	3.698	3.000	3.349	4.786	3.542	4.619
Lakehead	1.452	1.619	1.738	1.619	0.762	1.536	1.548	2.536	2.214	2.881
Rotoroa							1.651		2.517	

GRAPH 15: FANTAILS (MAY)



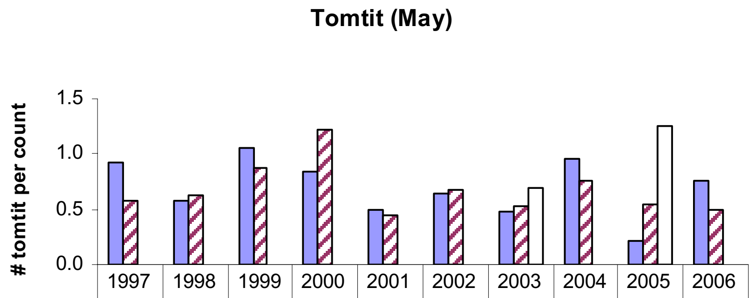
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.950	0.380	0.548	0.619	0.000	0.000	0.063	0.071	0.214	0.643
St Arnaud	0.333	0.555	0.508	0.397	0.174	0.050	0.210	0.214	0.333	0.667
Rotoroa							0.460		0.621	

GRAPH 16: YELLOW CROWNED PARAKEET (MAY)



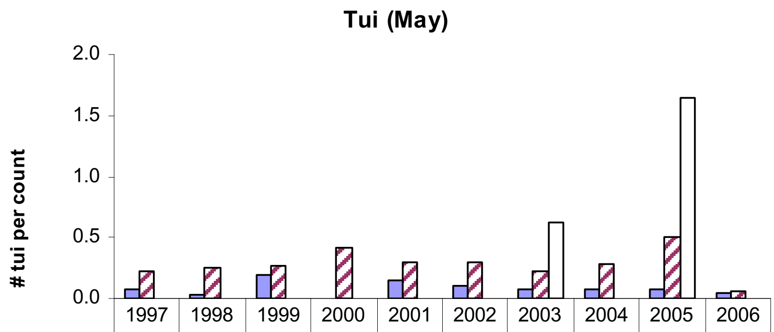
	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.000	0.000	0.143	0.000	0.000	0.381	0.179	0.000	0.024
St Arnaud	0.000	0.111	0.111	0.222	0.000	0.032	0.119	0.083	0.095
Rotoroa						0.0952		0.2759	

GRAPH 17: TOMTITS (MAY)



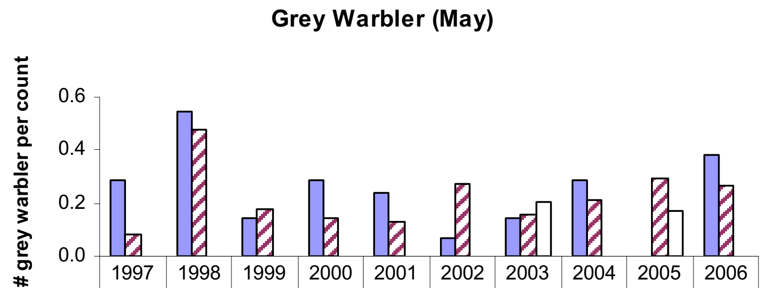
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.929	0.571	1.048	0.833	0.500	0.640	0.476	0.964	0.214	0.762
St Arnaud	0.571	0.619	0.873	1.222	0.444	0.680	0.524	0.762	0.542	0.492
Rotoroa							0.698		1.259	

GRAPH 18: TUI (MAY)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.071	0.024	0.190	0.000	0.143	0.107	0.071	0.071	0.071	0.048
St Arnaud	0.222	0.254	0.270	0.413	0.301	0.290	0.222	0.286	0.500	0.063
Rotoroa							0.619		1.638	

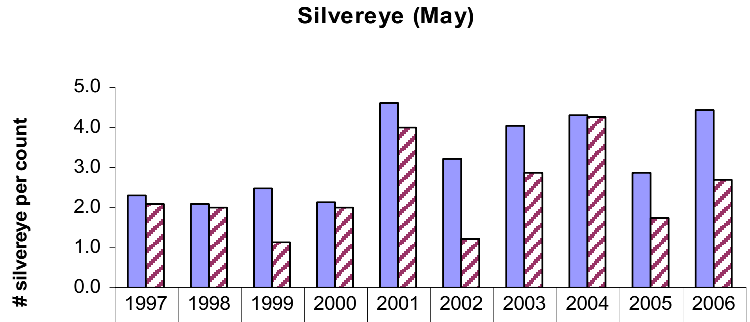
GRAPH 19: GREY WARBLER (MAY)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.285	0.548	0.143	0.286	0.240	0.070	0.143	0.286	0.000	0.381
St Arnaud	0.080	0.476	0.175	0.142	0.127	0.270	0.159	0.214	0.292	0.267
Rotoroa							0.206		0.172	

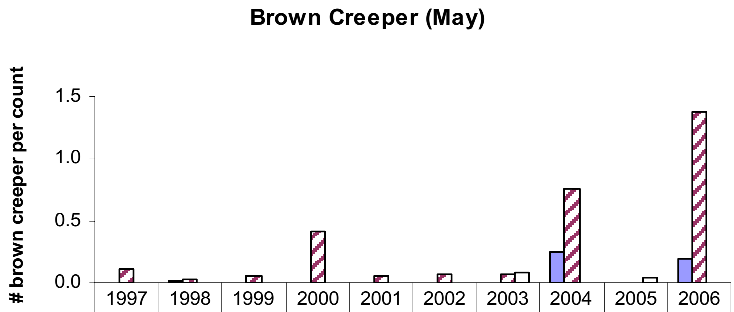
GRAPH 20: SILVEREYE (MAY)

NB. Rotoroa data is not presented. Silvereye numbers are often too numerous to count.



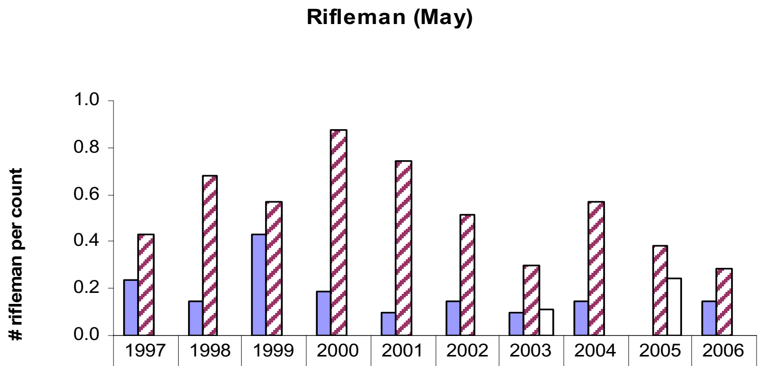
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	2.310	2.070	2.480	2.140	4.590	3.200	4.024	4.286	2.857	4.429
St Arnaud	2.080	2.020	1.130	1.980	4.000	1.210	2.873	4.262	1.750	2.683

GRAPH 21: BROWN CREEPER (MAY)



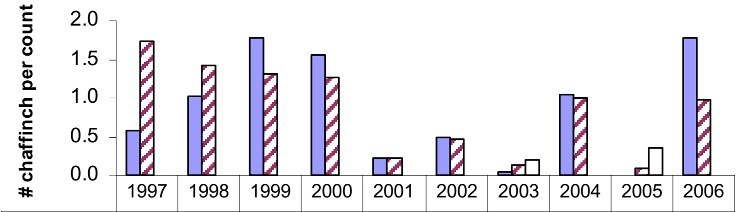
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.190
St Arnaud	0.110	0.030	0.050	0.410	0.060	0.073	0.071	0.762	0.000	1.381
Rotoroa							0.079		0.034	

GRAPH 22: RIFLEMAN (MAY)



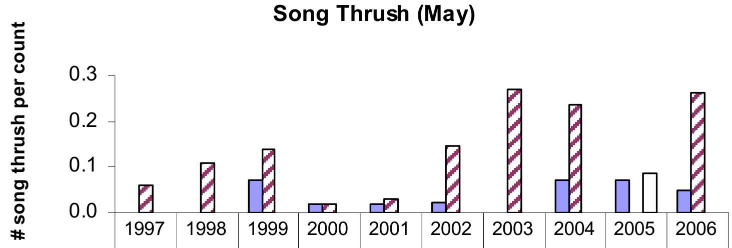
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.238	0.143	0.429	0.190	0.095	0.143	0.095	0.143	0.000	0.143
St Arnaud	0.429	0.683	0.571	0.873	0.746	0.512	0.302	0.571	0.381	0.286
Rotoroa							0.111		0.241	

GRAPH 23: CHAFFINCH (MAY)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.571	1.020	1.780	1.550	0.214	0.500	0.048	1.036	0.000	1.786
St Arnaud	1.727	1.430	1.317	1.270	0.222	0.463	0.143	1.000	0.083	0.968
Rotoroa							0.206		0.345	

GRAPH 24: SONG THRUSH (MAY)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lakehead	0.000	0.000	0.070	0.020	0.020	0.024	0.000	0.071	0.071	0.048
St Arnaud	0.060	0.110	0.140	0.020	0.030	0.146	0.270	0.238	0.000	0.263
Rotoroa							0.000		0.086	

Other species detected in five minute bird counts this year in low numbers are:

- Shining cuckoo
- Goldfinch
- Hedge Sparrow
- Kaka
- NZ falcon
- NZ pipit
- Paradise shelduck
- Redpoll
- South island robin

St Arnaud site only:

Australasian harrier

Rotoroa only:

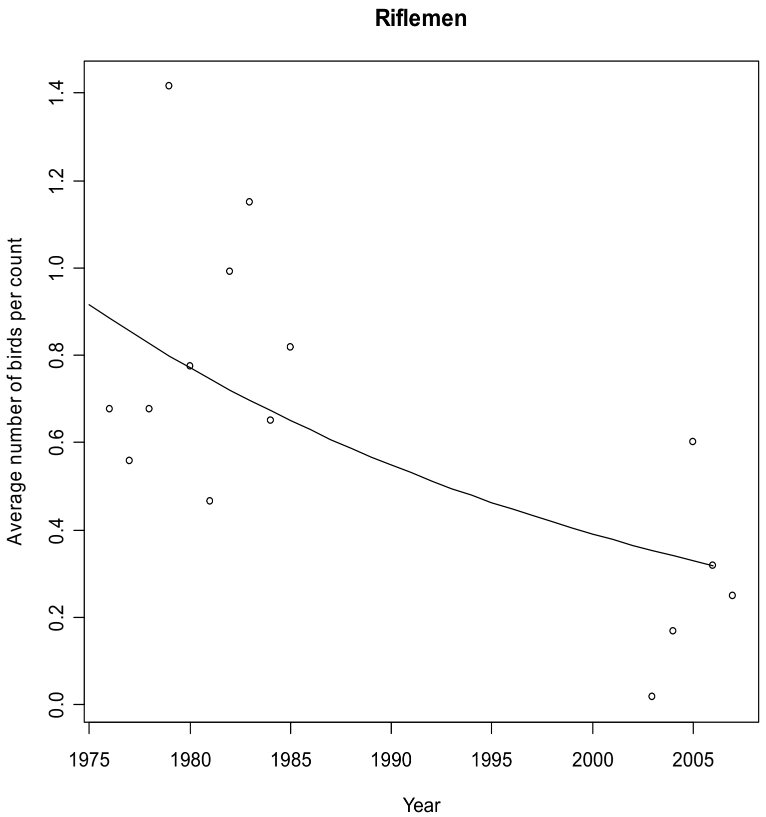
- Spur winged plover
- NZ pigeon
- Kea

Discussion

This data has only been subject to simple analysis comparing trends in mean counts. Refer to the RNRP 2003-04 Annual Report for discussion on factors influencing the data and the need for more detailed analysis. No discussion has been attempted this year due to this lack of analysis.

Bird counts from Mt Misery from 1975 till 2006 are being analysed and statistical models that account for differences between observers are being developed. Preliminary analyses of the counts without adjustment for possible inter-observer differences have been done for a couple of species – these suggest that riflemen have declined at an average rate of 3.3% per annum (Graph 25) and bellbirds at 2.8% per annum at the Mt Misery site (Graeme Elliott pers.comm.).

GRAPH 25: DECLINE IN RIFLEMAN AT MT MISERY 5MBC SITE 1975 - 2006



Recommendations

- Continue bird counts as an important monitoring tool at all sites to keep track of trends and feed into information about impacts of management.

- Further analysis of data is required to fully interpret the results (as discussed in the RNRP 2003-04 Annual Report). Funding should be sought to hire an expert to undertake this analysis and produce a paper for publication.
- Research initiatives targeting specific species need to be encouraged, to augment understanding of trends observed for these species (eg. Ceisha Poirot's work, refer Section 7.0).

4.1.2 Kaka (*Nestor meridionalis*) Monitoring

Project Objective

- To assess the effectiveness of the current stoat control regime in protecting the local kaka population.

Other Objectives 2005/06

- Conclusion of the kaka research project.
- Retrieval of live transmitters from breeding females.

Methods

Documentation of nesting success by locating nest sites, monitoring the outcome of all nesting attempts and determining causes of nest failure, were carried out as in previous years. Nest failures were investigated with the initial autopsies conducted by RNRP staff and probable predator hairs sent to Craig Gillies for identification.

Mist nets were set up outside nest trees to catch the adult females and remove their transmitters.

Nestlings were banded in the nest but were not radio tagged. All nests were monitored through to the fledging stage.

Results

2005/06 breeding season

This year we monitored 12 female kaka with live transmitters, nine adults and three fledglings from the 2003/04 clutches. Eight out of nine adult birds and one of the 2003/04 fledglings were confirmed attempting to breed. From the results this year, the projects target to monitor 30 nesting attempts within the RNRP management area was achieved concluding the kaka research project. Results for the project are currently being written by Genevieve Taylor et al.

This was the second breeding season to trial the extended stoat control regime, now following a four year knockdown period. Kaka did not breed in 2004/05 so this season's results are comparable with the 2003/04 season; with the exception that nests outside of the RNRP management area were left un-protected (i.e. no metal bands were placed on their trees).

Eight out of the nine birds that nested, did so within the management area, these nest trees were left 'unbanded' to test the Fenn™ trapping regime.

TABLE 12. KAKA NEST RESULTS FROM 2003/04 AND 2005/06

SITE RNRP	BREEDING FEMALES	NESTING ATTEMPTS	SUCESSFUL NESTS	% NESTING SUCCESS	TOTAL MALE FLEDGLINGS	TOTAL FEMALE FLEDGLINGS	UN-ID[2]
2003/4	7	9	6	66	11	6	1
2005/6	8[1]	9	5	55	8	7	1

[1] Excludes the results from one transmittered adult female kaka that nested in the Rainy river/Big Bush area outside of the RNRP management area.

[2] UN-ID (un-identified fledgling) fledged before being banded.

In March 2006 two females were killed on nests within the RNRP management area. It was the first time either female had attempted to breed and both were preyed on within days of laying their eggs.

The first female nested in a rotten spar located in Teetotal/ Big Bush roughly 400m from the Teetotal Fenn line. The actual nest floor was low at just 1m from the ground, although the nest entrance was 7m high. Results show predation by stoat.

The second female, a 2003/04 fledgling nested in a tree that had been used previously by a monitored female in 1998/99. The nest tree was located in the RNRP rodent core 70m uphill from the rat line SB 10-9 which is surrounded by Fenn lines. This female was found cached half a metre below the nest floor, results confirm that she was also preyed on by a stoat.

The kaka project suffered what is defined in the operational plan as a partial loss. Kaka nesting success addresses the Big Bush area and the St Arnaud range area separately for two reasons:

1. Landscape differences between the two areas may result in differing effectiveness of mustelid control programmes between areas.
2. Possum control differs between the two areas (possums are known to kill adult female kaka on the nest, but are predators of an unknown significance.)

At the time of these predations we were monitoring a further two kaka nests, both situated at the northern end of the management area. Because the project only suffered a partial loss the contingency plan (to protect/band any remaining nest trees when two or more female kaka are lost on the nests due to mustelid or possum predation) was not instigated. See the Rotoiti Nature Recovery Project Operational Plan 2005/06, docdm-624608 (Maitland et. Al).

Both nests fledged successfully.

Two birds nested outside of the RNRP management area, one in the Rainy River (Big Bush) and the other at Whisky Falls (western side of the lake). Both birds were loosely monitored due to their locations. The Rainy River bird's first nest was successful producing three chicks; she re-nested (again outside of the control area) and was found dead inside another nest tree, preyed on by a possum. It was presumed (from her stationary signal) that the Whisky Falls bird was also nesting, and a month after monitoring her signal she was located and found dead on the ground. We could not determine her cause of death, due to her decomposed state. (This data has not been included in the nest results)

Results outside of the breeding season

In March 2006 one of the 2003/04 female fledglings dropped her transmitter up Duckpond stream in Big Bush. Retrieval of the transmitter showed that the weak links had broken.

The third 2003/04 female's transmitter signal was last received in June 2005, over the Beebys Knob area/Richmond Ranges (well outside of the treatment area) by aerial survey.

In May 2006 a non-breeding adult female kaka. Ruby (1998/99 fledgling) was found dead on the ground within the RNRP management area, 400m uphill from the Black Sheep Gully Fenn line /Big Bush. The cause of her death could not be determined. Earlier in the season this female had a successful nest, producing one fledgling.

Mist-netting operation

Mist-net rig sites were established outside five nest tree sites within the RNRP area, three females were re-captured and their transmitters removed. The rig sites, on average, took two people two days to establish. With one mist net available to use attempts were made at each location a maximum of four times before the net was moved to another site.

Results throughout the breeding seasons

The Rotoiti Nature Recovery Project treatment area was originally an 825 hectare core block, on the slopes of the St Arnaud Range, Nelson Lakes National Park, in 2001/02 the project expanded its treatment area to take in further forest in the park to the north and south and part of Big Bush Conservation area which made the total area managed 5000 hectares.

