Animal Health Board Project R–80568-3

Development and Testing of a Deer-repellent Cereal Bait for Possum Control Part III: Cereal Bait Field Trial

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Summary

Project and Client

Landcare Research and Epro (Taupo) conducted a trial for the Animal Health Board to assess the effectiveness of a potential deer repellent (EDR) for reducing the incidental by-kill of deer during aerial possum poisoning operations using cereal baits containing sodium fluoroacetate (1080). The trial (AHB project R-80568-03) was conducted between July and August 2005.

Objective

- To confirm that addition of a deer repellent to 1080 cereal baits significantly reduces the number of red deer killed following aerial application of the baits for possum control.

Methods

- Two independent bush blocks in Hawke's Bay were selected as study sites. One (1446 ha) was treated with aerially applied cereal bait containing 0.15% 1080 (no repellent block), and the other (1074 ha) with similar bait, surface-coated with EDR (repellent block).
- At least 5 days after the application of baits, eight expert hunters searched each block consecutively on set transects for 5 days. Fresh tracking by deer and pigs along each transect and the number of live deer and pigs seen each day by hunters were recorded. Tissue samples were collected from any dead deer, pigs, birds and possums encountered travelling to and from, or on, transects.
- Two surveys were carried out in each block where two 1.14-m-diameter plots, every 200 m along a transect, were searched for deer, possum and pig faecal pellets, at points 2.5 m to the left and right of the 200 m point. Presence or absence of faecal pellets on plots was recorded.
- During the first survey of each block, deer-sized brown paper bags were placed on plots at 200-m intervals along transects, to imitate deer carcasses. Comparative visibility between the blocks was assessed by recording the mean visibility of all bags placed in the blocks. The percentage of these found during the following survey on transects at right angles to the first was used to estimate the overall percentage of real deer carcasses found.
- Sighting rates of live deer and percentage of plots with deer pellets present were compared to assess relative deer abundance between the blocks and to estimate percentage kill. Tissue samples from dead deer and birds were analysed to confirm 1080 poisoning.
- Possum kill was measured using standard NPCA protocol RTCI monitoring. Incidental sightings of deer carcasses by possum-monitoring staff were also recorded.

Results

- Seven deer and three pigs were encountered live in the no-repellent block compared with 30 deer in the repellent block. In the no-repellent block 40.4% of transects had

fresh deer/pig tracking compared with 58.2% in the repellent block. However, pig presence in the no-repellent block but not in the repellent block confounded the tracking index.

- The animals found dead after bait application in the no-repellent block included 12 deer (six adults and six sub-adults), 1 pig (weaner), 23 possums, 1 rat, 7 blackbirds, 2 chaffinches, and 1 hedgesparrow. In the repellent block, carcasses of 55 possums, 2 rats, 1 mouse, 4 blackbirds and 2 tomtits were found.
- The ratio of the deer faecal pellet index to live deer sightings indicates deer survival in the no-repellent block was 41% of that in the repellent block.
- The percentage of paper bags found indicated that 0.21 of the no-repellent and 0.31 of the repellent block was searched effectively for dead deer. The total number of deer killed in each block was estimated at 57 deer in the no-repellent block, and zero for the repellent block. From this we estimated a 59% kill in the no-repellent block and 0–6% kill in the repellent block.
- Average visibility was 5.1 m in the no-repellent block compared with 6.8 m in the repellent block.
- Sign and sightings suggested pigs were present in the no-repellent block but not in the repellent block, but pig kill appeared to be minimal (c. 5) in the former with live pigs and a lot of fresh tracking and rooting observed post possum control.
- All deer, pig and bird tissue analysed contained 1080 residue (0.23–32.00 mg/kg) suggesting all had been poisoned by 1080.
- The possum kill met the contracted threshold RTCI (3%) in both the repellent and no-repellent blocks (both 0.00%). Possum-monitoring staff found an additional dead deer in the no-repellent block but none in the repellent block.

Conclusions

- Tracking, faecal pellet counts and live sightings indicated that there were twice as many deer in the repellent block compared to the no-repellent block and even with a comparatively higher visibility in the repellent block, searchers did not locate any dead deer.
- The deer repellent successfully reduced the by-kill of red deer in the repellent block, possibly to near zero. In contrast, there was an estimated 59% kill in the no-repellent block.
- The possum kill was not measurably affected by addition of EDR, and there were no indications of other major non-target mortality in either block.

