ENVIRONMENTAL

TRUST

FINAL REPORT ON PILOT STUDY OF RAT MONITORING ON HIRAKIMATA[1]

Great Barrier Island Environmental Trust: Local Board Grant: LG1604-210

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May 2017

Executive Summary

° The relative abundance of rats on the summit of Hirakimata (Mt. Hobson) and at Windy Canyon was assessed using 10 GoodNature A24 multi-kill traps fitted with counters at each location during two seven-week periods (phases), in December 2016 – February 2017 and March – April 2017.

° Rats (*Rattus rattus*) were abundant in the first phase, with no numerical difference between the two locations, but were much reduced, especially on the summit, in the second phase.

° The reduction in rat numbers on the summit in March-April was statistically significant and contrary expected seasonal rat abundance trends. Possible reasons for this anomaly are discussed. Cat predation is one possibility.

° Problems were found with the set-off counters, and with the automatic lure pumps (ALPs) fitted to the A24s, necessitating more frequent monitoring trips than planned. The counts underestimated kills on 14-34% of occasions; the ALPs were considered dysfunctional more than 50% of the time in Phase 2.

° It is recommended (1) that the traps be left in place and the study repeated, (2) that GoodNature be advised of the problems with their traps and asked to attempt to rectify them, (3) that the co-managing agencies and all researchers cooperate more effectively to improve understanding of the summit ecosystem and the role of predators, (4) that an assessment of cat diet is made using the trapped cats and/or scats, and (5) that the importance of Hirakimata as a biodiversity hot-spot and the main world colony of black petrels be more widely recognised, both on Great Barrier and in the wider region.

[1] Local Grant Accountability Form is currently pending.

Introduction

In December 2016 the Great Barrier Island Environmental Trust (GBIET) set up a comparative study to estimate relative abundance of rats in two locations on Mt Hirakimata, Great Barrier Island. One location was the Hirakimata summit area (the black petrel colony, > 560m a.s.l.) and the other a 'control' area close to the start of the Windy Canyon track (c. 320m a.s.l.).

In the application for funding for this project various methods were considered (snap-traps, chew baits, tracking tunnels etc.) but it was decided to use GoodNature multi-kill traps with counters for two main reasons:

1. Each trap provides a number over a unit time period. Thus from (say) ten traps a mean and standard error can be calculated. In contrast tracking tunnels or 'chews' require at least ten units to provide a single number – that being a percentage of the tunnels or chews visited.
2. With set-off counters and long-lived bait the A24s could be placed in remote locations and would not require regular visits.

The monitoring was planned to take place in two phases, the first during the post-winter period of minimum rat numbers on Great Barrier (Nov – Jan) and the second during the late summer when the rats have bred and juveniles swell the population (Fig 1).

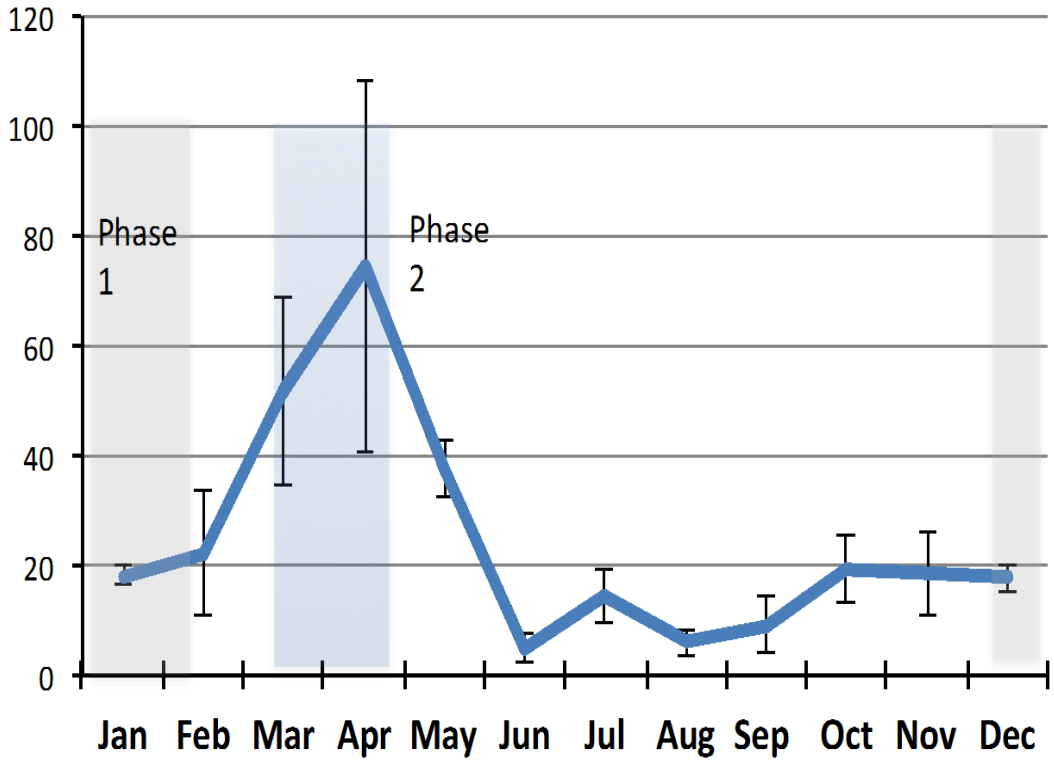

Fig 1. Rat monitoring in relation to 'expected' rat abundances on Hirakimata. Blue curve is standardised average rat catch from data at Hiwitahi (close to Windy Canyon) January 2014 to April 2017. Data from Alison Walker. Vertical bars are Standard Errors.

A Report on Phase 1 has been presented to the Local Board (See: Auckland Council; Great Barrier Island Local Board. 21/02/2017. Minutes Attachments, Attachment A. MAT_7077. PDF.

Methods

Monitoring.

At each monitoring the age (adult/juvenile), sex and colour morph of any rat killed was recorded where the rat was in good enough condition to do so. The number on the trap counter was also recorded, and the counter reset to zero. (see Appendix 2 for example of recorded data). A small fresh smear of peanut butter was added to the lower edge of the shroud. In Phase 2 notes were made on the condition of the lure, which was cleaned and re-squeezed if necessary.

Setting and monitoring the traps involved five trips up the mountain during each phase, plus a few additional trips to Windy Canyon. There were seven volunteers in Phase 1 and five in Phase 2. John Ogden attended all the main monitoring visits at weeks 0, 1, 4, 5 and 7 in each phase. There were 104 volunteer field hours in Phase 1 and 50 in Phase 2 (Table 1).

Table 1. Schedule of monitoring.