The RNRP developed the kaka research project in 1997 to assess the effectiveness of its stoat control regime. The intensity and extent of stoat control has varied during this period. During the 1997/98 breeding season the RNRP was in the early stages of establishing the stoat trapping grid. Due to the small population of female kaka all nest trees were individually protected with aluminium bands and a ring of 25 Fenn traps. During the 2001/02 breeding season, which was the second largest beech mast on record, kaka started breeding in Big Bush and the northern extension of the old RNRP core before all the proposed Fenn trap lines were established. The contingency protocol was activated early on in the breeding season following the death of two adult females on nests; many more deaths occurred throughout this breeding season due the nests being destroyed to quickly the staff weren't able to get there fast enough to protect them.

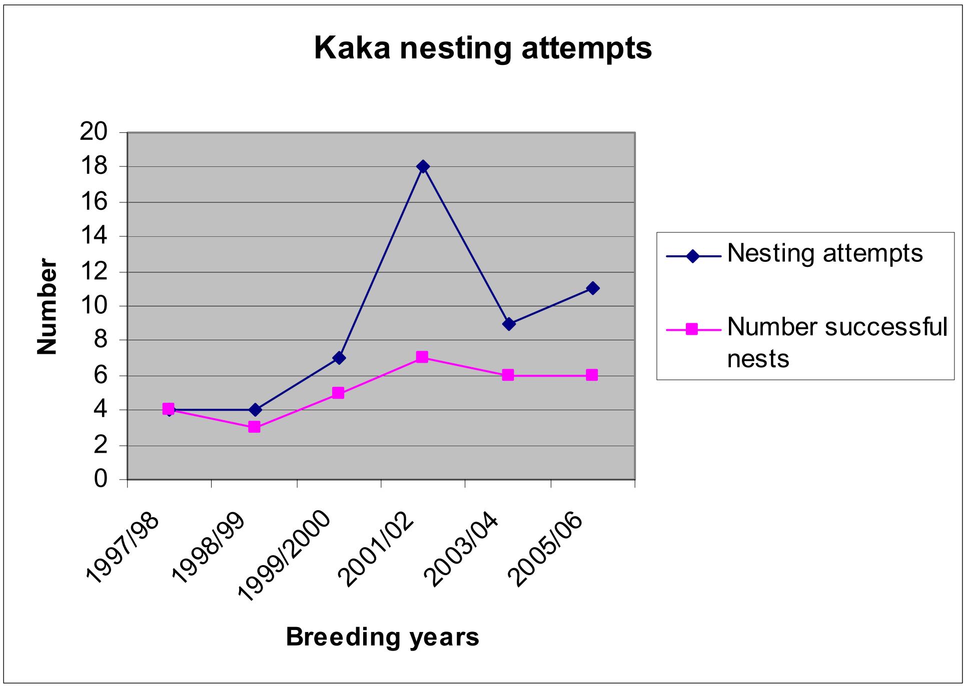
The project reached its conclusion based on those kaka breeding years when stoat control was comparable. These breeding years were 1998/99, 1999/2000, 2003/04 and 2005/06 during which 30 breeding attempts were monitored.

TABLE 13. KAKA NESTING SUCCESS AND STOAT CONTROL

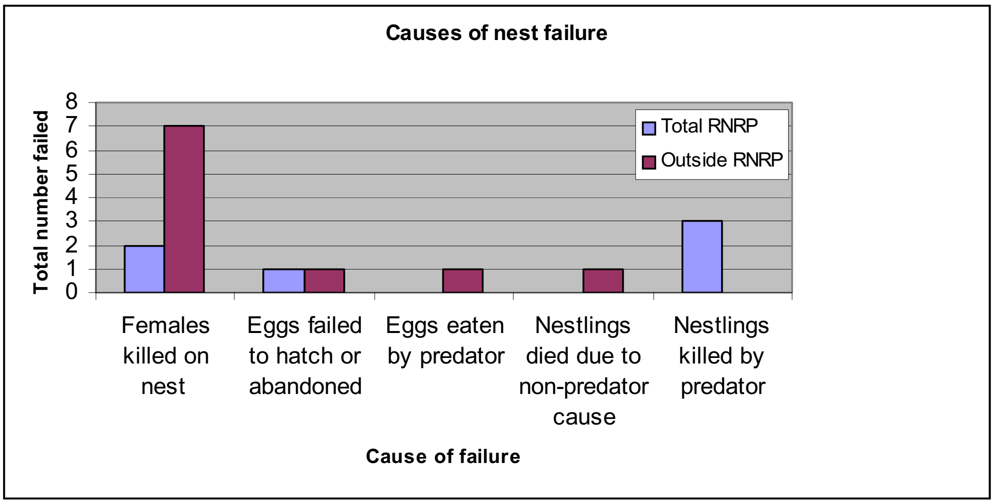
YEAR	NESTING ATTEMPTS	NUMBER SUCCESSFUL NESTS	% SUCCESSFUL NESTS	% SURVIVORSHIP OF NESTING FEMALES
1998/1999	4	3	75	100
1999/2000	7	5	71	100
2003/2004	9	6	66	100
2005/2006	11	6	55	80
Total	31	20	64.5	93.5

Only years of comparable stoat control included in the table above.

GRAPH 26: KAKA NESTING SUCCESS



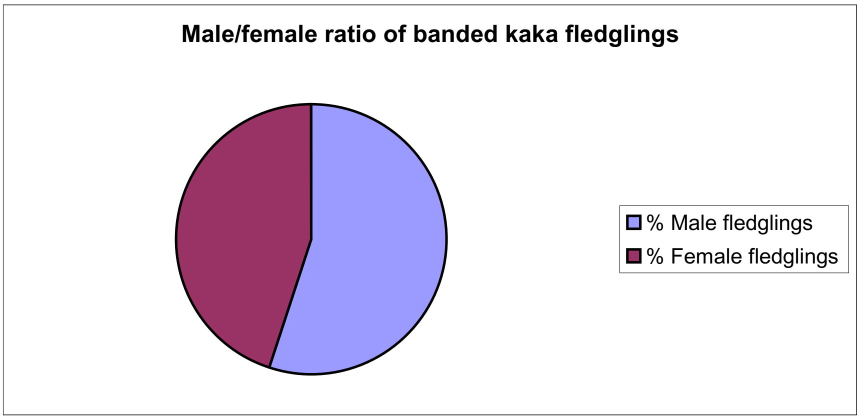
GRAPH 27: CAUSES OF NEST FAILURE



Results in Graph 27 include data from all the kaka breeding seasons.

The peak of females killed on the nest (Outside RNRP) in Graph 27, relates to the peak of nesting attempts in Graph 26 where females were being predated on nests in Big Bush prior to the extended RNRP treatment area.

GRAPH 28: SEX RATIO OF KAKA FLEDGLINGS (1997/98 TO 2005/06)



Discussion

The 2005-06 breeding season was the first time that any females within the management area have been preyed on while on a nest, since the RNRP was established in 1997.

The kaka breeding years that have comparable mustelid trapping intensities are: 1998-99, 1999-00, 2003-04 and 2005-06. It is data from these years that can be used to determine what predator control is necessary to safeguard a population of kaka.

Concerns were raised about the standard of Fenn™ trap maintenance and servicing this year, partly due to a high turn over of temporary summer trapping staff. It was noted that some traps were hard to set off and needed to be changed to waxed traps. An auditing system has now been put in place which will hopefully rectify this problem from happening in the future.

Results illustrate that nesting female survivorship within RNRP is significantly higher than that of the non-treatment area; Rotoroa where only 20% of nesting females survive a breeding season.

This year two female kaka were found dead on the ground, neither bird was cached. Possible contributing factors to these deaths are unknown, such as weakening of the kaka by illness. Remains for both birds were sent to Massey University for further analysis. Nothing of further interest resulted from this due to the condition of the birds.

During the year 2005/06 the mean mustelid track rate per line within the RNRP was held within the 5% threshold (ranging from 0% to 3%) as recommended by Greene et al. (2004) as providing most benefit to kaka populations.

Kaka project management

Table 14 gives an estimate of the total costs required to run the kaka monitoring programme from start to finish. Not included in the budget costs below, is the extensive work done prior to the establishment of the RNRP and during; by Science and Research, Landcare Research, University researchers, technical support officers and volunteers.

TABLE 14: ESTIMATED COSTS OF THE KAKA PROJECT

YEAR	ACTIVITY	OPERATING COSTS/SALARY/EQUIP $	TEMPORARY WAGE COSTS
1997/98	Kaka monitoring	7000	1000
1997/98	Field equipment	5000	0
1998/99	Kaka monitoring	8989	0
1999/00	Kaka feeder operation Big Bush	710	60
1999/00	Codfish transfer to Big Bush	95	160
1999/00	4 x kaka transmitters	1400	0
1999/00	Codfish post monitoring	0	1545
2000/01	Kaka monitoring	7344	5019
2000/01	Climbing gear, camera and monitor	3750	0
2000/01	15 Transmitters and yagi aerial	5980	0
2000/01	Batteries for camera	160	0
2001/02	tx and cameras	4178	0
2001/02	Kaka monitoring	32,944.00	0
2002/03	tx, cameras, banding and climbing gear	5630	0
2002/03	Kaka monitoring	11,184.00	0
2003/04	Kaka monitoring	7040	5,995
2003/04	Fauna monitoring contractor	0.00	5,220.00
2004/05	Kaka monitoring	1792	0
2005/06	Kaka monitoring	26,282.00	3147
2005/06	Equipment and maintenance	814	0
	Total Costs	**$152,438.00**	

Recommendations

- Remove the transmitters from the remaining two females during the next breeding season. Record their nesting results as per operational plan.
- Continue to record sightings of banded birds, correlate with old banding data for confirmation on birds identity, age etc.

4.1.3 Robin (*Petroica australis*) Monitoring

Objective

- To assess the effectiveness of the rat control regime in protecting the local robin population.

Methods

Territory mapping was undertaken, as in previous seasons, using survey methods as set out by Powlesland (1997). Refer to the RNRP 2003-04 Annual Report for further details.

Results

Territory mapping

Four pair of robins holding territories were detected in the survey area in 2005-06 (Table 15).

TABLE 15: NUMBERS OF ROBIN PAIRS HOLDING TERRITORIES IN SURVEY AREA

DATE	NUMBER OF PAIRS	SINGLE MALES	SINGLE FEMALES
August 1998 - February 1999	5	?	?
August 1999 - February 2000	5	?	?
September 2000 - February 2001	6	2	0
September - October 2001[1]	6	2	0
September 2002	2	2	1[2]
September 2003	2	1	1[2]
September 2004	1	1	0
September 2005	4	0	0

[1] Lower five lines in Water Tank block not surveyed in this year.

[2] Breeding status of this female (same bird) is uncertain. She was seen in the vicinity of a male in both years, but never exhibited positive pair-bond behaviour and is thus considered a single female by this data.

Note: numbers differ from those in the 2001-02 report, to include pairs present in the lower five lines of the Water Tank block in 2000-01; and that 2001-02 was the first time Powlesland's protocol was followed for territory mapping.

Discussion

In July 2005 rodent trapping intensities were stepped up in the water tank and loop section of the rodent grid, which is also the robin survey area. Further rodent traps were added to this section of the grid going from 100m x 100m trap density to a 50m x 100m density, which may explain the sudden rise in robins detected during the September 2005 survey. See section 3.2.1 on Ship rats.

The robin that was confirmed to have avian pox last year was found dead on the ground in July 2006. Results from Massey University showed that there were no fractures or evidence of trauma; possible causes of death were starvation/exposure or metatarsal deviation the possible result of a bacterial infection at the site of the avipox lesion (Maurice Alley, pers. comm.)

No further avian pox lesions were noted on robins this year.

Recommendations

- Continue robin territory mapping to monitor response to rodent control.
- Identify the need for further health surveillance of the local robin population and respond accordingly.

4.2 NON-WASP INVERTEBRATE MONITORING

Objectives

- To document the beneficial impacts of the control of wasps on the populations of the native insects that make up their prey.
- To examine changes in invertebrate communities across time and pest control treatments.

Methods

Malaise traps used for result monitoring of wasp activity also yield samples suitable for outcome monitoring of wasp control. Twenty traps at the Rotoiti treatment site and ten and six respectively at Lakehead and Rotoroa non-treatment sites are open from November to May and samples collected fortnightly. Wasps are counted and removed and the remainder of the sample stored in 70% ethanol.

Additionally this season weta, bumblebees, and honeybees were removed and stored separately. Weta have been proposed as indicators of ecosystem health as they are negatively affected by a range of pest animals both vertebrate and invertebrate. Weta here have not been sorted to species, sex, or age class.

Tachinidae (bristle-flies) and Tipulidae (craneflies) were not separated, sorted and counted from a sub-sample of material collected in malaise traps by contract entomologist as in previous seasons.

Results

No results are presented for any of the above groups.

Discussion

Weta will require analysis by species, sex, and age or size class, and possibly across years before any conclusions can be drawn.

Insects belonging to indicator groups were again not assessed for outcome monitoring as per Paton *et al* 2005. If the samples at Rotoiti are looked at later, it might be possible to detect differences in outcomes between years when poisoning reduced wasps below the EDT and those like this one when it did not. In those like 2005/06 Rotoiti might show outcomes more similar to the 'untreated' sites. This may help identify if any outcome measures can be attributed to the wasp control undertaken, and provide guidance for future outcome monitoring. Similarly a meta-analysis across years may yield information.

Reduction of wasps to target value below EDT may allow for analysis of invertebrate outcome indicator species at Rotoiti as an 'untreated' site. This may help identify if any outcome measures can be attributed to the wasp control undertaken, and provide guidance for future outcome monitoring. Similarly a meta-analysis across years may yield information. Discussion at the Technical Advisory Group meeting regarding invertebrate outcomes from wasp control indicated the only probable method for conclusively addressing this would be to treat and monitor the previously untreated Mt Misery site which has a decade of invertebrate community samples and data as a pre-control reference.

4.3 LIZARD SURVEY AND MONITORING

Objective

- To record changes in lizard populations in the Friends of Rotoiti and RNRP rat-trapping area and identify cause of change.

Methods

As in previous years, Terra Dumont, a Friends of Rotoiti member, operated two transects of 20 pitfall traps which were opened for four days in November 2005 only. Due to adverse weather conditions the planned opening of the traps in December and January did not occur. Refer to RNRP 2003-04 Annual Report for further detail on Friends of Rotoiti lizard pitfall trapping.

Results

TABLE 16: SUMMARY OF TOTAL LIZARD CAPTURES (RE-CAPTURES EXCLUDED) ON THE FRIENDS OF ROTOITI PITFALL TRAPPING TRANSECTS FOR 2005-06

YEAR	MONTH	DATES OPEN	MAX TEMP RANGE °C	TOTAL RAINFALL MM	WARD STREET	BLACK HILL		
					O. nig. pol.[1]	*O. nig. pol.*	*O. lin.*[2]	*O. inf.*[3]
2005	November	25-28	12.2 – 23.7	21.0	9	8	0	6

[1] Oligosoma nigriplantare polychroma (Common skink)
[2] Oligosoma lineoocellatum (Spotted skink)
[3] Oligosoma infrapunctatum (Speckled skink)

Discussion

Friends of Rotoiti traps have been operated every summer since November 2000. Because the work is undertaken by volunteers, with restricted time, weather conditions are not always optimised. More data is required before any analysis can be done.

Recommendations

- Friends of Rotoiti pitfall trapping should continue on an annual basis as a useful programme for identifying lizard species present, as an education tool and potentially for identifying population trends.
- Lizard work should remain a low priority for RNRP staff, given that a useful RNRP monitor population has not been identified and to get significant results more hours than are available need to be invested to the work. If time allows, work should focus on identification of lizard species and populations in the RNRP area.

4.4 PLANT AND VEGETATION MONITORING

4.4.1 RNRP Mistletoes – Possum Control Outcome Monitoring

Objectives

- Monitor the health of selected plants within the treatment and non-treatment areas, to test the hypothesis that the apparent decline is the result of possum browse.
- Record the anticipated recovery of the mistletoe population with sustained possum control.
- Use mistletoes to monitor possum presence/impact within the treatment area.

Methods

'Best practice for survey and monitoring of *Loranthaceous* mistletoe' using modified Foliar Browse Index (after Payton *et al.* 1997) for 30 individuals of each *Peraxilla tetrapetala, P. colensoi* and *Alepis flavida* to be followed.

Results

No mistletoe monitoring was undertaken this year. The Ranger responsible was on parental leave and no cover for this role allocated, primarily due to staffing instability and technical capacity.

Discussion

Despite recommendation from the Technical Advisory Group that this work be a priority, staff time was unable to be allocated. Condition of mistletoe as an indicator of possum browse sensitive vegetation can not be commented upon.

4.4.2 Pittosporum patulum

Pittosporum patulum is an endangered South Island endemic species subject to browse by deer and possums.

Objective

- To use *Pittosporum patulum* to monitor possum presence/impact within the treatment area and to document improved growth and survival of seedlings in response to possum control.

Methods

As for mistletoes, though details of measurements taken differ. Monitoring is planned for December to coincide with flowering.

Results

No monitoring was undertaken this year. The Ranger responsible was on parental leave and no cover for this role allocated, primarily due to staffing instability and technical capacity.

Discussion

The response of this threatened species to management action can not be commented upon.

4.4.3 Foliar Browse Index

Objective

- Foliar browse analyses are used to detect responses to herbivore control in relatively abundant, browse-sensitive and herbivore palatable plants.

Methods

A standard methodology developed by Landcare Research was used (Payton et al., 1997). Marked trees were re-assessed annually. Species monitored have been reduced to *Raukawa simplex* as the most possum sensitive of the previous suite examined, unless possum activity increases dramatically (Paton et al 2004).

Griselinia littoralis is monitored for ungulate outcome monitoring, with its canopy density a 'health' measure.