Recommendations

- Where appropriate (in relation to high-level management goals and policies), the AHB should consider operational use of EDR on cereal 1080 bait where the risk of a large deer by-kill is a primary driver of opposition to the use of aerial 1080 poisoning as a possum control tool.
- Factory-manufactured EDR cereal 1080 baits should be field trialled, both to replicate the trial reported here and to determine whether factory bait-preparation processes affect repellency. Future field trials should include more intensive and quantitative assessment of impacts on non-target native species.
- The possibility that EDR enhances the palatability of cereal bait to rodents should be investigated in pen trials.

1. Introduction

Landcare Research and Epro (Taupo) conducted a trial for the Animal Health Board to assess the effectiveness of a potential deer repellent (EDR) for reducing the incidental by-kill of deer during aerial possum poisoning operations using cereal baits containing sodium fluoroacetate (1080). The trial (AHB project R-80568-03) was conducted between July and August 2005.

2. Background

We aimed to confirm that a previously identified deer repellent (Forsyth 2002) would effectively deter wild red deer (*Cervus elaphus*) from eating (and being killed by) aerially sown cereal 1080 bait used to poison possums (*Trichosurus vulpecula*). Previous field trials have shown the repellent (hereafter EDR) was effective in reducing deer by-kill during possum poisoning when used with carrot bait (Nugent et al. 2004; Speedy 2004), and that consumption of cereal bait by captive deer was reduced when EDR was applied to the outside of the bait (Morriss et al. 2003).

The need for a deer repellent reflects a desire by some landowners and hunters to substantially reduce or eliminate the incidental by-kill of deer during possum 1080-poisoning operations. Antipathy to deer by-kill, in some instances, has historically been strong enough to force vector managers to use possum control techniques that are substantially less cost-effective than aerial poisoning. An effective deer repellent could therefore reduce possum control costs by improving local community acceptance of the aerial application of 1080 baits. However, any gains in cost-effectiveness achieved by using EDR must outweigh the additional cost of the addition of repellent. Three previous research trials using 1080 carrot bait indicated a reduction in by-kill of deer (Lorigan et al. 2002; Nugent et al. 2004; Speedy 2004) but small sample sizes made it difficult to be certain of the size of the reduction. An operational trial (Speedy 2003) reported five sika deer (*Cervus nippon*) were found killed by EDR carrot bait.

In previous trials we measured indices of deer abundance before and after aerial poisoning in repellent and no-repellent blocks, but the indices obtained were too sparse and imprecise to usefully estimate the percentage kills directly. Instead, we obtained comparatively precise estimates of the numbers of deer killed and compared those to the numbers expected given the relative abundance of deer in the two blocks. Because the most useful and compelling data in those trials were the number of carcasses found after poisoning, that design was modified to increase the amount of time spent searching for carcasses. This innovation was achieved by using estimates of faecal pellet abundance recorded soon *after* poisoning as an estimate of the abundance of deer *before* poisoning. The implicit assumption is that because faecal pellet groups (on average) in central North Island forest remain visible for about 3 months after deposition (Nugent et al. 1997), the number of faecal pellet groups present at any one point in time reflects their accumulation over the preceding 3 months. This assumption enabled us to combine ‘before’ and ‘after’ surveys within a single 5-day period after poisoning.

The trial reported here was therefore conducted to increase confidence in the efficacy of the repellent in reducing by-kill of deer, and to assess its effectiveness in the field when used with 1080 cereal bait.

3. Objective

- To confirm that addition of a deer repellent to 1080 cereal baits significantly reduces the number of red deer killed following aerial application of the baits for possum control.

4. Methods

4.1 Study design, approach, and areas

An unreplicated Before-After-Control-Intervention design was used, with the experimental treatment or intervention being the addition of EDR to 1080 cereal bait.

The study was undertaken at Waipunga, Northern Hawke's Bay, as part of a 21 000-ha vector control operation. The area was selected because of the relatively high density of deer present and a supportive landowner. Two blocks were chosen, separated by about 3 km to minimise the chances of deer moving between the blocks. Block size was set at 1000–1400 ha so that they were large enough to encompass the entire home ranges of most of the deer using each area (i.e. to minimise edge effects), but small enough to be able to effectively search at least 20% of the area for carcasses. The two treatments and blocks used (Appendix 1) were:

- Repellent 1080 cereal: a side branch of the Hautapu River, privately owned (1074 ha);
- No-repellent 1080 cereal: the headwaters of the Hautapu River, public conservation land (1446 ha).

We determined the relative abundance of deer, pigs and possums using faecal pellet counts and, at the same time, used a mark-recapture method to assess the number of dead deer in each block. To increase the precision around the estimated density of dead deer, we supplemented the number of deer carcasses by deploying fake 'carcasses' systematically throughout the forest. To determine whether the repellent had any effect on deer kill after the application of 1080 baits, we then compared the proportions of the total number of dead deer found in each block with the proportions expected (given the relative abundance of deer in each block) under a null hypothesis of no difference between the treatments.