Date	Hrs in field	Activity	Volunteers	Volunteer total hrs	Cumulative volunteer hrs
PHASE 1					
10 Dec 2016	7.5	Deciding on site locations	John Ogden, (Biz Bell and co-workers – 1 hr).	8.5	8.5
20 Dec 2016	7.5	Placing all 20 traps	JO, Caroline Ogden, Jim Kerr	22.5	31
26 Dec 2016	1.0	Prelim check Windy Canyon traps only	JO.	1.0	32
27 Dec 2016	7.5	First count – week 1	JO, CO, JK and Joachim Ogden	30.0	62
31 Dec 2016	1.0	Check on W.C. traps only	JO	1.0	63
16 Jan 2017	6.0	Second count – week 4	JO, Alison Walker	12.0	75
22 Jan 2017	1.5	Monitoring for counter errors. Windy Canyon.	A.W., Brian Walker	3.0	77
23 Jan 2017	6	Third count – week 5.	JO, AW.	12.0	89
6 Feb 2017	7.5	Fourth count – week 7.	JO, Barbara Ogden	15.0	**104**
PHASE 2.					
18 Feb 2017	5.0	GPS on WH traps	JO. (Jo Sim, Brook)	7	7
7 March 2017	7.0	Reset and test all traps with new counters	JO. Emmy Pratt (Kay Stowell – 1hr)	15.0	22
14 March 2017	5.5	Week 1. First count	JO	5.5	27.5
3 April 2017	6.0	Week 4 count	JO	6.0	33.5
10 April	6.0	Week 5 count	JO	6.0	39.5
25 April	5.25	Week 7 count	JO, AW	10.5	**50**
TOTAL (a)		Voluntary monitoring	All above		**154**
TOTAL (b)		Other related voluntary activities	All above	30	**184**

Notes: **Total (b)** includes return travel time and additional time (telephone/email) estimated as 30 hrs. for 12 volunteers and 15 vehicle trips.

Pre-treatment and baiting.

The twenty A24s were buried in a compost heap for three weeks to remove any new plastic scent. The internal part of the access tunnel (shroud) was smeared with peanut butter before the traps were assembled and put in place. Subsequently a smaller amount of peanut butter was added to the shroud entrance on each monitoring visit. Each trap was fitted with an Automatic Lure Pump (ALP), a gas cylinder and counter.

Location

Prior to setting up, the study areas and trap placements were discussed in the field with Elizabeth Bell (Bird Life International – Black Petrel Research Leader).

Ten A24s were attached near the bases of trees, located alternately to left and right of the Windy Canyon track c. 10m from the track and at c. 25m intervals along it. The summit traps were all attached to supports under the walkway at c. 25m intervals, in three groups, three traps on the first walkway section after the col at c. 560m a.s.l., four at 25 m intervals on the flattish ridge area of the walkway, and three under the summit branch steps, including one under the summit platform (all included within H in Fig 2.). The GPS positions are given in Appendix 1 and general locations shown in Figure 2.

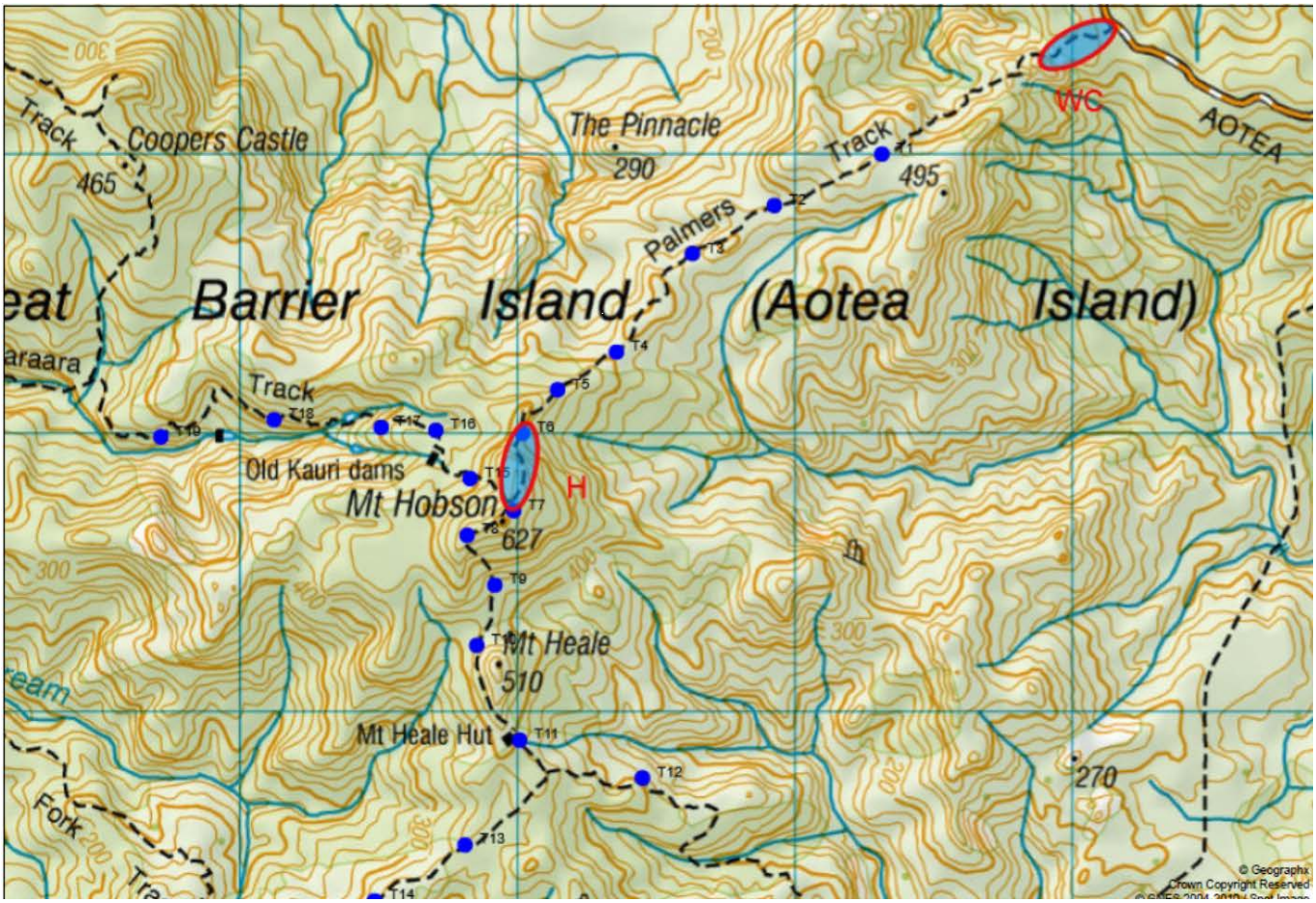

Fig 2. Study area. The red-circled areas are the two study areas (WC, Windy Canyon; H, Hirakimata summit). The blue spots are cat-trap locations administered by DOC.

Results.

The results relate both to the actual monitoring – rats killed in different locations at different times (Phases) – and to the functioning of the A24 Traps. These two aspects are dealt with separately in Part 1 and Part 2.

Results Part 1. Rat Monitoring

Phase 1: Dec 20 – Feb 6.
The Phase 1 Results were communicated in an earlier GBIET Report (February 2017: Auckland Council; Great Barrier Island Local Board. 21/02/2017. Minutes Attachments, Attachment A. MAT_7077. PDF.) These results are summarised below:

° The first phase monitoring showed no statistical difference between rat catch rates, sex and age structure, at Windy Canyon and in the summit black petrel nesting area of Hirakimata. Rats were abundant in both areas. Ten traps killed at least 23 rats at Windy Canyon and 25 in the summit petrel colony over the seven weeks (Fig 3.)