Results

No possum browse was observed on *Raukawa simplex* (n=14). Mean canopy foliage density was 46.4% (+/- 2.54%).

Griselinia littoralis coppices were observed to be browsed in 95.5% of monitored plants with epicormic coppices (n= 44). Mean percentage of epicormic coppices browsed was 63% (+/- 4.78). Canopy foliar density was 46.3% (+/- 1.5%).

Discussion

Foliar Browse Index of *Raukawa simplex* along with mistletoe monitoring is a primary measure of possum control outcome monitoring. In the current regime of possum trap catch indices on a triennial cycle it is imperative that any change in floral values attributable to changes in possum activity be detected as early as possible.

Results for browse and canopy foliar density are comparable with previous monitoring of this species since 1999, and indicate that current levels of possum control are adequate for this species. *Raukawa simplex* has been determined to be the most susceptible tree species to possum browse at this location, and thus it can be extrapolated that the current level of possum control is adequate for all tree species.

Monitoring of *Griselinia littoralis* should be retained as it is our only form of ungulate outcome monitoring. Issues remain regarding ability of observers to discriminate between this years' browse and that of the past, potentially allowing coppice browse events to be attributed to more than the season in which it occurs. Results indicate that both incidence and severity of browse of *Griselinia littoralis* have increased again from last year, which had in turn increased since previous measure in 2002-03. The implications of this for recovery of ungulate palatable species at this site are unknown.

4.4.4 Beech Seeding

Objectives

- The periodic seeding of beech (*Nothofagus spp.)* is the primary determinant of the population cycles of rodents and mustelid, and for native invertebrates and birds such as kaka in this forest.
- Monitoring of beech seedfall allows the placement of each annual seed event, and subsequent response, in an historical context.

Methods

Twenty x 0.28m² funnel shaped seed traps are used to collect seed and litter fall from canopy between 1 March and 30 June at both Mt Misery (Rotoroa) and RNRP. Seed is separated from litter, sorted to species and tested for viability.

Energy contribution is calculated by multiplying viable seed per square metre by energy values (after Beggs, 1999). Values of 180 kJ and 60 kJ are given for red and silver beech respectively. A median value of 120kJ has been assigned to mountain beech as it is sized and weighted approximately halfway between the values for red and silver. Tests showed that silver and red beech had similar energy values by weight, and that the difference in energetic contribution was attributable to the mass of the seed (Ibid).

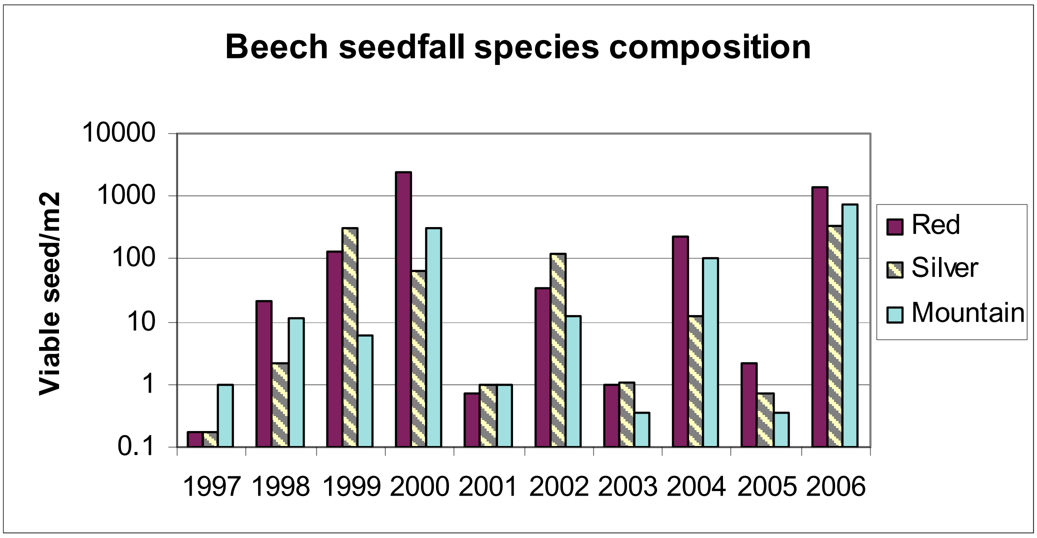
Results

The 2005 beech seedfall was negligible (Paton *et al,* 2005). A heavy beech flowering was observed in spring 2005. Beech seedfall for 2006 was observed to be heavy, and was dominated by red beech (*N. fusca*). Data for RNRP only exists at time of writing. The magnitude of the seedfall required the collection to be sub-sampled with results extrapolated. 3973 seeds/m² fell, with viable seed being 2527 seeds/ m² (63.6% of seed being viable). Energetic contribution calculations give a value of 538866 kJ/m².

TABLE 17: BEECH SEEDFALL RELATIVE CONTRIBUTION BY SPECIES 2006

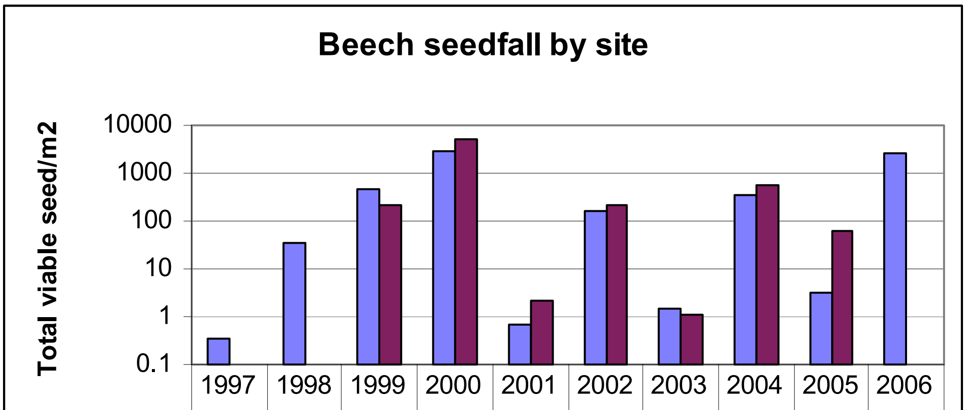
	N.FUSCA	*N. MENZIESII*	*N .SOLANDRII*
% total seedfall	56.9%	13.4%	29.7%
% total energy	70.1%	5.5%	24.4%

GRAPH 29: BEECH SEEDFALL COMPOSITION BY SPECIES SINCE 1997



Source data docdm-60998 sheet ‘summary’

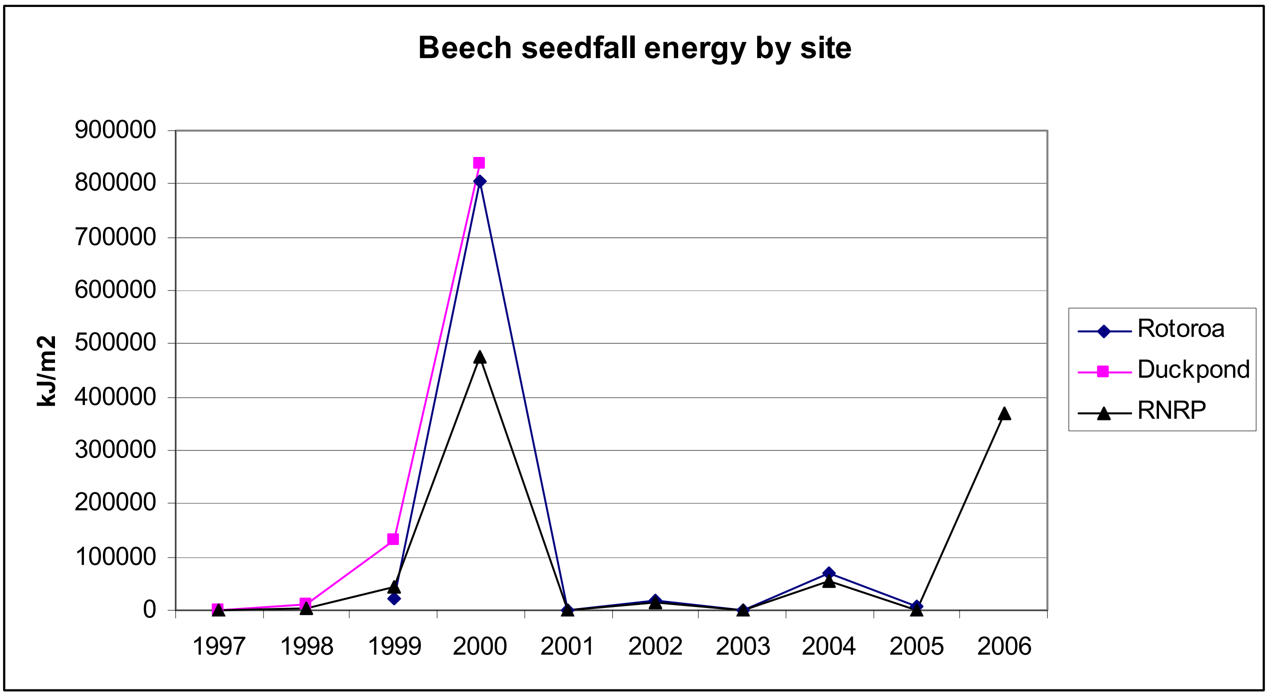
GRAPH 30: BEECH SEEDFALL BY SITE



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
RNRP	0.357	35	447.5	2779	0.714	166.4	1.429	345.4	3.214	2527
Misery			225.9	4883	2.143	212.7	1.071	536.3	61.43	

Source data docdm-60998 sheet ‘seedfall by site (MM)’

GRAPH 31: BEECH SEEDFALL ENERGY BY SITE



Source data docdm-60998 sheet 'energy'

Discussion

The 2005 seedfall gave very little energetic contribution to this site.

The 2006 seedfall can just be described as a full mast event (after Wardle, 1984) with seedfall at almost 4000 seeds/m². It was also energetically high due to dominance of red beech seed. This seedfall event ranks second in both number and energetic contribution of all seedfall events recorded at this site (from 1997). If a similar value is obtained for Mt Misery it will rank as either first or second highest magnitude since records have been collected (1974 - present). This is considered highly likely as there is usually a strong correlation between sites. This seedfall was sufficient to trigger kaka breeding, and also led to an increase in rodent tracking indices.

4.4.5 Tussock Seeding

Objectives

- Seeding of tussock is used as a good indication of the intensity of beech seeding that can be expected in the same year, although the relationship is not mathematically perfect.

Methods

Two species of tussock (*Chionochloa australis* and *C. pallens*) are monitored over a 1000m transect at Mt Misery (200 counts) and a 500m transect at RNRP (100 counts). (For the full methodology refer Appendix 2).

Results

Mt Misery only was monitored this year on 2 March.

Mean seed heads per count (± s.e.):

C .australis 1.353 (0.21)

C. pallens 9.195 (0.95)

Note: Counts by species cannot be directly compared as the method of collection varies slightly (primarily area/count).

Values are moderate for *C. australis* and extremely high for *C. pallens*

5. Reintroductions – Roroa/Great Spotted Kiwi (*Apteryx haastii*)

5.1 BACKGROUND

The 2005-06 year saw the continuation of the translocation of great-spotted kiwi/roroa to the Rotoiti Nature recovery Project.

Key activities for the year included:

- Ongoing monitoring of all birds;
- Breeding activity monitoring;
- Recapture of translocated birds including health checks and transmitter changes;
- Publication of technical report;

Second 'top up' translocation of an additional seven wild captured birds to Rotoiti.

5.2 MONITORING

5.2.1 Survival

Of nine kiwi released in May 2004 seven were known to be alive at 30 June 2006.

One adult female 'Rameka' was discovered dead and partly decomposed in a watercourse in the 'core area' of RNRP 13 February 2006 (grid reference 2498011 5931365). Initial autopsy by staff found no obvious injury, but due the nature of decomposition and the desire for maximum information regarding cause of death this bird was sent to IVABS, Massey University. Gross findings were that the body was severely autopsied and all soft tissues had been consumed by 20mm maggots. The skin and skeleton were intact and there were no evidence of external trauma or predation. Diagnosis was unknown cause of death (Gartrell, 2006). Heavy rain had been observed in the two weeks prior. The location of the carcass below a 1m drop in a watercourse contributes to the conclusion that while exact cause of death is unknown, the probable cause is misadventure (drowning or trauma from carriage by floodwater).

The lone male 'Onetahua' was last known to be alive 19 April 2006 (approximate grid reference 2497400 5928600). No radio transmitter signal was detected after that point despite intensive radio telemetry searching in the general Rotoiti area including the lower Travers Valley. Early in the 2006/07 year this searching included radio telemetry from helicopter over the Travers, Arnst and Hopeless valleys. Radio telemetry was also undertaken at Sabine hut/Mt Cedric, Lake Rotoroa following a report of kiwi from visitors (reliability of report and experience of observers unknown). Attempts to solicit calls from this bird by playing taped male and female great spotted kiwi were unsuccessful. This technique was successful in soliciting a response from another male bird with whom we had lost contact (see recapture). If the transmitter had been 'dropped' it should have been detected in mortality mode and retrieved. Possible explanations for fate of this bird include death by misadventure in a terrain trap preventing any signal from being heard, or extreme dispersal at a pace that exceeds our detection. No opinion is entered into and his fate remains unknown.

5.2.2 Location and Movement

Location and movement of kiwi was achieved by radio telemetry on a fortnightly schedule, with further checks if signals not received. Very little movement of individual kiwi was observed, with all birds seemingly settled in territories for the whole year. Locations ranged approximately from Grid Reference 2497400 5928600 to 2498000 5931400 and covered an altitudinal range from approximately 700m to 1300m a.s.l.

Two kiwi transmitters were dropped this year and were detected as the transmitter switched to mortality mode. 'Takaka' lost his transmitter on about 19 April 2006 at Grid Reference 2497715 5931805. Wainui lost hers about 3 May 2006 at Grid Reference 2499194 5929645.

5.2.3 Relationships

All kiwi associations exhibited shortly after translocation in May 2004 remained intact through to 30 June 2006. The exception to this was male 'Takaka' who became unpaired in February following the death of his mate 'Rameka'. All 'pairings' observed in the 2004/05 year can be assumed to be pair bonds rather than close associations inferred from territory overlap as all 'pairs' have now been observed to engage in breeding activity to some degree.

5.2.4 Recaptures, Health and Condition

Six of the seven resident kiwi were recaptured in May 2006 for annual health check and transmitter replacement. Capture was by means of radio tracking followed by extraction from burrow. The exception to this was 'Takaka'. This male had lost his transmitter prior to recapture and his mate had died three months earlier, thus removing the option of tracking him near his mate. An attempt to lure 'Takaka' to taped call of both male and female Great Spotted Kiwi was made. A call response was received from calls broadcast from a boat on the lake near his known territory and location where transmitter found. An attempt to further lure this bird by taped calls to a catch site near the lake edge was unsuccessful although he did come very close. Perhaps the experience of initial capture by this method two years ago remains. 'Takaka' was captured by Paul Gasson and dog Huxley later by tracking scent in the area the call response was estimated to come from. Capture involved an open chase lasting some 40 minutes, with the dog playing a greater role than her usual indicating style (see Gasson, 2006).

Female 'Wainui' who had also lost a transmitter 1 week before scheduled recapture was searched for during recapture of her mate 'Tata' by method of dog. She was sighted but ran and shortage of daylight did not allow time to pursue her. This female had also dropped her transmitter during the period of recaptures in May 2005 and was caught by using a dog in June 2005.

All kiwi recaptured underwent checks of weight, body condition, bill length, and band condition. Transmitters were changed as were RA bands on females from old style soft bands to new hard steel. It was planned to change transmitters to egg timer transmitters to assist incubation detection and hatch window prediction, but these were mailed to St Arnaud, Victoria, Australia instead and did not arrive until after the departure of the kiwi handler and dog.

TABLE 18: WEIGHT AND GENERAL CONDITION PRE-TRANSFER AND YEAR 1 AND YEAR 2 RECAPTURES

BAND NO.	WEIGHT PRE-TRANSFER	WEIGHT YEAR 1	WEIGHT CHANGE (1 YR)	WEIGHT YEAR 2	WEIGHT CHANGE (2 YRS)	CONDITION PRE-TRANSFER	CONDITION YEAR 1	CONDITION YEAR 2
R-31758 / ONETAHUA	2.17kg	2.38kg	210g (gain)	[1]	-	*Medium*	Moderate	[1]
R-31760 / TE MATAU	2.61kg	3.03kg	420g (gain)	3.1kg	70g (gain)	*Healthy*	Good	Excellent
RA-0443 / TAI TAPU	3.62kg	3.43kg	190g (loss)	3.6kg	170g (gain)	*Medium*	Good-very good	Good/Excellent
R-31759 / KAHURANGI	2.45kg	2.60kg	150g (gain)	2.55kg	50g (loss)	Poor-moderate	Good	Good
RA-0442 / RAMEKA	3.1kg	3.18kg	80g (gain)	[2]	-	Medium-poor	Good	[2]
R-31761 / TAKAKA	2.15kg	2.33kg	180g (gain)	2.2kg	130g (loss)	Poor	Moderate-good	Good
RA-0444 / AWAROA	3.2kg	3.18kg	20g (loss)	3.25kg	70g (gain)	Good	Moderate-good	Good
RA-0446 / TATA	2.57kg	2.63kg	60g (gain)	2.6kg	30g (loss)	Good	Excellent	Good/Excellent
RA-0445 / WAINUI	3.35kg	3.38kg	30g (gain)	[3]	-	Good	Very good	[3]

Note: Italics denote incorrect categories: medium is assumed to equate to moderate. No data indicates bird not recaptured.

[1] Unable to be located.

[2] Dead.

[3] Not recaptured but sighted alive.

All birds recaptured were found to be in similar body condition to the previous year, which were in general an improvement over original capture condition. Weight changes ranged from 130g loss to 170g gain.