To assess the size of the effect (i.e. the difference in percentage kill of deer between treatments), we used a change-in-ratio approach. The ratio between an index of deer abundance after poisoning (the number of deer seen per 'plot') and pre-poison abundance (faecal pellets) was compared between the two blocks, with the difference in these ratios assumed to reflect any difference in percent kill. These estimates of percent kill and of actual deer numbers depended on a series of several untested assumptions and should therefore be seen as somewhat conjectural. These estimates were developed to translate the core result

(the difference in the ratios of sacks and carcasses) into terms that were likely to be more readily understood by managers.
In addition to these core data, we also recorded deer tracking as a complementary index of post-control deer abundance, and the numbers of other dead animals found, to provide some largely qualitative indications of the effect of the treatments on other species. For possums, the primary target of the poison operation, the adequacy of the possum kill was assessed by the vector manager using the standard Residual Trap Catch Index (NPCA 2001).

4.2 Treatments

The aerial poisoning followed Epro's standard procedures for aerial 1080 cereal baiting operations. Non-toxic and 1080 cereal bait (12 g, No. 7) was sourced from Animal Control Products, Wanganui. The baits used in the repellent block were surface-coated with EDR by Epro staff and left to dry in the sun for a day prior to being sown. Both no-repellent and repellent blocks were pre-fed with undyed non-toxic cereal bait (2 kg/ha) and then toxic cereal bait (3 kg/ha; nominally 0.15% wt:wt 1080) was sown 20–37 days later. In the repellent block, both the prefeed and toxic bait were surface-coated with EDR and sun-dried prior to sowing.

The Landcare Research Toxicology laboratory, using laboratory method TLM023 (with a method detection limit of 0.0002%), determined the 1080 concentration of one sample of bait. Baits used in the repellent and no-repellent blocks were from the same manufacturing batch.

4.3 Assessment of deer, other non-target and possum kill

Deer and other non-target kill

Each block was surveyed twice during a 5-day period, commencing 5–17 days after bait application, using the same eight expert hunters to survey both blocks. During the first survey in each block, searchers traversed parallel transects 150 m apart that systematically covered almost all of each block (<10% was not completed), and recorded the number of live deer and pigs seen and the number of dead mammals and birds found, the presence or absence of deer and pig tracking, and the presence or absence of deer, possum, and pig faecal pellets on plots 200 m apart along the transects. During this first survey, hunters also deployed paper bags (filled with leaf litter and approximately the same colour and size as a deer carcass) as simulated deer carcasses. The second survey was conducted along transects placed at right angles to those used for the first survey, and with no deployment of simulated deer carcasses. The same data were gathered during the second survey, and in addition, the 'recapture' or rediscovery of actual or simulated deer carcasses found (or deployed) during the first survey was recorded. The same eight expert hunters were used in both the first and second surveys with individuals randomly allocated to transects so that each searched the full range of differing aspect and vegetation type throughout both blocks. Only 11–17% of the total area of each block that was covered in the second survey had been searched previously (see results), and of that only 1/8th would have been searched by the same observer. The potential for major bias as a result of a hunter recognising where he had previously placed a bag was therefore considered to be negligible, with no need for detailed analyses of the variation in detection rates between observers.

Surveys were conducted on 16–20 August 2005 (starting 17 days after control) in the no-repellent block and on 21–25 August 2005 (5 days after control) in the repellent block. Transects bearings were 200º or 20º (reverse direction) during the first survey, and 290º or 110º for the second. Start and end points were predetermined using natural features, such as ridgelines or creeks, as baselines. Where possible, transect location and bearing were checked using Global Position System devices (GPS). Each transect was divided into numbered 200-m-long segments or 'plots' and all on-transect data were assigned the relevant plot number.

Every 200 m along each transect, two 1.14-m-radius plots centred 2.5 m either side of the transect were searched, and the presence or absence of deer, pig, and possum faecal pellets was recorded. During the placement of paper bags on the first survey (as simulated deer carcasses), a subjective assessment of the furthest distance from which each bag could be seen, averaged across the four compass points, was recorded, as a check on whether carcass visibility varied greatly between the blocks. The presence or absence of fresh deer and pig tracking was recorded for every 200-m segment. The size and composition of any groups of live deer and pigs encountered were also recorded, both along transects and whilst travelling to and from transects (with a GPS used to identify the location of off-transect sightings).