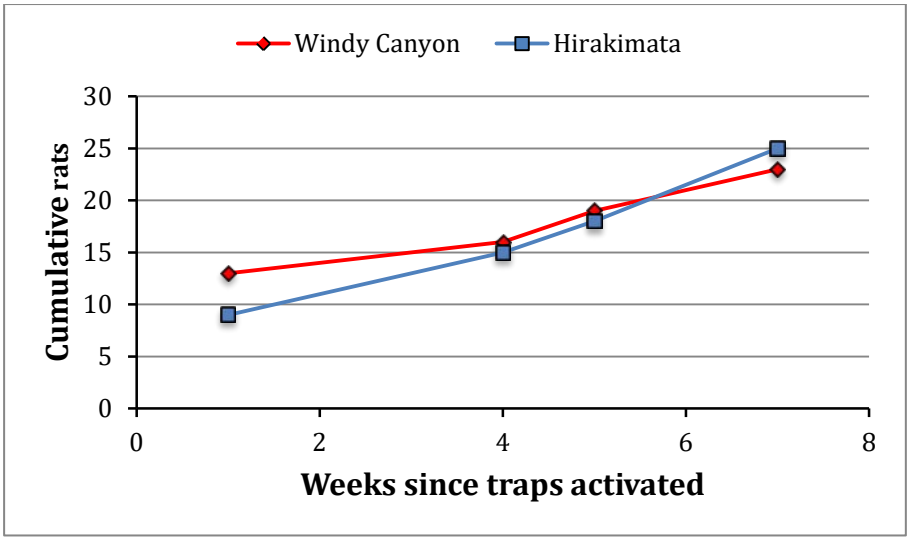

Fig. 3. Cumulative rats killed in Phase 1 (excluding 'set-offs' without dead rats present).

If additional 'set-offs' are assumed to represent scavenged or lost rats the indication is that there might have been more rats in the summit sample (Fig 4.)

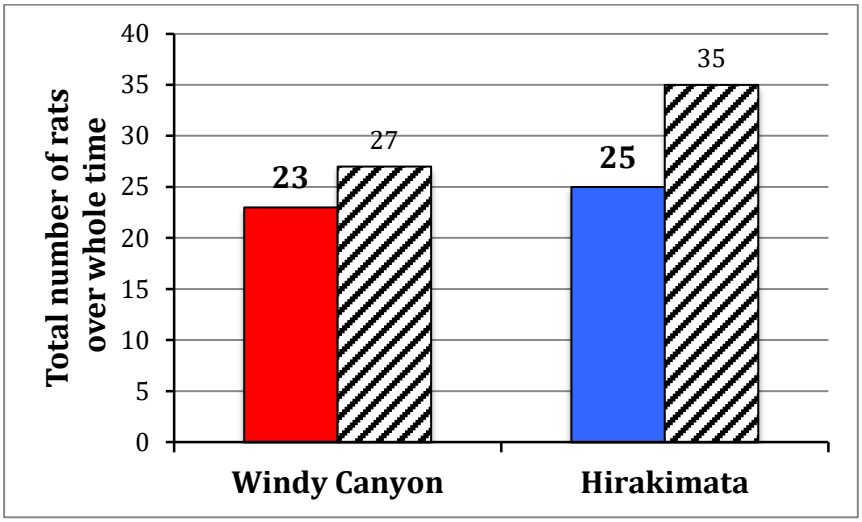

Fig 4. Total rats actually caught (solid colour), and rats potentially caught if all positive counter values are assumed to represent dead rats (hatched).

° The Hirakimata and Windy Canyon rat populations apparently had different proportions of the different colour morphs, implying some genetic differences (Fig. 5).

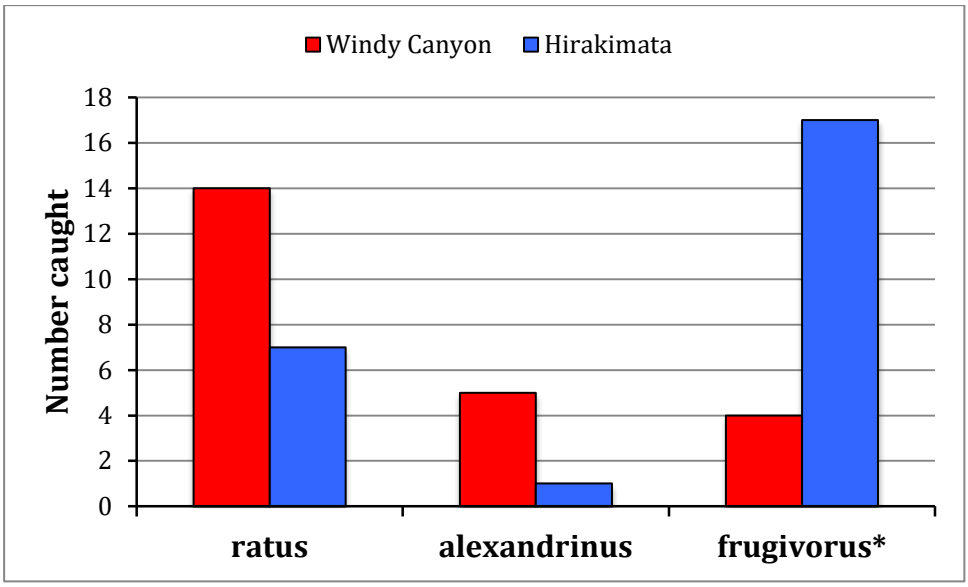

Fig 5. The three colour morphs described by King (1990). ***Rattus rattus rattus*** *is all black or dark grey;* ***R. r. alexandrinus*** *is brown/grey on back and off-white on the belly;* ***R.r. frugivorus*** *is brown on the back and white on the belly (See endplate in King 1990 for illustrations). Rats which were dark grey on the back but white or cream bellied were classified as* ****frugivorus*** *in this study.*

° In both locations most rats appeared to be male (Fig 6), though sexing was sometimes difficult, also the sample size was small. Judging mainly by size the vast majority were adults (Fig 7.)

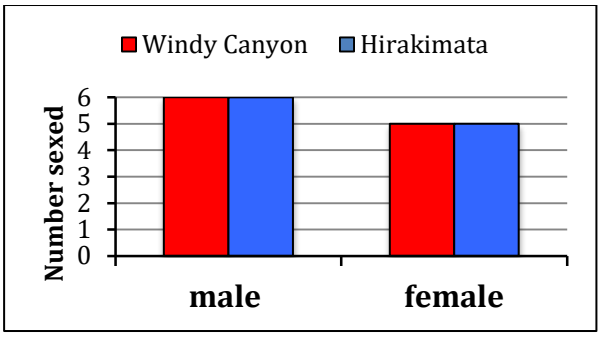

Fig 6. Sex distribution. Phase 1.

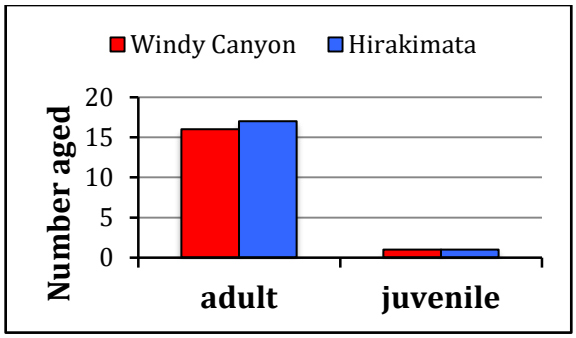

Fig 7. Age distribution. Phase 1.