5.2.5 Breeding Activity

Breeding activity monitoring addresses the performance standard in the initial operational plan (Gasson 2004a) that all kiwi nesting attempts are identified, the approximate location of each nesting burrow and the approximate duration of the incubation period is known. There is currently no outcome objective for breeding activity of great spotted kiwi in the Rotoiti Nature Recovery Project. This reflects the emphasis of this experimental translocation of identifying the efficacy of translocating adult (great spotted) kiwi as a means of establishing a new population. Obviously *in situ* breeding is necessary for such a population to be self sustaining, however the management requirements for ensuring recruitment and retention to the population is a separate question.

Monitoring for breeding activity commences in August with an increase in frequency of radio telemetry fixes with the objective of locating stationary male birds indicative of potential nesting. This will involve the use of multiple close fix telemetry to more accurately define a location. Nest monitoring has so far been non-invasive to limit any potential adverse effect that monitoring activity may have upon nesting activity and adult dispersal.

All four pairs of kiwi were observed to display behaviour indicative of nesting, namely occupation of a single burrow (or single location if the burrow was unable to be unidentified) for a period of consecutive telemetry fixes. By calculation from date of confirmed stationary position plus 89 days an expected hatch date is determined. Staff will then investigate the burrow or site for evidence of nest, egg, or chicks.

TABLE 19: BREEDING ACTIVITY SUMMARY 2005/06

PAIR M/F	DATE CONFIRM STATIONARY	EXPECTED HATCH DATE	DATE NEST INVESTIGATED	LOCATION	BEST EVIDENCE	CONFIRM BREEDING?
Te Matau/ Tai Tapu	8/11/2005	6/1/2006	20/1/2006	2497732 5930179	Egg shell	Yes
Takaka/ Rameka	8/9/2005	6/12/2005	23/12/2005	2497949 5931414	Egg shell	Yes
Tata/ Wainui	11/10/2006	5/1/2006	17/2/2006	249899 5929948	Nest material	No
Kahurangi/ Awaroa	12/10/2005	20/12/2005		Not found.	Chick (8/5/2006)	Yes

Egg shell remnants found in nests of Te Matau/ Tai Tapu and Takaka/ Rameka have not been analysed to assess if a likely hatch occurred.

The nest of Kahurangi and Awaroa was not located due to the difficult terrain, particularly the presence of an incised gorge and a very rocky environment causing a lot of telemetry signal 'bounce' and 'bend'. The chick was discovered 8 May 2006 in course of routine recapture of parents for health check and radio transmitter change. The chick was 520g when first encountered. A notable feature of this chick is that its bill is deeply down curved (approximately 14mm from straight). The sex of this bird is currently unknown and will not be known until it reaches maturity, or pending DNA analysis of feathers collected. If the calculated hatch date was correct then this chick was 5 months old at time of first encounter. No information has been found regarding expected development of great spotted kiwi. The weight of this chick does seem very low for its estimated age. At second check 28 June 2006 there had been no increase in weight. At this stage the chick was still sheltering with both parents in a single burrow at a similar location to that where first found. This area was covered in 10cm of snow at the time. At third check 17 August 2006 the chick weighed 590g and was again sheltering with both parents in another new burrow in same general area.

The absence of chicks with any of the other pairs confirmed or suspected of breeding does not indicate a negative outcome of breeding attempts, as the co-sheltering and close association with parents of one chick is insufficient to gauge 'normal' behaviour. The only other great spotted kiwi chick found in recent times in the Saxon area, Northwest Nelson was found to be in close proximity to one of its parents (H. Robertson, pers. comm.).

5.3 REPORTING

In December 2005 the technical report covering the first translocation (May 2004) and first year of monitoring was published. It should be cited as: Gasson, P.A. 2005. Translocation of great spotted kiwi/roroa (*Apteryx haastii*) to Rotoiti Nature Recovery Project. Occasional Publication No. 67, Department of Conservation, Nelson. The executive summary, performance standards, and recommendations were included in Paton *et al,* 2005.

5.4 SECOND TRANSLOCATION

A second translocation was recommended (Gasson, 2005) to allow further study and improvement of the transfer method, and to enhance opportunities for founder population monitoring and management in the future. It would also augment the small population currently living in the RNRP recovery area, creating a more robust founder population that may only require infrequent and minimal supplementation to maintain genetic viability.

5.4.1 Source Location

The source location of Cave Brook/Trocadero Stream, Gouland Downs (2455800 6033700) was selected as it met the criteria as recommended. These were to:

- Collect the second group of kiwi from a new source area some kilometres distant from Corkscrew Creek, to ensure that the founder population includes a range of genetic stock.
- Consider sourcing birds from a site near the Gouland Downs, as health screening prior to the transfer may not be necessary: the same procedure as for the first transfer could be followed.

Consultation with DOC Golden Bay Area Office and local iwi (Manawhenua ki Mohua) was undertaken with a high level of support received. This ability to build upon existing relationships and work in a similar area to last time were significant factors in selecting the Gouland Downs site. Boundaries were set with no birds to be caught with territory including Gouland Hut; south of the Ngai Tahu deed of settlement line; north of the Heaphy track; west of Shiner Brook. A secondary site of nearby Mt White was approved if the primary site was 'exhausted'.

5.4.2 Pre-transfer Monitoring

A three night call count survey was undertaken 30 April to 2 May around the new moon. Four permanent listening points were established approximately one kilometre apart from each other. Terrain in the area is relatively open, with the exception of steep incised rivers toward the centre of the listening area, allowing wide kiwi listening coverage of at least 400ha. Observers rotated around sites over the survey nights. Each night's listening comprised two hours listening, separated by a ten minute break after the first hour. Listening commenced at 1900 hrs. All calls heard were recorded with an estimated distance, compass bearing, and exact time of end of call. This allowed data to be used to draw territory maps to facilitate the capture team efforts.

A call rate of 9.7 calls per hour was observed.

5.4.3 Capture

Upon the recommendation of Gasson (2005) a specialist night dog and handler ('Murphy' and Lance Dew) were contracted to catch the kiwi. This reflects the fact that this method used in part in the 2004 operation was the most productive per unit effort.

Capture methods involved either direct capture by dog or using the dog to shepherd the bird to people.

5.4.4 Handling and Transfer

Birds caught were or transported in catch bag in pack to the hut where they were placed into transfer boxes. Some birds were held at catching sites in catch bags while the team targeted the caught birds mate or neighbour. Legs were not taped in transit at any stage upon the advice from veterinarians that this probably led to unacceptable levels of muscular stress evident from haematology results (Gasson, 2005).

Transfer boxes were modified from those used in the 2004 transfer. The double boxes had proved cumbersome to transport by foot and were halved for this operation (made into two singles). The boxes used in 2004 had caused a significant bill injury to one female which has prevented her being released into the wild. The probable cause was identified as the bill becoming caught between lid and box edge and severed with the leverage applied as the lid closed. The underlying cause was that handlers were unable to maintain visual or physical control over the bird in the last few inches of closure. Modification involved a 10mm x 10mm bead of timber being fitted approximately 10mm below the top of all four walls. A neat fitting polycarbonate lid could be placed on top of the timber bead and held in place using two small screws that came through the side walls on top of the polycarbonate. These screws could be adjusted from outside and could remain in the timber to prevent loss. The hinged timber lid could then be closed and latched. This method allowed full visual control of the bird as the lid is fitted, and could provide for visual checks while the birds were being held in the box. This method allowed birds to be displayed to the local school children as they awaited transfer by boat at Rotoiti.

Birds were processed on site at night to allow birds to be kept cooler and hopefully calmer. Measures were taken for sexing, weight, bill length, tarsus width and body condition. Radio transmitters were fitted and activated, potentially to facilitate recapture if they escaped at any stage of transfer. Leg bands were fitted, although RA bands were not fitted to females after the first one as the capture team were not happy fitting the stiff new steel bands with multigrip pliers provided. Attempts since to locate RA banding pliers have been unsuccessful and other RA band users indicate they use multigrip pliers.

Birds were held on site at Gouland hut until either a pair had been caught or they were held up to 40 hours. This allowed for no bird to spend greater than 48 hours in a transfer box when transfer time was included. Birds were held an average of 14 hours (range 9-36 hours). The bird held 36 hours was supplied with worms for hydration but these were quickly exhausted as the box of worms supplied was mainly soil. This bird was the bird held longest. All birds received hydration upon arrival at Rotoiti, and none seemed unacceptably dehydrated.

A pair captured or a single bird held for nearly 40 hours was the trigger for a helicopter to collect birds from Gouland Hut and fly direct to Rotoiti. Upon arrival they were immediately transported by short vehicle trip to the St Arnaud Area Office meeting room for health assessments.

5.4.5 Release

Principles for release of birds were: lone females near lone males, 'true pairs' closer to periphery, 'reconfigured' pairs closer to centre of release area. Justification for this was 'matchmaking' and probability that 'true pair' disperse less, and true pair and resident birds provide 'bookends' at edge of population to anchor wanderers.

Kiwi were transported following health checks by vehicle, boat and foot to pre-prepared artificial release burrows. This replicated the procedure of 2004. The first three birds were involved in a powhiri lasting about one hour between health checks and boat transportation. Burrows prepared for the 2004 translocation were re-used with exception K2 due to its proximity to resident birds. An additional pair of burrows was prepared near station CF9 (2498021 5932057)

One female was not placed in a release burrow and was 'hard released' instead. This bird, 'Waitapu', was translocated as a lone female and was intended as a potential mate for single male 'Takaka' whose mate had died earlier in the year. As 'Takaka' was known to change daytime roost burrow regularly it was considered a high risk to prepare a burrow in an area where the new female may not encounter the resident male if he moved on. It was considered that the best chance of ensuring these birds were aware of the presence of each other with view to encouraging a pairing was to release the female directly into the area the male would be as he exited his burrow at sunset. Takaka's roost burrow was determined by radio telemetry on the day and the transfer box containing the female transported by foot to within approximately 50m of his burrow. At sunset staff returned and moved the transfer box to within 30m of Takaka's burrow. Staff placed themselves so as to form a human barrier with the hope that their presence could encourage both the wild male and translocated female to move in the same direction. Once Takaka was determined by radio telemetry to have left his burrow, the female was released and was observed to move in the same direction as Takaka. Staff departed so as not to cause any further disturbance.

Birds placed in burrows had infra-red cameras and time-lapse video cassette recorders installed. This footage was collected to assess any stress behaviour exhibited. These are currently being assessed by Isabel Castro, Massey University. Reference footage of captive (open enclosure) great spotted kiwi at Willowbank Wildlife Reserve is to be collected for comparison.

Birds were placed in burrows usually in early to mid-afternoon. Burrows were then closed with a plywood cover to hold the birds in place. Plywood covers were removed at sunset and kiwi left to emerge in their own time. The sunset release was earlier than the dusk release of the 2004 transfer as the few birds videotaped then exhibited agitated behaviour in the last half hour prior to release, i.e. from time of sunset. One bird exited the burrow immediately it was opened. One true pair each left the burrow within five minutes of each other at 2110hrs, after 6.5 hours in the burrow. Another true pair left their respective burrows 1.5 hours apart (2054 and 2215hrs after 8 and 9.5 hours in the burrow). Birds spent an average 6 hours in the release burrows.

5.4.6 Post-release Monitoring

Radio-telemetry of each resident and translocated birds was undertaken on a planned daily basis until patterns of stability emerge, then eased to every third day, then weekly, then fortnightly, then monthly. Objectives were to identify any displacement effect upon resident birds of new arrivals, and to determine the extent and pattern of any dispersal from release site by the translocated birds.

There was no observed displacement effect upon resident birds. Transferred birds exhibited very little dispersal from release site. Range of movement can be split into two coarse groupings, with those birds transferred as true pair moving least from their release sites, and those transferred as artificial pairings moving greater distances. This supports similar findings from the May 2004 transfer. Maximum movement was approximately (4km), significantly less than the large ranging of female 'Rameka' in 2004 (8km). It is probable that the presence of other kiwi provide con-specific attraction, or an anchor to the site. It is possible that this effect would be lost or reversed if attempting to place new birds within an existing dense population where few territory gaps exist.

Two birds were recaptured in August for fitting of diagnostic and egg-timer transmitters to assist the monitoring of breeding activity.

5.4.7 Community Involvement

Representatives of source area iwi (Manawhenua ki Mohua), local iwi, Friends of Rotoiti conservation volunteers and local community were able to sit in on the health monitoring and processing of kiwi in the St Arnaud Area Office meeting room in small groups. A photographer from the *Nelson Mail* was present and generously offered to share images, thus limiting the need to manage individuals attempting to take their own photographs. Photography was undertaken without flash to limit stress upon birds.

A powhiri was held at Kerr Bay, Lake Rotoiti for the first pair to be transferred. This was approximately 1 hour in duration and provided an opportunity for locals and visitors to see boxes that allegedly contained kiwi.

The pupils of Lake Rotoiti School were invited to observe the last pair of kiwi transferred. Transfer boxes were placed in the shade at Kerr Bay, Lake Rotoiti with their wooden lids opened and the birds could be observed through the secured polycarbonate lids.

5.4.8 Health Monitoring and Management

Methods

The Department of Conservation Standard Operating Procedure for the translocation of indigenous terrestrial fauna and flora states that species should be managed pre-transfer to reduce the risk of transferring pathogens.

The previous translocation adopted the approach of using existing health data for the Saxon population and obtaining blood and faecal samples and undertaking physical examination of all birds translocated. This allowed for subsequent management of any health issues that may have become apparent following analyses. No such action was necessary. This information gave confidence to adopting the same approach this year. A point of difference between operations was the initial transfer took kiwi to an area where there was none, whereas the second was taking kiwi to an area with resident kiwi. As the original source area for both groups were part of a contiguous population this was not considered a significant concern. Advice was received to prophylactically treat all kiwi for coccidia (Kerry Morgan pers. comm.). The above approach was endorsed by DOC RD&I veterinarian Kate McInnes.

Veterinary support was recommended by Gasson (2005) to inspect and hydrate birds before release, and to deal with any injuries that may occur. This approach was validated at the previous translocation with skills on hand to manage the serious bill injury sustained by a female (Mohua).

Upon arrival at St Arnaud all birds were transported directly to the Area Office meeting room for examination by Andrew Hill, Resident in Avian and Wildlife Health, New Zealand Wildlife Health Centre, Massey University. All birds were physically examined, given 20ml fluids (0.9%NaCl + 2.5% Glucose) orally and were treated for coccidian (Baycox, 0.5 ml/kg). Blood was taken for biochemistry, haematology and parasitology analysis, and also for genetic study purposes.

Results

Physical examinations revealed mild to moderate dehydration, lean body conditions, and freedom form physical injury or clinical disease.

TABLE 20: BIOCHEMISTRY RESULTS GREAT SPOTTED KIWI

NAME	SEX	AST	CK	UA	GLU	CA	PHOS	TP	ALB	GLOB	K	NA	TIME[1]
Onahau	M	119	119	43	5.1	2.4	4.41	38	27	11	>8.5	157	38:25
Puremahaia	M	81	669	67	5	2.29	2.51	41	28	13	8	156	9:45
Pariwhakaoho	F	98	1242	156	7.6	2.86	1.83	53	28	25	8	150	9:45
Onekaka	F	124	2856	58	9.4	2.25	1.38	34	25	10	6.3	147	11:10
Waitapu	F	172	1199	56	11	2.45	1.59	41	33	8	6.2	151	13:30
Anatoki	F	103	1482	74	6.3	2.46	1.96	38	26	11	6.3	151	11:20
Motupipi	M	106	2519	171	5.4	2.27	1.46	50	24	26	6.9	148	9:20
Average		114.71	1440.86	78.13	7.11	2.43	2.16	42.14	23.88	14.86	6.95	151	14:20
Reference[2]		(64-138)	(521-971)			(1.85-3.1)							

[1] Time from capture to sample collection
[2] Northern Brown Kiwi reference values used

TABLE 21: HAEMATOLOGY GREAT SPOTTED KIWI

NAME	SEX	HETEROPHIL	LYMPHOCYTES	MONOCYTES	BASOPHILS	EOSINOPHILS
Onahau	M	70%	19%	3%	6%	2%
Puremahaia	M	89%	5%	1%	3%	2%
Pariwhakaoho	F	81%	13%	1%	5%	
Onekaka	F	82%	6%	5%	7%	
Waitapu	F	64%	16%	5%	13%	2%
Anatoki	F	87%	8%	3%	2%	
Motupipi	M	89%	6%	1%		4%

Discussion

Andrew Hill (2006) reported that:

Results reflect birds in good health that have been subject to capture and handling. No signs of overt disease were detected and no clinical disease was detected during examination.

Biochemistry showed very mild elevations in muscle breakdown enzymes (CK and AST) indicating muscle damage consistent with capture and handling. Previous translocations to St Arnaud resulted in increased CK levels up to 20000 u/L compared to a maximum of 2856 u/L in the current survey which may reflect changes in handling and management such as the cessation of taping legs during transport. Lack of reference values made interpretation difficult and Northern Brown Kiwi normal results were used as a guide.

Haematology showed no significant abnormalities while parasitology demonstrated a low parasite burden considered normal for wild members of this species. Electrolyte changes were heavily influenced by the long duration of between sampling and processing of samples.

Hill concluded that this was an excellent project because kiwi were given priority treatment and a great deal of thought was obviously put into achieving a minimum-stress environment. These results are a good reflection of an adapting transport protocol aimed at reducing the impact of management procedures on kiwi.