Phase 2. March 7 – April 25.

Contrary to the expectation of more rats being caught in March-April (the usual peak of annual rat abundance on Great Barrier), *fewer* rats were caught at both sites (Table 2).

Table 2. Number of rats killed at both sites and phases. Figures in brackets assume all positive counter records represent dead rats (see discussion).

	Windy Canyon	Hirakimata	Both sites
Phase 1 (Dec – Jan)	23 (27)	25 (35)	48 (62)
Phase 2 (March – April)	17 (19)	3 (8)	20 (27)
Total	40 (46)	28 (43)	68 (89)

This difference between the two phases was particularly noticeable on Hirakimata, and is statistically significant (see later). The monitoring data are shown cumulatively in Fig 8. The difference between actually observed dead rats and the number which might have been killed if all set-offs (positive counter readings without dead rats) are assumed to be scavenged rats is shown in Fig 9.

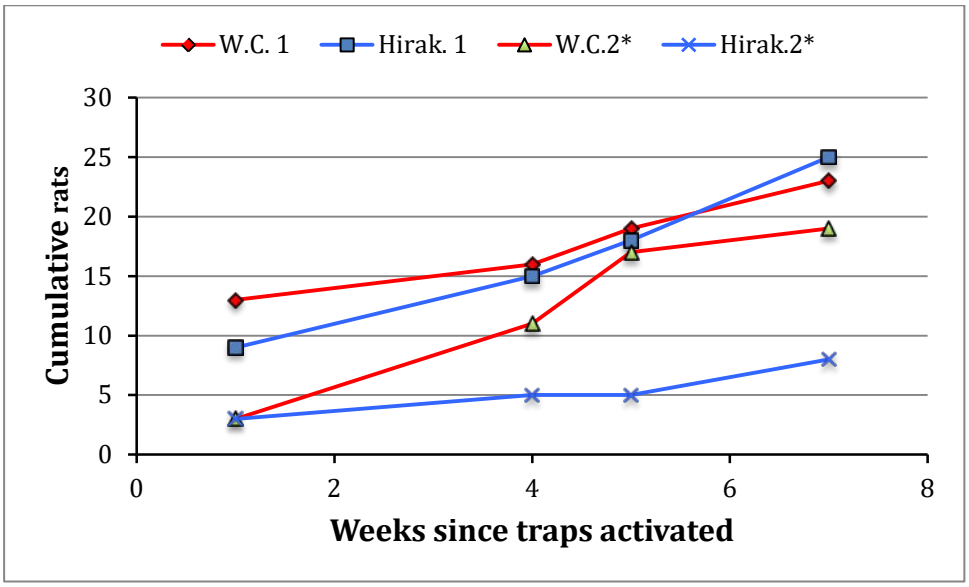

*Fig 8. Cumulative catch rates for both phases. The two lower curves are Phase 2. * The Phase 2 data includes set-offs (i.e. the values are maximal)*

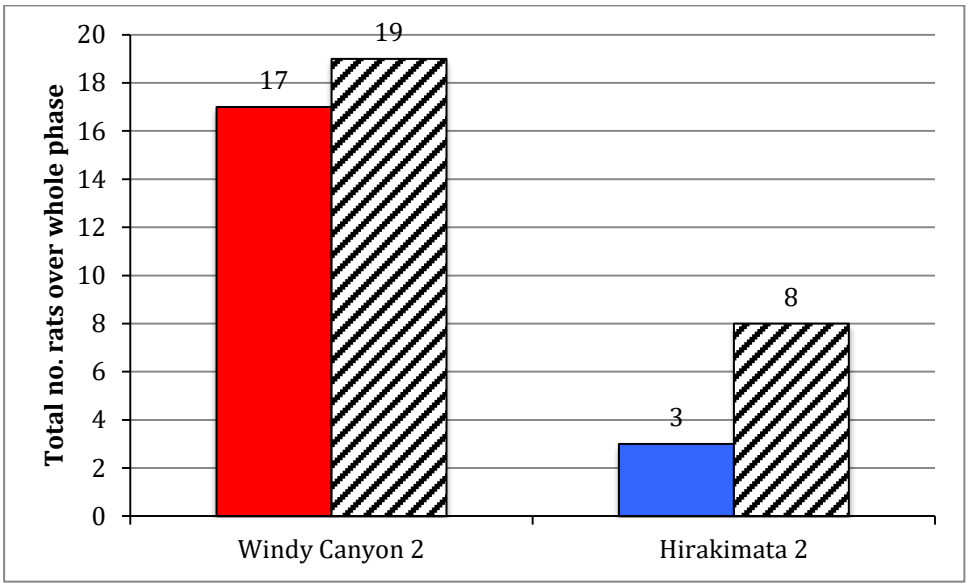

Fig 9. Total rats caught in Phase 2. Hatched bars assume that all set-offs (positive counter values) represent dead rats scavenged.

The very low number of rats caught (3) or potentially caught (8) on the summit in Phase 2 is noteworthy in view of the expected numbers. Based on the known seasonal rat abundance patterns (see e.g. Fig 1) and the results from Phase 1, more than 25 rats were expected on the summit in Phase 2. The monthly pattern further emphasises the low rat numbers on the summit, and indeed at Windy Canyon in Phase 2, excepting week 5 (Fig 10).

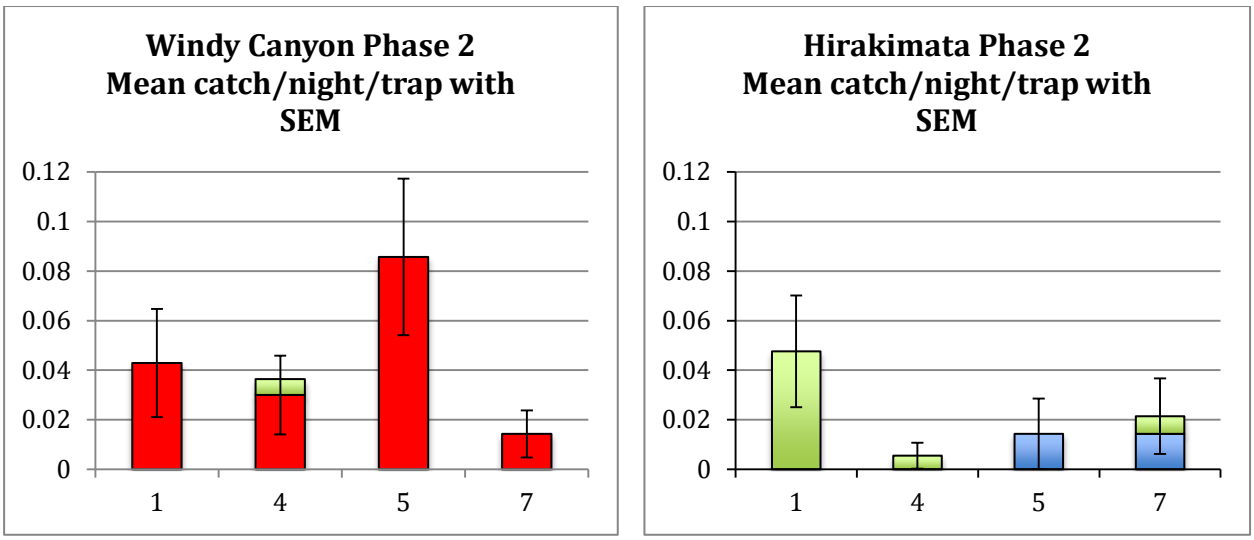

Fig 10. Mean catch at each monitoring week (1 to 7) in Phase 2. Red= actually observed dead at Windy Canyon. Blue = observed dead at Hirakimata. Green = additions for set-offs without observed dead.