5.4.9 Conclusions

This second wild to wild transfer can be considered a partial success. The principal factor preventing this being declared a full success was the inability to capture and transfer the target number of ten kiwi. Otherwise operational targets were met:

- the target composition of the transfer population was achieved
- the operation was achieved in the allocated time
- no kiwi were injured
- all birds collected for transfer met the health condition requirements
- kiwi were handled in a manner that prevented unacceptable stress
- health assessments were undertaken and samples collected from all kiwi
- all kiwi were monitored post-release with the extent of dispersal and displacement of resident birds known

Recommendations

- That advice be sought as to the need for a further top up transfer to increase number of individuals and genetic diversity of founder population
- That wild to wild transfer of adults be considered a viable technique for establishing a new population or augmenting an existing one.
- That any initial wild to wild transfer of kiwi target a minimum number of individuals as a critical mass for conspecific attraction to anchor them to the new site.
- That any wild to wild transfer of kiwi target true pair as these demonstrably disperse less than artificial pairings.

That the modified kiwi transfer box be considered for adoption as best practice.

6. Advocacy and Education

6.1 OBJECTIVES

The project's third overall objective is:

- To advocate for indigenous species conservation and long-term pest control, by providing an accessible example of a functioning honeydew beech forest ecosystem, so a large number of people can experience a beech forest in as near-to-pristine condition as possible.

The advocacy and education programme is working towards this, and has identified five aims as follows:

- Develop a high public profile for the project, enhancing opportunities for its key message to be put across.
- Develop and seek opportunities to express the key message that the conservation of indigenous species requires the control of pests. The use of poisons, shooting and traps are currently the only practical options for this control.
- Develop opportunities to involve the St Arnaud and wider community in the project.
- Extend the work of the project into the St Arnaud area through the involvement of its community.

Develop opportunities for schools to contribute to the project and achieve education outcomes at the same time.

6.2 DEVELOPING AND MAINTAINING PROJECT PROFILE

6.2.1 Spreading the Message

The Rotoiti Nature Recovery Project is readily accessible to visitors. The Bellbird and Honeydew Walks within the original core area at Kerr Bay offer all weather tracks with a series of detailed panels about many aspects of the project. Returning visitors often comment on the increased bird song and presence of native wildlife around the village and the tracks through the RNRP area. The presence of kiwi has increased interest and there have been several reports from members of the public of hearing kiwi calls.

The potential threat of dogs to the newly released kiwi is an area of ongoing concern. 'Kiwi Zone / No Dogs' signs remain in place and have proven to be largely effective in reducing the incursion of dogs in the adjacent national park. There have been no recent incursions of dogs recorded in the kiwi area aside from in the car parks.

The ever increasing number of 'mainland island' type projects outside the department's management (both on and off private land); provide testimony to the inspiration that the early departmentally-managed projects have provided. RNRP staff also provided technical support to several community groups involved in mainland restoration work such as the Friends of Flora group and a broader Landcare Trust trapping workshop.

RNRP staff participated in the Department's annual mainland island hui held at St Arnaud at which individuals from a number of groups outside the Department were exposed to the work going on at Rotoiti.

Ongoing community support is vital to the long-term future of the project. We continue to aim to keep the community informed through regular (at least monthly) contributions to the local newsletter, and indirectly through the media, and offer opportunities for more in-depth contact through talking to groups, providing guided walks and opportunities for 'hands on' involvement through involvement with the Friends of Rotoiti (refer Section 6.5 Volunteer Involvement).

6.2.2 Revive Rotoiti Newsletter

Two editions of Revive Rotoiti (Appendix 1) were published in the year (spring 2005, autumn 2006). These newsletters (including photocopies of back-issues) are available in the Nelson Lakes National Park Visitor Centre.

6.2.3 Meetings

Project information has been supplied regularly to meetings of the Rotoiti District Community Council and community forums held by the Department in Nelson.

6.3 MEDIA LIAISON

Media interest in the kiwi remains high. The highlight was the discovery of a kiwi chick, named Rito. This was an important discovery as it gave some credit to this season and to the previous season's speculation on kiwi hatchings when only egg fragments were found. Several media contacted the area office on a regular basis to follow up on the kiwi and check whether any other chicks were found. The death of one kiwi by drowning was reported without any adverse reporting which reflects well on the openness of the relationship with the media.

6.4 EDUCATION PROGRAMMES

6.4.1 Intermediate, Secondary and Tertiary Education

Groups given talks on the project in 2005-2006 included:

- West Mount Tasman School
- Area Schools
- Nelson Girls College
- Newlands College

- Marlborough Girls College
- Marlborough Boys College
- Waimea College
- Nayland College
- Motueka High School
- Queen Charlotte College
- Salisbury School
- Broadgreen Intermediate School
- Garin College
- Founders School
- Horsham Downs School
- Golden Downs
- Victoria University

A talk was given at Rotoiti Lodge every week in term time. Two staff were involved in this activity. 1,098 secondary school students were given the power-point presentation at Rotoiti Lodge.

Groups given guided walks round the project site were:

- Ecoquest
- Probis Walking Club – Stoke
- Horsham Downs School
- Rudolf Steiner School
- Collingwood Area School
- Garin College
- Mapua School
- Marlborough Girls College
- Nayland College
- Waimea College
- Nelson Girls College

The total number of people given guided walks around the project in 2005-06 was 587. Many of these were Year 12 biology and geography students doing NCEA unit standards on conservation and resource management.

6.4.2 Primary School Resource Kit

Most primary schools that visited in 2005-06 used the resource kit to plan their trips. They are still requesting a staff member to give an introductory talk to their classes, and some requested a power-point presentation on the great spotted kiwi transfer.

6.5 VOLUNTEER INVOLVEMENT

6.5.1 RNRP Volunteers

RNRP received 194.8 volunteer work days this year from 17 individuals.

(Note: This does not include the Friends of Rotoiti hours).

6.5.2 Friends of Rotoiti

The Friends of Rotoiti (FOR) community group was set up in 2001. Its objectives are to provide opportunities for the community to be involved in pest control, species monitoring, re-introductions and for individuals to receive training from the department in best practice techniques in these areas. In this year there was one organised training day for all group members. All new members are inducted by either staff or experienced volunteers on their first day. The group conducts rat trapping in the village, 'filling the gap' between the old core and the new rat control area at Duckpond Stream and they also run a Fenn™ trap line up the Wairau Valley and from Six Mile Road to the top of the Rainbow Ski field, and from the Buller Bridge to Mt Robert Car Park. In September a new stoat trapping line was set up, which runs from the start of the Lakeside Track on the western shore of Lake Rotoiti to Whisky Falls. This new line consists of both Fenn™ traps and DOC 200 traps. Predator control methods are identical to RNRP techniques, with the frequency of trap checking also the same where possible. Results can be found in Sections 3.2 and 3.3.

Friends of Rotoiti had over 70 members at the end of 2005. The number is necessarily vague as some of the "members" are representatives of groups such as the 50+ Tramping Club and Forest and Bird may bring up to ten volunteers on a day.

The Friends of Rotoiti did 301.5 volunteer days of work over the 2005-06 twelve month period. This is a big increase form the previous year which is largely due to the set up and subsequent checking of the new stoat line running to Whisky Falls.

6.6 VISITOR SERVICES

No major activity took place in this area. Nelson Lakes National Park Visitor Centre staff continued to distribute information about the project. Most requests for information come from school and tertiary students.

7. Research

Projects funded or assisted by the project to differing levels in 2005-06:

Genevieve Taylor, former A2 RNRP ranger began writing the up the results for the entire RNRP kaka research project. The anticipated date for completion is June 2007.

Daniela Schenk, University of Applied Sciences, Germany, planned an MSc project on the role of introduced birds as possible competitors with native birds in the Nelson Lakes National Park. Daniela will be starting her research work here in September 2006.

RNRP provided logistical support to Rex Bartholomew (University of Victoria) who continued his study investigating factors influencing the recruitment and establishment of *Fuchsia excorticate* in the Nelson Lakes National Park. Rex carried out pilot studies in April 2001 and 2005. The anticipated date for completion of this study is now May 2007.

The RNRP continued to be a research site for Landcare Research, Nelson and Lincoln, to undertake research into the impacts of mice and wasps on soil chemistry and soil microbes and invertebrates in a honeydew beech forest. This work is supervised by David Wardle and has one more field season programmed.

Reports received in 2005-06 for completed research:

Graeme Sandlant and Rachel Standish, Landcare Research Nelson, Contribution of malaise samples for analysis of indicator groups of invertebrates as a response to wasp control.

Wardhaugh, Carl W, Didham, Raphael K, journal "Factors influencing the distribution of the beech scale insect (*Ultracoelostoma*): Implications for the ecology of honeydew beech forests was published in: Ecological Entomology. Volume 30, Number 6, pp. 733-738.

Ceisha Poirot, University of Canterbury, MSc, completed a thesis reporting on her work investigating bellbird nesting success and time budgets in the RNRP during the 2002-03 and 2003-04 seasons. In November 2006 she approached the RNRP for further bellbird work to assist in her research. Her final report will be important in contributing to more detailed analysis of RNRP bird count data.

8. Project Management

8.1 BUDGET

TABLE 22: BUSINESS PLAN SUMMARY 2005-06

ACTIVITY	STAFF HOURS[1]	OPERATING COSTS ($$)	TEMPORARY WAGE COSTS ($$)
Predator management	1,237	1,369	25,960
Wasp control	372	750	8,360
Management of rodents	660	300	28,520
Vegetation monitoring	376	400	800
Native fauna monitoring	912	0	6,000
Small mammal monitoring	352	400	2,400
Project management	2,117	5,500	2,160
Reintroductions	436	5,600	0
Possum control	0	800	0
Ungulate control & monitoring	168[2]	1,600[2]	0
Research support	124	800	0
Advocacy	548	3,000	0
TOTAL	7,302	$20,519	$74,200

1 Does not include volunteer effort (refer Section 6.5 Volunteer Involvement)
2 Planned but not carried out.

8.2 STAFFING

- Brian Paton, Programme Manager Biodiversity, 50% RNRP
- Matt Maitland, Project Supervisor
- Genevieve Taylor, A2 Ranger
- Tammy Bruce, temporary A2 Ranger.
- Andrew Taylor, 2 year temporary A1 Ranger
- Brett Thompson, 10 month A1 Ranger
- Dylan Hogg, Ollie Gansell, Emma Carrad, Glen Greaves, Stu Bennett, Jo Tilson, Tammy Bruce (casual), Mark Murphy
- Riley Neame, 3 month Trainee Ranger

Others that contributed business-planned hours were:

- John Wotherspoon, Programme Manager Community Relations
- Sally Leggett, Community Relations A2 temp Ranger
- Paul Gasson, Biodiversity A2 Ranger (Assets)

Dave Seelye, Biodiversity A2 Ranger (Threats/Assets)

8.3 TECHNICAL ADVISORY GROUP

The RNRP Technical Advisory Group continues to contribute valuable input in providing advice to the project team. The advisory group met formally from 10-11 February 2005, prior to business planning, to review the previous years' work and provide recommendations for the coming year. Minutes of the meeting can be found in dme:\\staao-11243 (16pp). Technical Advisory Group members in 2004-05 were:

- Jacqueline Beggs, Auckland University
- Peter Wilson, Auckland
- Eric Spurr, Landcare Research, Lincoln
- David Kelly, Canterbury University
- Graeme Elliott, RD&I, Nelson
- Dave Butler, Private Consultant, Nelson
- Peter Gaze, DOC, Nelson Conservancy
- Mike Hawes, DOC, Nelson Conservancy
- Kerry Brown, DOC, Nelson Conservancy

Elaine Wright and Craig Gillies from the Terrestrial Conservation Unit (TCU) also attended the meeting as Mainland Islands are now nationally coordinated through this unit.

References

Beggs, J.R. 1999. Comparison of the quality of red and silver beech (Nothofagus) seeds in Nelson Lakes National Park, New Zealand. New Zealand Journal of Botany 37 (3), pp. 495-501

Beggs, J.R. & Rees, J.S. 1999: Restructuring of insect communities by introduced *Vespula* wasps in a New Zealand beech forest. *Oecologia* 119: 565-571.

Beggs, J.R. 2001. The ecological consequences of social wasps (*Vespula* spp.) invading an ecosystem that has an abundant carbohydrate resource. Biological Conservation 99: 17-28

Butler, D.J. 1998. Rotoiti Nature Recovery Project. St Arnaud's Honeydew Beech Mainland Island Strategic Plan. Department of Conservation, Nelson/Marlborough Conservancy, Nelson. 52pp.

Butler, D.J., Maitland M.J., Taylor G.E., Parlane K.J. and Gasson P.A. 2003. Rotoiti Nature Recovery Project Annual Report, 2001-2002. Department of Conservation, Nelson.

Butler, D.J. (Ed.). 2003. Rotoiti Nature Recovery Project Triennial Report 1998-2001. Department of Conservation, Nelson.

Gartrell, B. 2006. Unpublished Massey University Pathology report 38176

Gasson, P.2004a. Operational Plan for: Translocating great-spotted kiwi (*Apteryx haastii*) from the Gouland Downs to the Rotoiti Nature Recovery Project mainland island. Unpublished internal report. Department of Conservation, St Arnaud Area Office. Olddm-62295

Gasson, P.A. 2005. Translocation of great spotted kiwi/roa (Apteryx haastii) to Rotoiti Nature Recovery Project. Occasional Publication No. 67, Department of Conservation, Nelson

Gasson, P. 2006 Great Spotted Kiwi Trip – Nelson Lakes & Kahurangi National Parks, May – June 2006 Unpublished internal report. Department of Conservation, St Arnaud Area Office. Docdm-91132

Gillies, C. & Williams, D. 2004. Using tracking tunnels to monitor rodents and other small mammals. Department of Conservation unpublished report (HAMRO-60778) Northern Regional Office, Hamilton.

Greene, T.C., Powlesland, R.G., Dilks, P.J., Moran, L. 2004. Research Summary and Options for Conservation of Kaka (*Nestor meridionalis*). Department of Conservation Science Internal Series #178, Department of Conservation, Wellington.

Hill, A. 2006. Unpublished report. Health monitoring results translocated great spotted kiwi 2006.

Maddigan, F. 2003, 2004. Summaries of national tracking tunnel survey data. Unpublished report. DOC St Arnaud Area Office, File NHE 04-08-13-04.

Moller, H. 1990. Wasps kill nestling birds. *Notornis* 37: 76-77.

Moorhouse, R. 1998. Predation of female kaka in the RNRP area: How much is too much? Unpublished Report, Department of Conservation, held at St Arnaud Area Office.

Paton, B.P., Maitland M.J., Taylor, G.E., Knevel A.W.J., Wotherspoon, J.A. 2003. Rotoiti Nature Recovery Project Annual Report 2002-03. Department of Conservation, St Arnaud, Nelson.

Paton, B.R., Maitland, M.J., Taylor, G.E., Knevel, A.W.J., Parlane, K.J., Wotherspoon, J.A., Gasson, P.A. 2004. Rotoiti Nature Recovery Project Annual Report 2003-04. Department of Conservation, St Arnaud, Nelson.

Paton, B.R., Maitland, M.J., Taylor, G.E., Wotherspoon, J.A., Gasson, P.A., Leggett S.A.; 2005. Rotoiti Nature Recovery Project Annual Report 2003-04. Department of Conservation, St Arnaud, Nelson.

Payton, I.J., C.J. Pekelharing & C.M. Frampton. 1997. Foliar Browse Index: A method for monitoring possum damage to forests and rare or endangered species. Contract Report LC 9697/60, Landcare Research, Lincoln.

Powlesland, R.G. 1997. Protocols for monitoring New Zealand robins (*Petroica australis*) Department of Conservation technical series No.13, Wellington.

Thomas, C.D., H. Moller, R.J. Toft, J.A.V. Tilley, G.M. Plunkett & R. Harris. 1989. Impact of Vespula wasp on native insects and birds - Second year research report. Contract Report No. 25 to Department of Conservation, DSIR Ecology Division, Nelson.

Wardle, J.A. 1984. The New Zealand Beeches. Ecology, Utilisation and Management. N.Z. Forest Service. Caxton Press, Christchurch.

Appendix 1

REVIVE ROTOITI NEWSLETTER

Rotoiti Nature Recovery Project
Nelson/Marlborough Conservancy
Newsletter No. 14
Autumn 2006

Revive Rotoiti

Kiwi breeding and update

It has been a busy breeding season in the Rotoiti Nature Recovery Project (RNRP) area with the resident kiwi population being no exception. The RNRP team have kept close tabs on the kiwi males' movements to determine whether any were settling down to nest. Four of the five males were stationary for the length of time required to incubate an egg and on investigation of two of the nest sites, both nests were found to contain remnants of egg shell indicating successful hatches.


Te Matau, resident male kiwi.

Paul Gasson, the former St Arnaud ranger who led our kiwi work, is visiting in May with his kiwi trained dog Huxley. They will spend time in the project area trying to locate any kiwi chicks from this breeding season and the previous one. Any chicks located will be banded and fitted with a transmitter to monitor their movements. It is believed at least two kiwi chicks hatched this last breeding season and one the previous season.

Monitoring of kiwi chicks will enable us to assess the effectiveness of our stoat control regime as kiwi chicks are more vulnerable to stoat attack than adults. For this reason, we will in the future try to locate any chicks hatched and fit them with a transmitter.

Paul and Huxley will also be assisting with this year's annual health checks of the kiwi. It is hoped to recapture all the adult kiwi moved to the Rotoiti area in May 2004 (to set up the resident kiwi population). Their weight and general health will be checked and transmitters changed.

The kiwi have caused excitement in the St Arnaud village over summer with locals hearing kiwi calling in the village area and the discovery of a kiwi poo in the Kerr Bay car park area. The poo was found and identified as being from a kiwi by a DOC staff member on his way back to the visitor centre after carrying out bird counts in the project area.

These reports, exciting as they are, have confirmed the importance of the need to control dogs in the area. Tasman District Council bylaws allow dogs to be walked on roads and footpaths in the St Arnaud village, but they must be on a leash at all times. Dogs are not allowed in Nelson Lakes National Park, (which includes Kerr Bay) at all unless they have a DOC permit for entry to the park or they are a certified guide or companion dog. Unfortunately, kiwi do not recognise the difference between the national park and someone's backyard so could venture outside the park.

Along with the good news this season, we unfortunately had some bad. Rameka, one of the original females transferred from Kahurangi National Park in 2004, was found dead on 13 February. We suspect she drowned as she was found in a creek bed after heavy rain and her carcass showed no signs of predation.

KIWI RECOVERY™
Bank of New Zealand

More kiwi to move in

The next great spotted kiwi transfer has been set for the end of May. An additional 10 birds are to be transferred from the Gouland Downs area of Kahurangi National Park to the Rotoiti Nature Recovery Project to increase the founder population in the project area. The Rotoiti Nature Recovery team are presently preparing for the transfer. Look out for the next Revive Rotoiti issue, due in spring/summer of 2006-07, for news of how the transfer went.

Department of Conservation
Te Papa Atawhai

Wasp control

Wasp poisoning using the insecticide Finitron was carried out on 19 January with a satisfactory result. This will be the last time we will be using Finitron as the insecticide Fipronil has now been registered as X-stinguish and will be available for use next year.

Fipronil was used in the project area between 1999 and 2001 under an experimental permit held by Landcare Research who were developing the formulation with chemical companies. This insecticide is our preferred choice of control for wasps as it has proved to be faster acting. Wasp nests show dramatically reduced activity on the day of poisoning with Fipronil whereas Finitron appears to take up to two weeks to show its full effect.

In 2006–07 we will also be undertaking further experimentation with the operational deployment of wasp control. We will be looking at carrying out single strip plot treatments and small site repeat treatments and comparing the results with our original grid treatment site.

Kaka breeding

After a heavy beech flowering in spring last year the kaka got down to the business of nesting.

Out of eight nesting attempts this season, we have had four successful nests (i.e. the chicks have fledged from the nest). From these nests we had a total of 10 chicks: five males, four females and one of unknown sex as the chick fledged before it was banded. The RNRP team are currently monitoring two more nests both north of the RNRP core area.

RNRP Ranger Tamsin Bruce radio tracking kaka.The radio transmitters attached to the kaka are able to be tracked using telemetry.

Two kaka nests failed at the egg stage. In one case, the reason is unknown; the eggs were intact and had been incubated for one week before being abandoned. One suggestion was that perhaps the female was spooked off the nest. The second nest was possibly predated; two broken egg shells and one intact egg were found inside the nest. The nest contents are being sent off for analysis to determine if there are any hairs in the nest and if so what they are from. Both adult female kaka were unharmed.

RNRP Ranger Tamsin Bruce climbing a nest tree. Once the kaka is located using radio tracking the nest tree is climbed and a camera is placed at the entrance to the nest. Nests are monitored up to three times per week using a portable TV monitor which is attached to the end of the camera lead.

For the first time since the broader stoat trapping regime has been in place we have had two adult female kaka killed on nests within the managed project area. One was killed in the Teetotal/Big Bush area; the predator is yet to be confirmed. The second kaka was killed within the RNRP core area, and looks to have been killed by a stoat as she was cached. Both of these birds have been brought back to the lab for autopsy and are being sent away for further analysis.

While these events are unfortunate it has answered a big question for the RNRP team. Since the extended stoat control regime has been in place there has been a 100 per cent survival rate for adult female kaka on the nest up until this season. While this is a wonderful result it was not deemed a realistic percentage. The stoat control regime in place reduces the numbers of stoats to aid in kaka nesting success but does not completely eradicate them.

Above Tamsin 's head is the entrance to the kaka nest. Kaka commonly nest in natural tree cavities.

Looking ahead to 2006-2007

A kaka fitted with a radio transmitter.

This kaka season concludes the experimental test of stoat control in the Rotoiti Nature Recovery Project.

Final numbers need to be analysed but we are confident that the regime provides for a growing kaka population.

This allows us to explore new options in the 2006–07 year. We have chosen to tackle a number of one year questions as we may be engaging in new multi-year national experiments from 2007– 08 onward.

A beech seedfall and a rising rat population is underway at present and we will be using this as an opportunity to explore a few options for rat control, including revisiting the use of toxins at a high population level.

Friends of Rotoiti news

The Friends of Rotoiti have had a busy season checking their rat and stoat control lines and servicing 20 possum traps which have been placed along their stoat lines to reduce possum interference with the stoat traps.

The new Whisky Falls stoat control line has come into its own, clocking up a steady number of stoat kills and the possum traps along this line have been responsible for over 38 possum deaths in eight months.

Members of the group helped with kaka nest monitoring over the Christmas and New Year period, monitoring nest sites with a small portable TV monitor which is hooked up to a camera placed over the nest entrance.

The group will be carrying out bait trials over 2006-07 on several of their village rat lines to compare bait palatability and longevity.

If you are interested in becoming a Friends of Rotoiti member please contact Sally Leggett at the St Arnaud Area Office, phone (03) 521 1806.

The three goals of the Rotoiti Nature Recovery Project are:

- *restoration of the native ecosystem's components and processes.*
- *reintroduction of species lost from the area.*
- *advocacy for indigenous species conservation and long term pest control.*

Some of the Friends of Rotoiti at their Spring meeting in 2006. Friends of Rotoiti meetings are held twice a year at the St Arnaud Area Office meeting room and are often combined with a working bee or trap clearance along their 26 km of mustelid lines and 250 ha of rat lines.

Research projects

This year two students are carrying out research in the Rotoiti Nature Recovery Project as part of their university degrees.

An overseas student, Daniela Schenk, will be undertaking research towards the end of this year on the role of introduced birds as possible competitors with native species in the Rotoiti Nature Recovery Project area.

Rex Bartholomew is currently researching the factors influencing the recruitment and establishment of *Fuchsia excorticate*, an indicator species used for monitoring the impact of possum and deer in the RNRP. The objective of the study is to quantify the effects of various site factors on Fuchsia recruitment and survival in the St Arnaud Range and to test the hypothesis that intensive pest control management enhances recruitment. Rex's work will help the recovery project confirm whether the pest control regime in place for possums is aiding the recruitment of this threatened species.

Tree fuchsia, *fuchsia excorticate.*

Recovery of tree fuchsia in the stream beds of the St Arnaud range have been monitored since 2000 when plants from 3m to 3cm high were located and tagged. Rex's recent resurveys have begun to reveal a complex picture of gain and loss. Of 145 plants tagged in 2001 only 70 survived the floods of Easter 2005. Many were uprooted and had their bark stripped bare, in some cases the entire bank had been washed away or buried in rock. But Rex has found this Easters surveys have illustrated nature's tenacity. Several fuchsia that had been uprooted and stripped in the 2005 flood and washed up to 50m downstream have begun to send up epicormic shoots in their new locations. Rex found in some streams close to adult trees, recent bank fall debris were liberally covered in scores of fuchsia seedlings, testimony to the dispersal talent of the increasing number of frugivorous birds in the RNRP. On the other hand though Rex found significant damage on plants above 1m which he suspects may be due to deer browse.

A second line of research which Rex is investigating is the impact of rodents and possums on seedling mortality and site factors that promote high germination rates. You may come across some small wire cages used as rodent/possums exclosure plots in the RNRP which are part of Rex's studies.

Revive Rotoiti is published by the Department of Conservation, c/- St Arnaud Area Office, PO Box 55, St Arnaud. Ph: (03) 5211806 Fax: (03) 5211896 For more information or to subscribe, contact: Sally Leggett Email: starnaudao@doc.govt.nz

www.doc.govt.nz

Revive Rotoiti on-line

If you would like to receive future copies of Revive Rotoiti by email, (saving the project printing and mailing costs), please email Sally Leggett at sleggett@doc.govt.nz.

Appendix 2

OPERATIONAL FIELD MANUAL CONTENTS

The Operational Field Manual is a folder that is available for field staff to reference in the Area office. It contains hard copies of prescriptions and instructions for specific tasks. It is arranged in numerical order according to business plan task codes.

7405 126 210 - Predator Management

- Mustelid control and monitoring: an overview document.
- Sketch of Fenn™ cover design.
- Sketch of Fenn™ trap set.
- Fenn™ trapping data sheet masters.

7405 126 220 - Wasp Control and Monitoring

- Wasp Poison Decision Maker. Scanned version: dme:\\olddm-622541.
- Non-toxic wasp count protocol.
- Wasp strip plot transect map RNRPI.
- Malaise collection and sorting methods at: dme:\\olddm-621065.
- Malaise/honeydew suppliers list.
- Malaise trap location maps: RNRP, Misery, Lakehead.
- Malaise trapping data sheet master.
- Honeydew sampling protocol (refractometer method).
- Honeydew location map and instructions filter paper method.
- Honeydew tree location map.

7405 126 230 - Rodent Management

- Rat trap checking prescription at: dme:\\olddm-621607.
- Rat trapping data sheet master: dme:\\olddm-620920.
- RNRP core grid map S:\Camera|Mainland Island\maps\core grid.bmp.
- Rat trap information sheet (includes photos of tunnels set): dme:\\olddm-621902.
- Rat trap cover cutting pattern sketch, scanned version: dme:\\olddm-621971.
- Snap trapping database instructions. Printed from screens from Citrix database St Arnaud Snap Trapping.
- Rodent snap trapping for monitoring instructions RNRP and Rotoroa.

- Cunningham and Moors rodent paper with identification features and protocol for calculating snap trap index.
- Protocol for tissue sampling and testing for Vertebrate Pesticides. G.R.G. Wright, Landcare Research.

7405 126 310 - Vegetation Monitoring

- RNRP vegetation monitoring synopsis.
- Mistletoe monitoring protocol Kerr Bay and RNRP. See also: dme:\\olddm-485983.
- Tussock counts protocol Misery and RNRP. See also: dme:\\olddm-618015.
- Beech seed collection and analysis instructions.
- Equipment list for two 20x20 plots.

7405 126 320 - Fauna

- Lizard survey protocol and data sheet.
- Robin monitoring protocol.
- Snail monitoring protocol.
- Kaka monitoring protocol.

7405 126 330 - Monitoring of Small Mammals

- Rodent monitoring documents with line locations and written instructions for setting tunnels, analysis results and suppliers. Requires updating but useful as guide.
- TT (Tracking Tunnel) line locations (including treatment types, hazards, best combinations): dme:\\olddm-623087.
- Maps for tracking tunnel lines: Rotoroa A-D (with notes), Lakehead, Big Bush rat area, RNRP core.
- Sketch diagram for galvanised 1m possum proof tracking tunnel.
- TT ink and paper preparation (ferric/tannic method).
- TT field data sheets: dme:\\olddm-623080.
- TT rodent and mustelid data sheets form Rotoiti and Rotoroa.
- TT rodent and mustelid synopsis sheets.
- TT guide to prints: dme:\\olddm-63018.
- TT protocol for SRU investigation sites dme:\\olddm-118330 Note – some variance from protocol noted on hard copy.
- TT protocol for field from dme:\\olddm-118330 with variances.

7405 126 100 - RNRP Management

- Etrex settings.
- Mainland Islands Agreement to Strategic Principles.
- Maps.
- Project codes and task managers dme:\\olddm-611783.

- Business planning calendar tables.
- Iwi contact list.
- Acetate map grids for estimating area.
- Mainland Island Draft reporting guidelines.
- Memorandum of Understanding – Borlase farm access dme:\\olddm-623177.

7405 126 240 - Possum Management

- NPCA trap catch protocol for field operatives.
- Kill trap line and trap locations.
- Kill trap data sheets.
- Wax tag spreadsheets.

7405 126 250 - Ungulate management

- Deer, chamois, hare protocol, including stomach sampling: dme:\\olddm-620040.
- Hunter return sheet: dme:\\olddm-621252.

7405 126 500 - Research support

RNRP request for research proposals with research needs.

Appendix 3

INTERNAL DEPARTMENT OF CONSERVATION DOCUMENTS

(DOC computer document reference numbers in brackets)

1. RNRP Strategic Plan 1998 (dme:\\olddm-623824).
2. Mainland Islands Agreement to Strategic Principles (dme:\\olddm-565335).
3. RNRP Feratox Field Trial 2004 (dme:\\olddm-623614).
4. RNRP Operational Plan 2004-05 (dme:\\olddm-624608).
5. RNRP Wasp Poison Decision Maker (dme:\\olddm-622541).
6. RNRP Wasp Finitron Preparation Prescription 2004 (dme:\\olddm-623726).
7. RNRP Wasp AEE 2003-04 (dme:\\olddm-623524).
8. Draft RNRP Strategic Plan - review of 1998 plan (dme:\\olddm-623404).
9. Falcon nesting data (dme:\\olddm-621933).
10. Tussock Count RNRP (dme:\\olddm-618015).
11. Maitland 3rd International Wildlife Congress Abstract (dme:\\olddm-622951).
12. RNRP Advisory Group Minutes February 2005 (dme:\\olddm-624491).
13. RNRP 3rd International Wildlife Management Congress Presentation (dme:\\olddm-623506).
14. Draft management plan for great-spotted kiwi recruitment and founder population in the RNRP 2005-11 (dme:\\olddm-624129).
15. Great-spotted Kiwi Translocation Technical Report 2005 (currently in print) (dme:\\olddm-624584).
16. Trans-GSK Source Options (dme:\\olddm-623611).
17. Trans-GSK-Operational Plan (dme:\\olddm-622957).
18. Trans-GSK Proposal dme:\\olddm-622630
19. RNRP Honeydew Post Statistician (dme:\\olddm-623051).
20. Department of Conservation's Translocation of New Zealand's Indigenous Terrestrial Flora and Fauna SOP. QD number NH1042 (dme:\\olddm-718296).
21. Best Practise for Survey and Monitoring of Loranthaceous Mistletoe (dme:\\olddm-485983).
22. Wasp Operational Plan (dme:\\olddm-625170).
23. Finitron key facts sheet (dme:\\olddm-624447).

Appendix 4

OPTIMUM SPACING OF BAIT STATIONS FOR CONTROLLING HOUSE MICE (*MUS MUSCULUS*) DURING MAST SEEDING IN A BEECH (NOTHOFAGUS) FOREST

Billy Hamilton, Ecological Networks Ltd., 10, Coughtrey Street, Dunedin, New Zealand.

Note: this publication was contracted by the Rotoiti Nature Recovery Project in 1999. The work was completed by Billy Hamilton from Ecological Networks but prepared for publication. The work has now been edited and is presented here for future reference:

Ecological Networks Ltd. 2000. Optimum spacing of bait stations for controlling house mice (Mus musculus) during mast seeding in a beech (Nothofagus) forest. in Rotoiti Nature Recovery Project Annual Report July 2005 – Department of Conservation December 2006.

Abstract

This study measured the efficacy of brodifacoum in different bait station grid densities to control feral house mice (*Mus musculus*) during a population irruption following beech (*Nothofagus* sp.) *mast* seeding in the Rotoiti Nature Recovery Project 'Mainland Island' of Nelson Lakes National Park, South Island, New Zealand.

Bait stations were set at five different densities (100 - 25m between stations) within ten 200 x 200m grid trial replicates in the beech forest and baited with brodifacoum. Tracking tunnels were used to measure mouse activity within and between the different grid trials. Following poisoning, mouse abundance did decrease and was inversely related to bait station density. Within seven days there was a resurgence in mouse abundance. Calculating the overall relationship between bait station density and mouse abundance suggests that a bait station density of 39/ha or a bait station ca every 20m would be required to give a mouse tracking rate of 10%. The study confirmed other findings that mice take some time to get used to tracking tunnels and maximum mouse tracking rates were not reached until at least 12 days after they were put out.

Keywords: Mainland Islands, mice, conservation, *Mus musculus*, pest control, beech, forest, brodifacoum.

Introduction

In the months following a beech (*Nothofagus* sp.) seedfall feral house mice (*Mus musculus*) are capable of large increases or irruptions in population density. These population increases result from the increased productivity and survival of mice brought about by increased food availability (King 1983). Ship rats (*Rattus rattus*) are also known to pulse in abundance following beech masting (King and Moller 1997).

While rats are known to have a direct effect on native bird species through predation of nestlings and eggs (Hay 1981; Moors 1983; Innes *et al.*, 1994), the direct impact of mouse population irruptions on New Zealand's indigenous invertebrates, lizards and bird populations is unknown. But, it is likely that mice cause a reduction in indigenous species population densities through interactions such as competition for resources, and/or predation (Ramsey 1978).

An important indirect effect of mouse population irruptions is the correlated increase in small mammalian predators, particularly ship rats and stoats (*Mustela erminea*). These predators have in the past been responsible for the extinction of native birds and are a continuing threat to the conservation of several remaining species (Holdaway 1989; Innes and Hay 1991; Clout and Saunders 1995). Studies have shown that native bird communities suffer heavy predation from these predators following beech seed fall (King 1984; Elliott 1996; O'Donnell *et al.*, 1996).

The stoat is considered to be one of the most important predators of native avifauna in New Zealand (King 1984; O'Donnell *et al.*, 1996). With the increase in mouse abundance during the winter, stoat numbers increase in the early summer following a seedfall. This population increase is caused by an influx of a high numbers of young stoats being produced (Rinney *et al.*, 1959; King 1983; Murphy and Dowding 1995; King and Moller 1997). Once beech seeding finishes, rodent numbers decline dramatically during the following spring and subsequently the large number of stoats present switch to prey on native birds (O'Donnell *et al.*, 1996; Elliot *et al.*, 1996).

In the past, New Zealand's conservation managers have responded to predation threats such as those posed by stoats mainly by translocating threatened species to offshore islands where such predators do not occur. Control of predators *in situ* has been considered too unreliable, difficult and expensive. Recently there has been a shift of emphasis towards restoration of mainland ecological communities now that most of the critically threatened species are secure on offshore islands (Clout and Saunders 1995). This shift has manifested in the establishment of mainland islands by the Department of Conservation. Here intensive programmes of pest/predator control impose a "press perturbation" (Bender *et al.*, 1984). Mainland 'islands' are normally isolated from the surrounding areas either by geographical features but more generally their isolation is artificial and is only maintained through intensive pest management protocols. Therefore these 'islands' are under continual pressure of re-invasion by pests and predators from surrounding areas.