The colour morph distribution also appeared different in Phase 2, but the sample size is too small for any certainty. Due to wet weather the colour morph of some individuals could not be assessed with much confidence. Overall the dark R. r. rattus morph was the most frequent. R. r. *frugivorous, formerly the most abundant morph, was not recorded on the summit (Fig 11).

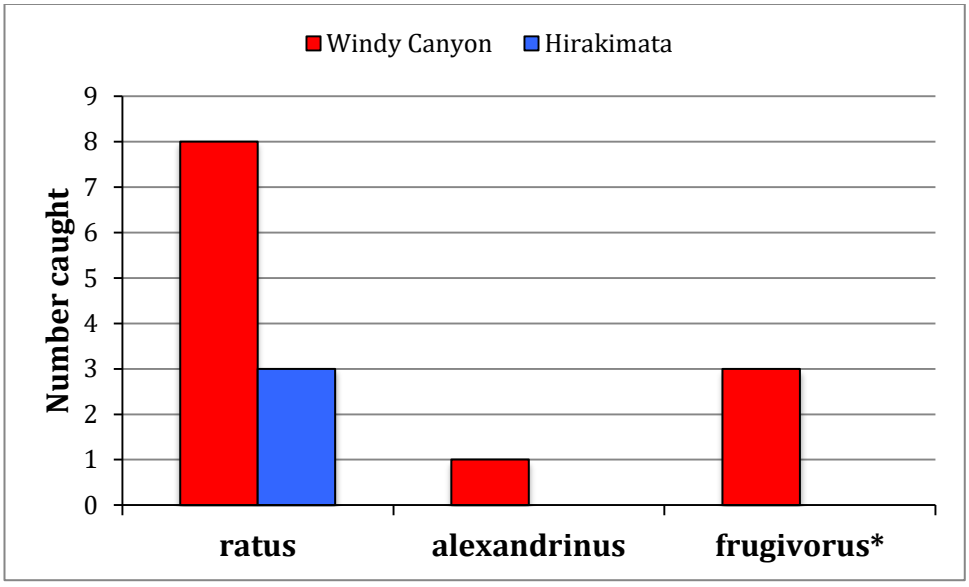

Fig 11. Colour morph distribution (where known). (c.f. Fig 5).

Ship rats were apparently predominantly adult males at both locations (Figs 12 & 13), but males are generally easier to identify when in poor condition.

One definite, and possibly two, kiore (*Rattus exulans*) were recorded in the Windy Canyon sample.

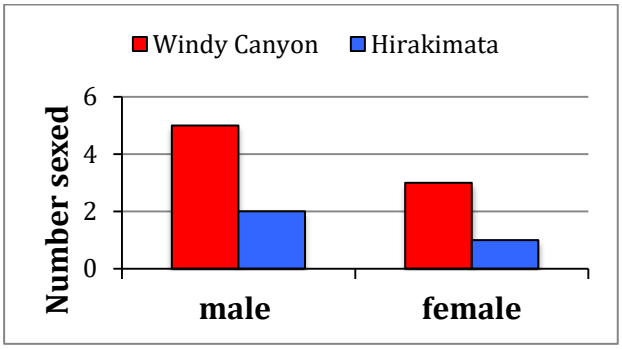

Fig 12. Sex distribution. Phase 2.

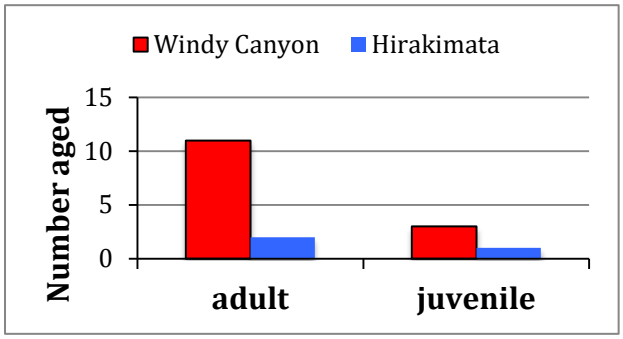

Fig 13. Age distribution. Phase 2.

Statistical comparisons between phases and locations.

Differences in catch rate (rats/trap/night) allow estimates of error bars for the different phases and locations, and statistical tests. Figure 14 and Table 3 indicate that catch rates were significantly lower on Hirakimata in Phase 2.

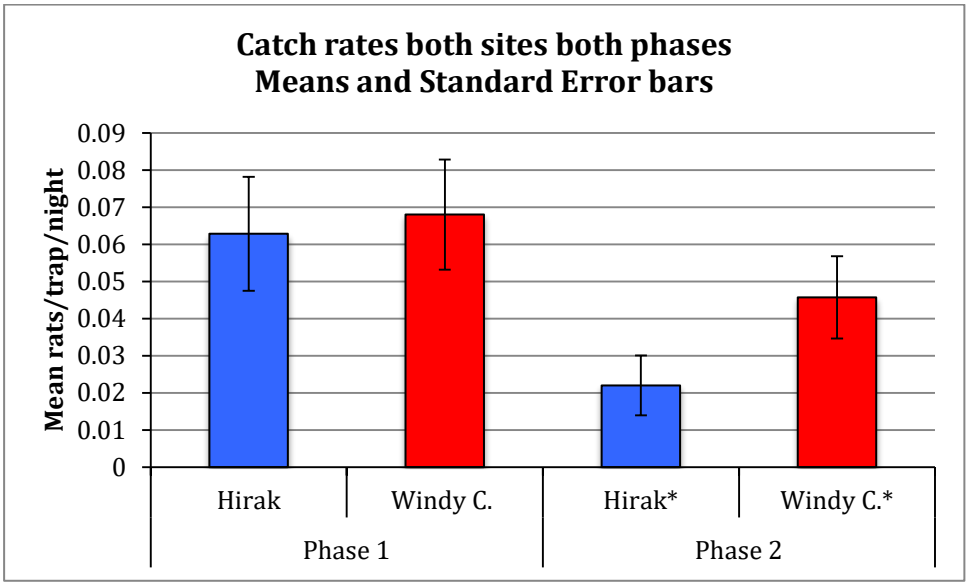

Fig 14. Catch rates at both sites over both phases, with standard error (SEM) bars.

- *Phase 2 data include 'set-offs' which slightly <u>decrease</u> the difference between Phase 1 and Phase 2.*

Table 3. T-test results for data in Fig 13. W.C. = Windy Canyon. Hirak. = Hirakimata. 1 and 2 refer to Phases 1 and 2. Yellow highlighted values are considered statistically significant. 3a gives P values for 2-tailed unpaired t-tests; 3b gives interpretation in terms of % probability of difference being due to chance alone. NS = Not Significant (No difference).

Table 3a.

	W. C. 2	Hirak. 1	Hirak. 2
W.C. 1	0.2312	0.8088	0.0087
W.C. 2		0.3676	0.0899
Hirak. 1			0.0228

Table 3b

	W. C. 2	Hirak. 1	Hirak. 2
W.C. 1	NS	NS	< 1%
W.C. 2		NS	< 10%
Hirak. 1			< 5%

Results Part 2. Trap functioning

The A24s worked well, especially in the first week, as killing devices, but not as monitoring devices. Counters both over-estimated and under-estimated kills. The latter amounted to c. 30% of cases in Phase 1 (Based on data in Table 4 and additional data reported to GoodNature). The monitoring errors are summarised in Table 4.[2]

We also recorded problems with the ALP lure becoming skinned-over or not working properly for other reasons. These difficulties were mainly (but not totally) in Phase 2, after the lures had been in use for at least 76 days (10 weeks).

Counters:
Apparent counter over-estimates could arise if a rat was scavenged by a morepork or feral cat, or where the body had rolled some distance away on the steeper slopes of the summit area. We found no clear evidence of scavenging (but see later), but there were a few cases where rats had rolled some distance but were found on a later visit. The earlier data were then adjusted.

Counter under-estimates – where a dead rat was present but not recorded – are clearly due to counter mal-function. We also found that the counters could record even though the trap had not gone off. This happened if the counter was manually struck with a stick.

These counting errors, or possible errors, imposed the need to revisit traps, thus greatly increasing the person-hours required for monitoring, and complicated the analysis and interpretation of the results.

Table 4 shows strictly comparable results for each location and phase (10 trap observations x 4 visits). The % data column – based only on rows 1, 2, and 3 – is the most stringent test and implies that 34% of traps were underestimating. When all the traps are considered, including those with no data, this figure drops to 14%, which can be considered a minimum for underestimation. Apparent overestimates account for 11 to 26% by the same criteria, while properly functioning counters are between 16 and 40%. For most trap-occasions there was no data (59%).

Table 4.Counter errors. Over-estimation is where the counter registers a kill but the dead rat cannot be found. Under-estimate is where a dead rat is present but has not been registered. OK indicates dead rat presence and counter agree. No-data relates to those counters which did not change *and* no dead rats were found.

Error	Phase 1		Phase 2		Overall analyses		
	Windy C.	Hirakimata	Windy C.	Hirakimata	Total	% data	% overall
Over	3	7	2	5	17	26	11
Under	10	7	5	0	22	34	14
OK	6	10	8	2	26	40	16
No data	21	16	25	33	95		59
Totals	40	40	40	40	160	100	100

[2] Counter errors in xlsx files: COUNTER ERRORS GOODNATURE A24. [Phase 1], and HIRAKIMATA RATS DATA2: (Counter anal.) (ALP REPORT) (APPENDIX 3) [Phase 2]

Automatic Lure Pumps (ALPs):
During Phase 1 it was noticed that the lures were often 'skinned' and seemed to have stopped extruding. The peanut butter added inside the base of the tunnel or shroud also sometimes became mouldy. In Phase 2 more systematic records were made of the status of the ALPs and the bait. On each occasion the ALP was removed and the bait surface reactivated by scraping off the skin or bacterial colonies, and if necessarily gently re-squeezing the container. Old peanut butter (if present) was removed and replaced on the lower edge of the shroud. The results are summarised in Fig 15 and Table 5. A partial spread-sheet is given in Appendix 3.

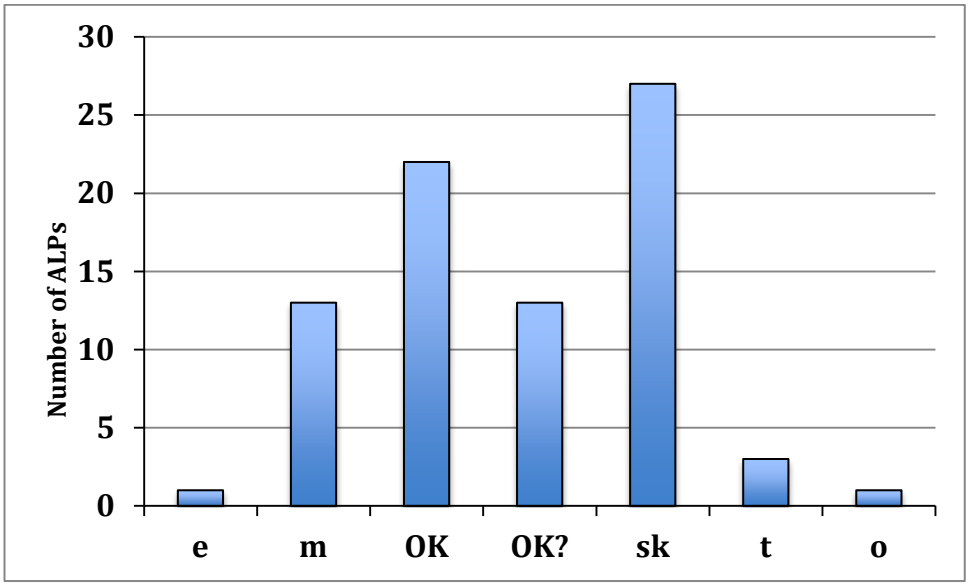

Fig 15. Condition of ALPs based 20 traps on 4 occasions (80 observations). Traps were re-activated at each visit - see text. Key: e = empty; m = mould or bacterial growth; OK = bait still fresh looking; OK? = part of bait still fresh, but partial skin or mould; sk = skinned (surface pale); t= trigger (bait blob on trigger); o = no data.

Table 5. ALP condition in Phase 2, simplified to 'OK' (or possibly OK), and 'not OK'. Figures in body of table (italicised) are numbers out of the 10 traps at each location and sampling date. Percentage 'not OK' by subtraction of OK or OK? from 100.

Date	Wks since start	Wks since service	OK or OK? Windy Canyon	OK or OK? Hirakimata	total	% OK or OK?	% 'not OK'
14-Mar	12	4	*4*	*3*	7	35	65
3-Apr	15	3	*4*	*6*	10	50	50
10-Apr	16	1	*5*	*4*	9	45	55
25-Apr	18	2	*3*	*6*	9	45	55
		Totals	16	19	35		
		%	40	47.5		43.75	56.25

More than a quarter of the ALPs developed skinning in the second phase. Despite regular cleaning and re-squeezing of the ALPs (at each visit) a large proportion were clearly not in good condition. Had no servicing been done it is likely that *all* the ALPs would have been essentially non-functional before 4 months in the field. The main problem seemed to be skinning over the bait surface, followed by bacterial growth. Very few seemed to have continued extruding bait for more than a few weeks.