One such mainland island, the Rotoiti Nature Recovery Project, is located within Nelson Lakes National Park. This beech forest mainland island of approximately 825 ha (at the time of this study) is predominately red (*Nothofagus fusca*), silver (*N. menziesii*) and mountain (*N. solandri*) beech. It is situated alongside Lake Rotoiti and is bounded by farmland, lakeside, mountain ridge and forest. A poisoning and trapping management programme aimed at the control of predators, browsers and rodents has been in operation within this mainland island since November 1997. While this management programme has resulted in a low relative abundance of most of these mammals, a heavy beech seedfall during 1999 saw an increase in mouse tracking rates (Butler, 2003). Mouse abundance continued to remain high under the normal management protocols. This research was designed to test whether it was possible to control mouse populations during such a beech seeding event by poisoning with brodifacoum using set bait station spacing and protocols, and how intensive a programme was required. To this end the relative efficacy of 5 different bait station grid spacings, including the normal 2.25 stations/ha, to kill mice with brodifacoum during a beech seeding year were assessed. The cost-effectiveness of the 5 bait station spacing regimes was also assessed to determine the most effective management approach to poisoning operations during a beech mast year.

Objectives

- Determine whether the current bait station grid is adequate to manage mice in a year of high numbers.
- Determine the efficacy of brodifacoum applied in bait stations spaced at different grid densities when mice are abundant.
- Determine the most effective bait station spacing to reduce mouse numbers to a 10% level (tracking tunnel index (Gillies & Williams, 2004)).

Study Area and Methods

The study was based within the mainland island (41° 50'S, 172° 50'E) beech forest (*Nothofagus fusca, N. menziesii, N. solandri*) on the north-eastern shore of Lake Rotoiti, South Island, New Zealand. This beech forest ranges in altitude from 620m to c. 1440m a.s.l. The mainland island beech forest and adjacent national park support several threatened species of native bird, including the South Island kaka.

Two transects of five different bait station grid spacings (i.e. treatments) were established, each covering an area of 200m x 200m (Figure 1). Philproof™ bait stations were used but modified by adding a galvanised metal plate to reduce bait interference by possums. This lowered the height of the opening from which animals could remove bait from 65mm to 25mm, ensuring that only rodents would be targeted and reducing cost because bait would not be cleared as quickly from stations. In addition treatment grids were placed within areas where possum numbers were very low ('residual trap catch index' no more than 1.09% (Butler, 2003).)

Bait stations were placed on tree trunks 30-50cm above the ground with a stick fastened to each reaching the ground to facilitate mouse access, after research showed that they did not use stations without this (Taylor *et al.*, 1998). Bait stations were spaced at 100m x 100m, 100m x 50m, 50m x 50m, 50m x 25m, and 25m x 25m intervals, corresponding to 2.25, 3.75, 6.25, 11.25 and 20.25 bait stations/ha respectively. Treatments were allocated randomly to five grids isolated from each other by at least 250m along a transect next to Lake Rotoiti's shoreline. Another five treatment grids were established along a second parallel transect at higher altitude so that upper and lower altitude edges of the grids were at least 300m apart (Figure 1). The 250m and 300m spacings were used to give at least two complete mouse home range spacings, at beech seeding population density, between treatments and transects (see Fitzgerald *et al.*, 1981 for home ranges versus mouse density). The grids at both ends of the transects were set at least 300m from farmland on one side and beech forest on the other.

Sixty-five footprint tracking tunnels (King and Edgar, 1977) were placed at 50m intervals, running from the farmland boundary through the middle of each grid (within 20m of the bottom of each treatment) and extending 250m beyond the last treatment. An additional five footprint tracking tunnels were placed within 20m of the top of each treatment and spaced at 50m. This gave a total of eighty five tracking tunnels along the lower transect of which ten were placed within each grid. This same layout was repeated for the upper transect except that only 80 tunnels were used because of topographical constraints.

All tracking tunnels were baited with a mixture of peanut butter and rolled oats and operated on the schedule shown on Figure 2. On the lower replicate tracking tunnels were run for a night on three occasions five nights apart before poisoning; and a further nine single nights after poisoning. During poisoning 'track-nights' were spaced at two or three day intervals for three runs to measure the time of any reinvasion by mice from outside poison areas. Thereafter runs returned to five nightly intervals. A similar pattern was used for the upper treatment but here there were six nights of tracking before poison followed by six nights post-poison. During poisoning 'track-nights' were spaced at three day intervals for three runs. Tracking commenced and finished at the same time for both transects.

Poisoning in the lower replicate commenced on 1 September 1999 (i.e. the day following the lower replicate's third track night) and in the upper replicate on 19 September 1999 (i.e. the day following the upper replicate's sixth track night) (Figure 2). Each bait station was initially loaded with 250g of Talon 20P™ (20 ppm brodifacoum) pelleted cereal baits. Toxic bait was added when needed so that stations always had an excess of pellets[1]. The poisoning finished on 7 October 1999.

Bait take was estimated by inverting each bait station prior to emptying and measuring the level of bait remaining using a calibrated stick. Five pellets from sample bait stations (two from each grid) were weighed at intervals to gauge moisture uptake by bait.

[1] Four stations were found to be empty on 3/10/99, these stations were immediately filled. These stations had been checked on 1/10/99 and were thought to have sufficient bait to suffice until 3/10/99 check.

Results

Mice

After poisoning, tracking rates declined in both transects but then increased again to reach pre-poisoning levels by the end of the trial (Figure 3). Prior to poisoning there were no significant differences in tracking rates between treatment grids and adjacent non-treatment areas, and between the two different treatment grids (Table 1). Following poisoning there was a difference in the mouse tracking rates between treatments (Table 1) which were a product of both the different treatment grids and an altitudinal effect (Table 2).

Mouse abundance was highest in the lower replicate (see Table 2 and Figure 4). While tracking rates decreased in both transects following the poison operation, the lowest mouse abundance was achieved in the upper replicate where initially the abundance was lower (Figure 4). Although there was a trend for grids with a higher density of bait stations to have the lowest mouse abundance in both transects, only in the lower replicate was this relationship significant (Table 3).

Calculating the overall relationship between bait station density and mouse abundance suggests that a bait station density of 39/ha or a bait station ca every 20m would be required to give a mouse tracking rate of 10% (see Figure 5).

Changes in Toxic Bait

On average bait increased in weight by 14% due to moisture uptake, but mice appeared unaffected by this and continued to visit bait stations and take bait.

Possums, Rats and Hedgehogs

There was no evidence of possum disturbance of tracking tunnels or bait stations during the study and there were no records of their footprints being tracked. Hedgehogs were only tracked in the upper replicate both before (1.3% mean tracking rate) and after (6.0% mean tracking rate) poisoning. Hedgehogs were tracked after poisoning in two of the three treatment grids where hedgehogs were not present before poisoning. In the one grid (3.75 bait stations/ha) where hedgehogs were present before and after poisoning the tracking rate increased from 7.2% to 12.0% although this was not a significant difference (Mann-Whitney U-test; $p=0.3597$).

Few rats were tracked in the upper replicate (maximum 1.4% and 2% pre and post-poisoning respectively). In the lower replicate there was no difference in the pre and post-poison tracking rates of rats that were present before and after poisoning (Mann-Whitney U-test; all three $p>>0.05$). In one of these treatment grids (6.25 bait stations/ha) the tracking rate reduced from 33.3% to 11.1%. Overall the tracking rates for the treatment grids were 8% before poisoning and 4.4% after poisoning. The tracking rate in the non-treatment areas was not significantly different between pre and post-poisoning (Mann-Whitney U-test; $p=0.1600$).

Tunnel Placement

There was no difference in the tracking rates of 'control' tunnels placed between grids and those at the extremes of the treatment (ANOVA; 43 d.f. and 38 d.f. for lower and upper transects respectively, $p >> 0.05$). There was also no difference in the tracking rates for 'treatment' tunnels that were on the boundary either with a non-treatment area or with those tunnels within the grid (ANOVA; 8 d.f., $p >> 0.05$).

Discussion

Mainland Islands can exist as ecological sanctuaries in part due to their intensive pest management protocols. These pest control measures are especially important during periods when native species are most at risk. In the beech mainland island forest of the Nelson Lakes National Park the beech seeding event of 1999 posed a particular problem for species management. While previous intensive management protocols had reduced the numbers of pests such as stoats, ferrets, cats, and rats to manageable levels, heavy beech seeding allowed mouse numbers to remain high during winter. This study has shown that by increasing bait station density mouse abundance can be reduced. This relationship was variable, affected by altitude and not always significant, but overall the higher the density of bait stations the lower the incidence of mice.

Reduction in mouse abundance also seemed to be dependent upon the initial pre-poisoning abundance as seen in the different results from the two transects. In the upper transect mouse abundance was initially lower than in the lower replicate, and after poisoning it also had a much lower abundance.

During times of high mouse abundance, for example, during beech seeding events, the density of bait stations required to reduce mouse abundance to a 10% level is exceedingly high. It should also be noted that mouse numbers reached even higher levels in 2000 than in 1999 when this research was conducted, as a result of two consecutive seasons of heavy beech seeding (Butler, 2003). A yet higher density of bait stations may have been required to achieve the same level of control then. Such a high density bait station poisoning programme may be too expensive both in terms of money and time if it were to carry on continuously, but this may not be necessary to get the desired results.

While mice may cause a reduction in the abundance of native birds during beech seed fall years through a variety of interactions, a more significant threat to New Zealand's birdlife comes from stoats. Therefore, a poisoning programme that reduces the threat of stoat predation during and immediately after a seed fall year may be as effective as and less costly than a programme that is run continuously using a high density of bait station coverage. Studies have shown that secondary poisoning using brodifacoum is an effective method of killing stoats, provided that there is enough prey available as poison vectors (Alterio, 1996; Alterio *et al*., 1997; Brown *et al*., 1998). Timing of such a programme is important and could be governed by two factors. The first is the predation rate on vulnerable native bird species during times of increased stoat numbers. Timing poisoning operations during vulnerable stages in threatened species life cycles could help reduce the predation pressure. For example, kaka, and yellowhead or mohua (*Mohoua ochrocephala*) are especially vulnerable to stoat predation during their breeding season (Elliott 1990). These species are hole nesters and the females are the incubators, making them especially vulnerable to being killed on the nest by stoats. Mohua also nest later than other hole nesting forest birds at a time when stoat numbers are at their highest (Elliott 1996; O'Donnell 1996). Nest destruction by stoats causes a loss in the number of adult females available for re-nesting as well as the number of young recruited into the population. By targeting poisoning operations during this vulnerable stage, it is possible that predation by stoats can be decreased and the number of successful nests increased.

Another factor is the initial flush of mouse abundance during autumn and a poisoning operation could be timed to coincide with it. This has the potential to reduce the abundance of mice and thus the abundance of food resource available to adult stoats. This might in turn result in a reduction in the number of young stoats surviving the winter, and of those born the following summer and thus reduce the predation risk to bird species.

The best approach might be to make use of both of these factors and have a double pulse of intensive poisoning during beech seeding years, one during autumn/winter to coincide with the increase in mouse abundance and a further one in summer during the vulnerable breeding stage of hole-nesting birds. It should be noted that poison control operation timing will need to be tailored to suit the species to be protected. For example, non-breeding mohua have been observed to roost in holes and thus are not only at risk during the breeding season (Lawrence *et al.*, 2000) while parakeets have been observed to breed throughout the winter in a heavy beech seedfall year (Elliott *et al.*, 1996). Factors influencing the repopulation of the poisoned area by predators (timing, scale and effectiveness of control, size of home range and breeding and dispersal rate of stoats) (Brown *et al.*, 1998) must also be taken into account when designing poison operations.

Reinvasion

Mice and rats can quickly detect the death of a nearby conspecific (Fitzgerald *et al.*, 1981; Hickson et al. 1986). In this study, tracking rates declined after poisoning for all grid spacings, with the lowest tracking rates occurring at the highest density of bait stations. In all cases there was then a resurgence of mouse tracking rates, from as little as five days later on the higher bait station density grids (Figure 1b). This resurgence may have occurred through re-invasion of the depleted areas after poisoning of many of the original residents. Such a re-invasion has also been found with rats (Hickson *et al.*, 1986). It is unlikely that such resurgence was caused by expansion of home ranges of neighbouring mice as mouse home range length is greatly reduced with increased mouse density (Fitzgerald *et al.*, 1981). This increase in tracking rates is also unlikely to have been caused by newly born young migrating into the area as the time taken between declines caused by poison and increased tracking rates are too short for successive cohorts to be raised. Further research is required to determine whether reinvasion is indeed the sole cause of this effect and whether it would be less significant if larger grids were used.

This effect is of concern to poisoning operations as it shows that while there can be a significant drop off in tracking rates post-poisoning within a set area, this only gives temporary respite from the effects of mice. This rollercoaster effect continues with each new reinvasion and subsequent poisoning event.

Mouse Behaviour and Tracking Rates

It has been assumed that mice are neophilic (Crowcroft, 1973; Fitzgerald *et al.*, 1981) and are therefore unlikely to avoid tracking tunnels initially. Any avoidance of tracking tunnels by mice in previous research has been attributed to their avoidance behaviour of rats. While it is possible that such behaviour does occur, results from this study suggest that here this may not be the case.

Similarly to other studies there was a delay of greater than 10 days in tracking tunnels reaching saturation by mouse tracking rates pre poison. It is possible that mice were avoiding tunnels previously tracked by rats but in this case rat numbers were already low so there should have been limited interference at best.

This result has some very important far-reaching implications in the use of tracking tunnels for relative indices measurements. If as is the case here, mice avoid tracking tunnels for up to 12 days, tracking rates collected before this time will be unreliable and provide a lower estimate of the number of animals tracked. This is also true when an area is poisoned and the success of the poison operation is based upon the tracking rates immediately after. If it takes up to 12 days before mice track tunnels then again estimates of abundance will be lower than is actually there. Therefore it is important for tracking rates to be maximised both before and after treatments to ensure effects of treatment can be measured. While here it was seen that mice take time to track within tunnels this may be the case for other species. Also it is possible that this behaviour will vary both temporally and spatially. This delayed tracking effect is recognised in the Department of Conservation's rodent and mustelid tracking protocol (Gillies & Williams, 2004) which requires that all tunnels are set out at least three weeks before the first survey.

Rats and Hedgehogs

Rats were present in both transects but the highest abundance was recorded in the upper replicate. Hedgehogs were only present in the upper replicate. It is possible that the difference of numbers between transects for rats, mice and hedgehogs may have to do with their winter requirements. While temperatures in the lower replicate are probably warmer than the higher altitude, the lower lie of the land and the beech forest may make this lower replicate wetter. Therefore while rodents prefer a warmer habitat as does the hedgehog, the latter is mainly restricted in its winter range to an area that will provide a dry hibernaculum (see Hamilton 1999). Rats are one of the key targets for mainland islands because of their particular impacts on birds as well as invertebrates. In addition it is only relatively recently that the threat posed by hedgehogs to native invertebrate and bird species has been recognised (Hamilton and Alterio 1998; Hamilton 1999).

Implications for Conservation

Providing a cost-effective method for the control of pest populations during times of their high abundance is an important step towards the restoration of New Zealand's wildlife communities. To provide these methods we must be able to accurately measure the effectiveness of the treatments used and also determine the most appropriate time to use them. This research has provided evidence that the use of high density of a bait stations will reduce the mouse abundance during a beech seeding year. But practical consideration must be given to the question of when does a grid spacing become so small that it is unrealistic? The 25x25m spacing in this study resulted in significant trampling of forest undergrowth. Servicing the smaller grid took 10 to 11 times longer than the 100x100m grid.

It has also shown that the behaviour of the targeted species is important in interpretation of the results obtained and future design of pest management strategies. While toxins such as brodifacoum and 1080 are important tools in providing the pest control needed to keep the integrity of an area, such as a mainland island, intact they do have risks (see Eason and Wickstrom 2001; Hamilton and Moller 2000 for reviews). While these toxins kill the targeted pest species, and also through secondary poisoning other non-target mammalian pests (Alterio *et al.*, 1997), there is concern as to their effect on non-target native species (Hamilton 2004). Therefore while toxins help provide the framework for pest management techniques that enable species conservation and restoration of New Zealand's ecological communities, poisoning methods will always involve some unwanted risks and it is important that these risks are researched and highlighted.

Following the outcome of this study the Rotoiti Nature Recovery Project has ceased targeting mice with rodent control strategies, and focussed on ship rats only. The project acknowledges that mice cause an un-quantified level of damage, but accepts this damage in lieu of appropriate and affordable techniques to control them in a beech forest system.

Acknowledgements

I am grateful to Department of Conservation for funding this research and providing the logistical support in running this project. Thanks to Dr. Dave Butler, Genevieve Taylor and their St. Arnaud team of the Department of Conservation for all their fieldwork. Thank you also to Dr. Henrik Moller and Genevieve Taylor for helpful comments on an earlier draft and to Dr Dave Butler for editing.

References

Alterio, N. 1996: Secondary poisoning of stoats (*Mustela erminea*), feral ferrets (*Mustela furo*), and feral house cats (*Felis catus*) by the anticoagulant poison, brodifacoum. *New Zealand Journal of Zoology* 23: 331-338.

Alterio, N.; Brown, K.; Moller, H. 1997: Secondary poisoning of mustelids in a New Zealand *Nothofagus* forest. *Journal of Zoology, London 243*: 863-869.

Bender, E.A.; Case, T.J.; Gilpin, M.E. 1984: Perturbation Experiments in Community Ecology: Theory and practice. *Ecology 65*: 1-13.

Brown, K.P.; Alterio, N.; Moller, H. 1998: Secondary poisoning of stoats (*Mustela erminea*) at low mouse (*Mus musculus*) abundance in a New Zealand *Nothofagus* forest. *Wildlife Research* 25: 419-426.