Discussion

This discussion deals briefly with interpretation of the rat trapping data and the conclusions relating to the A24 traps. The work was conducted on a smaller scale than originally envisaged and with limited resources. It should be regarded as a pilot study intended to scope the question of rat abundance on the mountain – definitive figures and firm conclusions will require a more extensive piece of work. However, sufficient has been gained to indicate that periodically rats are abundant in the summit area, though at other times they may decline to near zero.

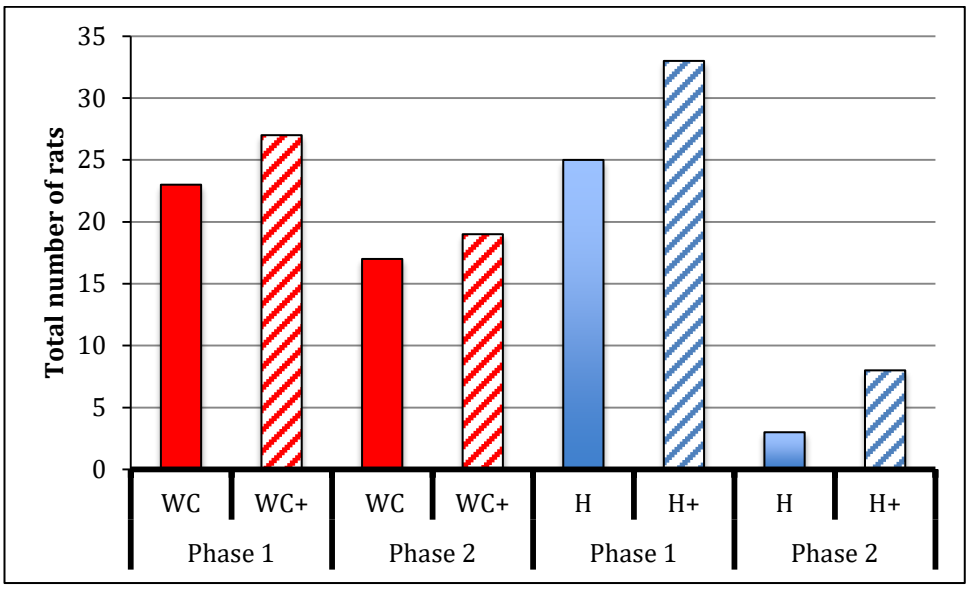

Fig 16. Comparisons between phases and locations. Solid bars are number of recorded dead, hatched bars include counter set-offs where no dead rat was found (+). WC = Windy Canyon; H = Hirakimata.

The most notable feature of the results was the reduction in rat-catch in the second phase (Fig 16), when numbers were expected to be higher. This was most noticeable on the summit (H). Windy Canyon also showed somewhat reduced numbers in phase 2, while numbers in nearby Hiwitahi were high, as expected (Fig 1). There are indications that both declines represent real reductions in rat numbers rather than just chance differences in capture. For example, at Windy Canyon one (or possibly two) kiore were caught in Phase 2 (none in Phase 1) – kiore characteristically increase in abundance as ship rats decline. On the summit, bread dropped by visitors remained uneaten for several days. The lower catch-rate there in Phase 2 is statistically significant.

However the results also indicate that by Phase 2 the ALPs at Windy Canyon were no longer as attractive to rats as they were at the start. They were clearly not delivering the bait as intended. This explanation might also apply to the summit traps, but there are other possibilities.

It is possible that the Phase 1 trapping on the summit - taking mostly mature adults before they could breed - may have led to the low catch in Phase 2. If this is indeed the cause it is important from a conservation perspective (protection of nesting birds – especially robins).

It is also possible that the rat population declined as a result of predation by cats. This latter hypothesis is supported by cat catch data reported by the Department of Conservation (Louise Mack). During April 2017, five feral cats were caught on Hirakimata, one of these very near the summit (Trap 8; 5th April). Four of these were sub-adult (one a kitten) suggesting breeding nearby. Given the high mobility and overlapping territories of feral cats it is quite possible that

these cats were using the boardwalks and thus could have reduced rat catch, either by direct predation or scavenging killed rats, or by causing the rats to move away. The relatively high set-off counter numbers (without a dead rat being found) on Hirakimata in Phase 2 are notable in this context, as the traps are along the boardwalk that would be used by feral cats.

Whether the unexpected decline recorded in Phase 2 on the summit was related to (1) the initially high kill rate in Phase 1 decimating an already low rat population, or (2) later predation by cats feeding kittens, or (3) the progressively deteriorating function of the traps, or (4) some other factor (chance, weather), is impossible to know. But if (1) is a possibility it indicates that rat trapping during December – January could be beneficial for smaller biota.

The apparent success of colonising robins during the last few years (Nikki McArthur, *Personal communication*) suggests that rat numbers are generally or periodically lower on the summit than elsewhere on Great Barrier.

The A24 traps did not function as anticipated. Initial counter errors were partially addressed with a new set of counters supplied by GoodNature, but, though better, these were not totally accurate either. The ALP lures were attractive at first, but soon seemed to be less so. Examination of the lures at each monitoring in the second phase showed that many were either skinned over and/or had developed patches of bacterial or fungal growth. Consequently the traps did not function well, necessitating much more frequent visits than planned. This had a significant impact on volunteer hours, especially because safety considerations ideally required two people to be present on each monitoring. Overall a total of 184 hours of voluntary labour were involved, equating to $4048 (at $22 per hour).

An unanticipated outcome of the work was frequent interaction with visitors on the mountain, providing an ideal opportunity to talk about endangered black petrels and the role of rats in Great Barrier's forested ecosystems.

Conclusions

This pilot study showed that rat numbers within the main black petrel breeding area on the summit of hirakimata were similar to those at Windy Canyon during Phase 1 (December – January), but considerably lower in Phase 2 (March – April), when *higher* numbers were expected. Possible reasons for this are discussed, but the small scale and limited time coverage of the study make firm conclusions impossible.

The study also demonstrated problems with both the counters and the lures (ALPs) on the A24 traps. The counters failed to record rats killed on between 14 and 34% of occasions, and also 'counted' when no dead rats could be found. While scavenging (by cats) may account for some or all such 'errors', counters also counted when tapped, without the trap being fired. The unreliability of the counters meant that the traps had to be regularly visited rather than simply left to kill and count.

A further difficulty probably influencing the results, especially in Phase 2, was that the ALPs did not continue to deliver attractive bait as intended. This necessitated more time at each trap to refresh the lure (and add peanut butter). During Phase 2 more than 50% of the lures were skinned over and/or with bacterial growth, and no longer working as intended.

Recommendations

° That the existing 20 A24s be left in place and the rat trapping exercise repeated over the same time periods in 2017 and 2018.

Comment: This is to see if the late summer rat decline on the summit occurs again, and to continue the potential biodiversity gains from trapping in December/January. Some of the traps under the walkway near the summit should be moved slightly to prevent dead rats rolling away. After another year it should be possible to make a more reliable decision about the long-term presence and number of rat-traps required on the summit.

° That a recommendation is made to GoodNature that they undertake more research to improve the counting and lure functions of the traps.

Comment: The results clearly show that in the Hirakimata environment the ALP lures do not work for as long as the advertising claims. The counters also require improvement. Unless the ALPs work correctly the traps will still require regular visits. The counters should provide data giving confidence in the long-term viability of the trapping method, but do not do so.

The potential for the A24 traps to be useful for killing rats, and monitoring the kill appears high, but this potential will not be achieved unless the counting accuracy is improved, and the lure made to function as advertised.

° That the agencies doing biodiversity research on Hirakimata coordinate research efforts and share data.

Comment: The Department of Conservation and Iwi have co-management responsibilities for the area. Research on black petrels has been undertaken there for 21 years by Wildlife Management International and a large data base is available. The Great Barrier Island Environmental Trust has undertaken research on the vegetation and sponsored studies on tomtits, kakariki and bird diversity on the mountain (Cook 2013). The Department of Conservation (and GBIET) have undertaken some cat control. The various predators, ship rats, kiore and cats, interact and have varying impacts on petrels, other birds, reptiles and invertebrates, so a combined approach will provide more insight into their ecosystem impacts.

° That cats trapped on the mountain are dissected to find what they are eating.

Comment: Cat predation on petrels or rats pose very different issues for the biodiversity. It should not be difficult to distinguish between bird and mammalian stomach (or scat) content.

° That the importance of Hirakimata as a hot-spot of biodiversity and the key worldwide refuge for black petrels be more widely recognised.

Comment: During the field-work we spoke to numerous visitors on the mountain. None of them seemed to know about the black petrels or about the threat to native biota posed by rats and feral cats. While a good sign is present at the start of the track, there is nothing further in, at resting points, explaining the unique vegetation or the birds. The summit is visited by many people, almost every day during the summer months, so there is a significant opportunity here to publicise both the co-management process and the biodiversity. The significance of the area appears to be not well known within DOC outside Great Barrier.

NOTE: The first of these recommendations will require an application for financial support from the Local Board or other organisation being submitted by GBIET, and also an available research leader and volunteers. The amount required would depend on discussions with other organisations, but with little up-scaling it would probably be approximately $5000.

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APPENDIX 1. GPS data for trap locations.

Trap No.	NZTM Easting	NZTM Northing	**Altitude m**
1	1819126	5994459	332
2	1819116	5994436	331
3	1819087	5994435	333
4	1819067	5994417	334
5	1819044	5994434	335
6	1819021	5994419	334
7	1818997	5994423	333
8	1818992	5994396	328
9	1818961	5994390	327
10	1818915	5994365	317
10 repeat	1818939	5994385	320
11	1817016	5993021	575
12	1817011	5993011	581
13	1817009	5992996	563
14	1817020	5992843	621
15	1817022	5992826	626
16	1817013	5992814	624
17	1817000	5992795	621
18	1816987	5992737	625
19	1816999	5992730	538
20	1816973	5992717	632

APPENDIX 2. EXAMPLE OF RAW CATCH DATA and COUNTER ERRORS –DATA FOR WEEK 1PHASE 1 ONLY. Full data available: johnogden@farmside.co.nz

Key:

wc = Windy Canyon traps; h = Hirakimata summit traps

Red values are possible field errors

type - colour morph: ratus, alexandrinus, frugivorus

mo	day	trap no.	location	catch	type	sex	adult/juv	counter	error	Setoff error
12	20	1 to 20	wc & h					Setting up all traps		
12	27	1	wc	1	frug*	m	a	1	0.00	OK
12	27	2	wc	2	alex	f	a	1	-1.00	under
12	27	2	wc		alex	f	a			
12	27	3	wc	1	alex	m	a	1	0.00	OK
12	27	4	wc	1	ratu		a	0	-1.00	Under
12	27	5	wc	1	ratu	m	a	0	-1.00	Under
12	27	6	wc	1	ratu			1	0.00	OK
12	27	7	wc	1	ratu			1	0.00	OK
12	27	8	wc	2	ratu	f	a	1	-1.00	Under
12	27	8	wc		ratu					
12	27	9	wc	1	alex		j	1	0.00	OK
12	27	10	wc	2	ratu			1	-1.00	under
12	27	10	wc		alex	f				
12	**27**		**wc**	**13**				**8**	**-5.00**	**WEEK 1**
12	27	11	h	1	ratu			2	1.00	Over
12	27	12	h	3	frug*	m	a	0	-3.00	Under
12	27	12	h		frug*	f	a			
12	27	12	h		frug*	f	a			
12	27	13	h	0				0		No data
12	27	14	h	0				0		No data
12	27	15	h	0				0		No data
12	27	16	h	0				0		No data
12	27	17	h	1	frug*	m	a	1	0.00	OK
12	27	18	h	1	ratu	m		0	-1.00	Under
12	27	19	h	2	frug*	m	a	3	1.00	Over
12	27	19	h		ratu					
12	27	20	h	1	frug*			0	-1.00	Under
12	**27**		**h**	**9**				**6**	**-3.00**	**WEEK 1**

etc.
etc.

APPENDIX 3. ALP data report Phase 2. EXAMPLE DATA ONLY. Full spreadsheet available from author: johnogden@farmside.co.nz

Date	Trap No	ALP condition. Note p nut b. added to all traps at start and after each monitoring.	Other notes	Summary by traps		Summary by condition	
14-Mar-17	1	OK	Old Catscat nearby	1	OK	4	empty
14-Mar-17	2	Mouldy, not working		1	m	2	m
14-Mar-17	3	OK		1	OK	10	m
14-Mar-17	4	grey skinned. probably not working properly		1	m	18	m
14-Mar-17	5	grey skinned. probably not working properly		2	m	1	m
14-Mar-17	6	grey skinned. probably not working properly		2	sk	4	m
14-Mar-17	7	grey skinned. Definitely not working		2	sk	5	m
14-Mar-17	8	grey skinned. Definitely not working	prior pnb gone	2	OK	6	m
14-Mar-17	9	greyish but probably OK		3	OK	7	m
14-Mar-17	10	Mouldy, not working		3	sk	17	m
14-Mar-17	11	Grey surface removed. Resqueezed		3	OK	1	m
14-Mar-17	12	Grey surface removed. Resqueezed		3	sk	10	m
14-Mar-17	13	OK - resqueezed		4	sk	15	m
14-Mar-17	14	Not dripping, grey skin removed & requeezed		4	m	17	m
14-Mar-17	15	ALP w. grey skin.	Gas Cylinder and Counter removed by someone	4	e	1	OK
14-Mar-17	16	ALP OK but mouldy bait congealed on trigger.		4	OK	3	OK
14-Mar-17	17	Grey. Not working.		5	sk	13	OK
14-Mar-17	18	Mouldy, not working. Cap not fitting well.		5	m	20	OK
14-Mar-17	19	grey skin removed		5	OK	1	OK
14-Mar-17	20	Grey but ? Still working		5	sk	3	OK
3-Apr-17	1	mould' Grey surface removed. Resqueezed	Note 'mould' probably bacterial colonies	6	sk	5	OK
3-Apr-17	2	Grey skin remove. Resqueezed		6	m	7	OK
3-Apr-17	3	Grey skin remove. Resqueezed		6	sk	8	OK
3-Apr-17	4	mould' Grey surface removed. Resqueezed		6	OK ?	9	OK
3-Apr-17	5	mould' Grey surface removed. Resqueezed		7	sk	10	OK

etc.