Butler, D.J. (Ed.). 2003: Rotoiti Nature Recovery Project Triennial Report July 1998 – June 2001. Occasional publication No. 56, Department of Conservation, Nelson. 165pp.

Clout, M. N.; Saunders, A. J. 1995: Conservation and ecological restoration in New Zealand. *Pacific Conservation Biology 2*, 91-98.

Crowcroft, P. 1973: *Mice all over*. The Chicago Zoological Society, Brookfield Illinois, USA. 123 pp.

Eason, C.T.; Wickstrom, M. 2001: Vertebrate pest toxicology manual (poisons). Department of Conservation Technical Series *23*: Wellington, New Zealand.

Elliott, G.P. 1990: The breeding biology and habitat relationships of the yellowhead. Unpublished Ph.D. thesis, Victoria University, Wellington, New Zealand.

Elliott, G.P. 1996: Mohua and stoats: a population viability analysis. *New Zealand Journal of Zoology 23*: 239-247.

Elliott, G.P.; Dilks, P.J.; O'Donnell, C.F.J. 1996: The ecology of yellow-crowned parakeets (*Cyanoramphus auriceps*) in *Nothofagus* forest in Fiordland, New Zealand. *New Zealand Journal of Zoology 23*: 249-265.

Fitzgerald, B. M.; Karl, B. J.; Moller, H. 1981: Spatial organisation and ecology of a sparse population of house mice (*Mus musculus*) in a New Zealand forest. *Journal of Animal Ecology 50*, 489-518.

Gillies, C. & D. Williams. 2004. Using tracking tunnels to monitor rodents and other small mammals. Unpubl. Report, Northern Regional Office, Department of Conservation, Hamilton.

Hamilton, W.J. 1999: Potential threat of hedgehogs to invertebrates with a restricted range, Otago region. *Conservation Advisory Science Notes* No. *254*: Department of Conservation, Wellington, New Zealand.

Hamilton, W.J. 2004: Monitoring of the non-target effects of an aerial 1080 poison operation on native tomtits in the Hampton area of Otago. Ecological Networks Ltd, Dunedin Report 35.

Hamilton, W.J.; Alterio, N. 1998: Rodent populations present at the Cromwell refuse disposal facility and surrounding habitats and their potential threat to the Cromwell Chafer Beetle Reserve. Ecosystems Consultants Ltd., Dunedin Report No. 11: pp16.

Hamilton, W.J.; Moller, H. 2000: Use of brodifacoum and cyanide poisons to control introduced small mammals in New Zealand forests brings net conservation benefit. Ecosystems Consultants Ltd, Dunedin Report 17.

Hay, J.R. 1981: The kokako. Unpublished report, Forest Bird Research Group, Rotorua.

Holdaway, R. N. 1989: New Zealand's pre-human avifauna and its vulnerability. *New Zealand Journal of Ecology 12*, 11-25.

Hickson, R. E.; Moller, H.; Garrick, A. S. 1986: Poisoning rats on Stewart Island. *New Zealand Journal of Ecology 9*, 111-121.

Innes, J. G.; Hay, J. R. 1991: The interactions of New Zealand forest birds with introduced fauna. *Acta XX Congressus Internationalis Ornithologici 4*: 2523-2533.

Innes, J.G., Crook, B., Jansen, P. 1994. A time-lapse video camera system for detecting predators at nests of forest birds: A trial with North Island kokako. Pp 439-448 in Proceedings of the Resource Technology 1994 Conference. Melbourne, Australia.

King, C.M. 1983: The relationships between beech (*Nothofagus* sp.) seedfall and populations of mice (*Mus musculus*), and the demographic and dietary responses of stoats (*Mustela erminea*), in three New Zealand forests. *Journal of Animal Ecology 52*: 141-166.

King, C. 1984: *Immigrant killers*. Oxford University Press, Auckland, N.Z. 224 pp.

King, C. M.; Edgar, R. L. 1977: Techniques for trapping and tracking stoats (*Mustela erminea*); a review and a new system. *New Zealand Journal of Zoology 4*: 193 - 212.

King, C.M.; Moller, H. 1997: Distribution and response of rats (*Rattus rattus, R. exulans*) to seedfall in New Zealand beech forests. *Pacific Conservation Biology 3*: 143-155.

Lawrence, B.; Palmer, D.; van Hal, J.; Low, M.; McInnes, K.; Mcleod, J.; Molloy, R. 2000: Report on field trial of trapping perimeters for stoat control; Dart and Caples Valleys, Upper Wakatipu. Department of Conservation, Southland, unpublished report.

Moors, P.J. 1983: Predation by mustelids and rodents on the eggs and chicks of native and introduced birds in Kowhai Bush, New Zealand. *Ibis 125*: 137-154.

Murphy, E.C.; Dowding, J.E. 1995: Ecology of the stoat in *Nothofagus* forest: home range, habitat use and diet at different stages of the beech mast cycle. *New Zealand Journal of* Ecology *19*: 97-109.

O'Donnell, C.F.J. 1996. Predators and the decline of New Zealand forest birds: an introduction to the hole-nesting bird and predator programme. *New Zealand Journal of Zoology* 23: 213-219.

O'Donnell, C.F.J.; Dilks, P.J.; Elliott, G.P. 1996: Control of a stoat (*Mustela erminea*) population irruption to enhance mohua (yellowhead, *Mohoua ochrocephala*) breeding success in New Zealand. *New Zealand Journal of Zoology 23*: 279-286.

Ramsey, G. W. 1978: A review of the effect of rodents on the New Zealand invertebrate fauna. *In:* Dingwall, P. R.; Atkinson, 1. A. E.; Hay, C. *ed.* The ecology and control of rodents in New Zealand nature reserves. *Department of Lands & Survey Information Series No 4.* Pp. 89-95.

Rinney, T., Watson, J.S., Bassett, C., Turbott, E.G., Howard, W.E. 1959: Lake Monk expedition, an ecological study in Southern Fiordland. *DSIR Bulletin* 135: 1-75

Taylor, R.H.; Studholme, B.; Walker, K. 1998: Trials on the siting and effectiveness of various types of bait station for mouse control. Department of Conservation, Nelson unpublished report.

FIGURE 3:

Percentage of the tunnels tracked by mice on a single night on successive days of the study for different transects and grids: (a) lower transect where □ is the 2.25 stations/ha and ✧ is the 6.25 stations/ha treatment (b) lower transect where □ is the 20.25 stations/ha and ✧ is the 11.25 stations/ha treatment (c) upper transect where □ is the 3.75 stations/ha and ✧ is the 6.25 stations/ha treatment. The arrows represent when poisoning operations began (↑) and ceased (↑). (Poisoning ceased on day 43 on upper transect (c)).

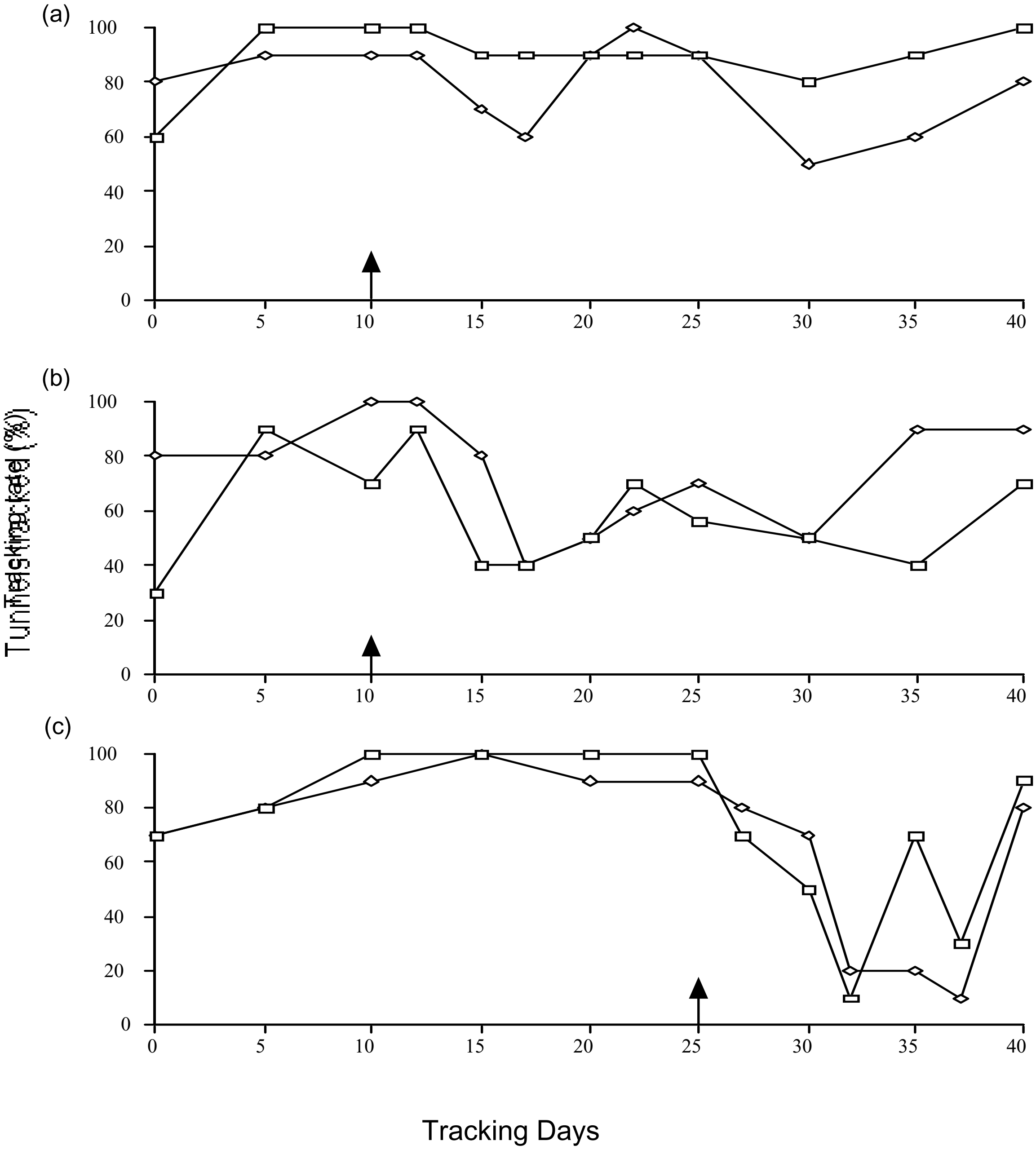


FIGURE 4:

Relationship between bait station density (Stations/ha) and mouse tracking rates post-poisoning in (a) lower replicate and (b) upper replicate. Error bars indicate 95% confidence intervals.

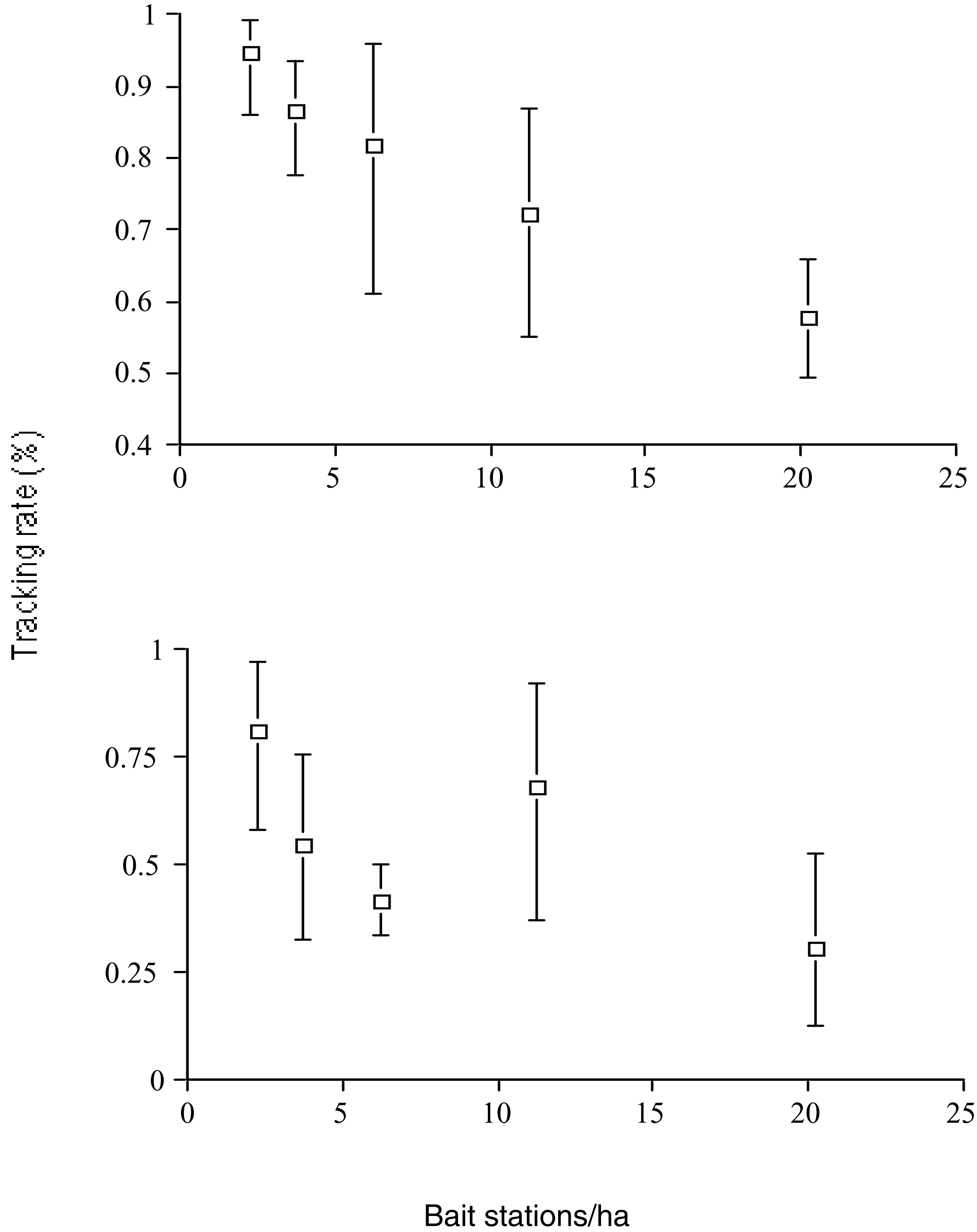


FIGURE 5:

Relationship between bait station density (Stations/ha) and mouse tracking rates post-poisoning overall. Line is extrapolated to show bait station density required to reduce mouse tracking rate to 10%. Error bars indicate 95% confidence intervals.

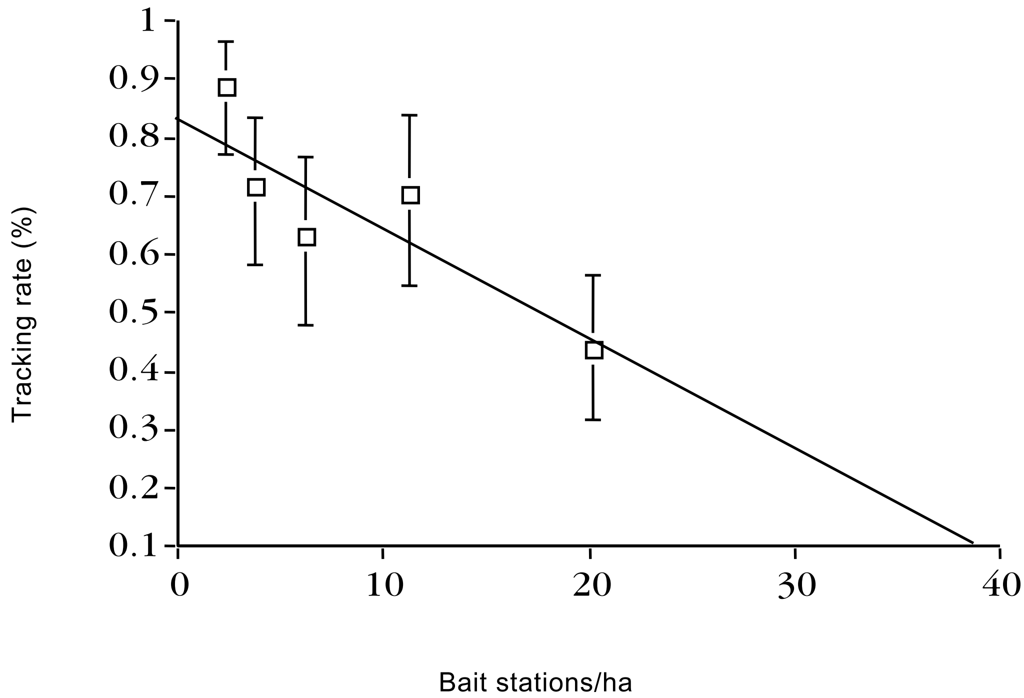


TABLE 1:

Results of four Kruskal-Wallis analyses testing for differences between the tracking rates of non-poisoned areas and each treatment before and after poisoning (N=12); and between each treatment before and after poisoning (N=10).

TREATMENT	N	P
Pre poison	12	0.1676
Post poison	12	0.0001
Pre poison	10	0.1965
Post poison	10	0.0010

TABLE 2:

Effects of bait station density and transect position on mouse tracking rate after poisoning. Shown are mean tracking rates and significances, where P is the interactive effect, P* the effect of replicate position and P** the effect of bait station density. All sample sizes were N = 10.

TREATMENT (stations/ha)	TRANSECTS			
	LOWER	P*	UPPER	P**
2.25	94.7%		80.9%	
3.75	86.5%		54.5%	
6.25	81.9%	0.0001	41.8%	0.0001
11.25	72.3%		68.1%	
20.25	57.7%		30.8%	
Interaction		P=0.2739		

TABLE 3:

Relationship between bait station density and mouse tracking rate. Results are from simple regression analysis.

	r	p
Upper replicate	0.6496	0.2358
Lower replicate	0.9864	0.0019
Overall	0.8729	0.0535