The location of mammal or bird carcasses and previously deployed sacks was likewise recorded both on and off transect. When dead deer were found, the lower jawbone was removed for ageing, and a sample of muscle (50 g) taken for 1080 analysis.

Bird carcasses were collected, identified to species, and submitted whole for 1080 residue analysis. The 1080 concentration in deer (and bird muscle) was measured using Toxicology Laboratory Method TLM 005 (with a method detection limit of 0.001 mg/kg) at the Landcare Research Toxicology Laboratory.

Incidental sightings of live birds were recorded to assess composition of forest bird species and compare that with species found dead. This subjective monitoring was intended only as an informal check for evidence of any major impacts of repellent bait on the more visible common native birds.

The percentage of paper bags found was used to estimate the detection probability for dead deer, with the total number of deer killed in each block then calculated by dividing the number of deer found by this detection probability. We used the frequency of faecal pellet plots with pellets present to estimate relative deer abundance before poisoning, and used that to predict the expected distribution between blocks of the number of carcasses found. A contingency table was then used to determine statistical significance.

Estimates of the population size and percentage kill in each block were also derived, but as these are supplementary rather than critical estimates, and because each estimate involved a series of steps with unverifiable assumptions, no analyses of statistical precision were undertaken.

Possum monitoring

To confirm previous evidence that addition of EDR does not substantially reduce efficacy against possums, we obtained estimates of post-control possum abundance from the vector manager. Residual possum densities were assessed on 13 and 12 lines of 10 traps set for 2 or 3 fine nights in the no-repellent and repellent blocks, respectively. The field staff undertaking this trapping also recorded the location of any deer carcasses found. The work was undertaken as part of the post-control monitoring for the whole Waipunga vector control operation by independent NPCA-certified possum-monitoring contractors.

5. Results

5.1 Treatments

Both treatment blocks were pre-fed on 10 July 2005, followed by toxic cereal bait in the no-repellent block on 30 July 2005. Weather delays meant that toxic cereal bait was not sown in the repellent block until 16 August 2005. At least 3 nights of fine weather followed the sowing of the toxic bait in both blocks. The concentration of 1080 in the standard cereal bait was assayed at 0.13%.

5.2 Deer kill

A total of 1178 ‘plots’ (= 200-m transect segments) were surveyed along a total of 236 km of transect. Faecal pellet frequency (the percentage of plots with pellets present) was higher in the repellent block for deer and possums, but pigs were absent from this block (Table 1). The percentage of 200-m plots with fresh tracking was consistent with this, but the usefulness of these data as an index was undermined because it was often not possible to distinguish between pig and deer tracking. Overall these indices suggest there were almost twice as many deer present before control in the repellent block than in the no-repellent block.

Table 1 Indices of abundance recorded on surveyed transects. For tracking and sighting indices, the plots represent 200-m segments of transect, but for faecal pellet indices the plots were circular 1.14-m-radius plots. Pellet frequency is the percentage of plots with at least one faecal pellet present.

	1080 + repellent	**1080 no repellent**
No. of plots surveyed	579	599
Plots with deer tracks present	58.2%	18.3%
Plots with pig tracks present	0.0%	5.0%
Plots with deer or pig tracks present	0.0%	17.1%
Deer faecal pellet frequency	43.7%	24.0%
Pig faecal pellet frequency	0.0%	2.0%
Possum faecal pellet frequency	26.7%	10.1%
Number of live deer seen	30	7
Number of live pigs seen	0	3

Based on the faecal pellet indices, we predicted that under the null hypothesis (no reduction in kill) that 64.5% of all deer carcasses found would be expected to occur in the repellent block.

A total of 13 dead deer were found, all in the no-repellent block (10 on transects, two whilst travelling between transects, and one by the possum-monitoring contractors). The 12 deer carcasses found by searchers comprised six adults (4 females, 1 male and 1 of undetermined sex) and six sub-adults (4 females and 2 males).

No dead deer were found in the repellent block and this was significantly lower than predicted (χ^2 = 22.3, d.f. = 1, P < 0.001), indicating that the repellent had reduced the percentage of deer killed, possibly to zero.

Using the upper 95% CL of the faecal pellet index for the no-repellent block and the lower 95% CL for the repellent block, the lower 99% CL for the ratio of pellet counts predicted we should find 59% of carcasses in the repellent block, yet we observed none (χ^2 = 17.3, d.f. = 1, P < 0.001).

Consistent with the actual deer carcasses found, the number of surviving deer seen (30) was higher relative to the faecal pellet index in the repellent block (sighting per pellet presence = 0.1185) than in the no-repellent block (7 deer seen, sighting per pellet presence = 0.0487). Assuming the pre-control ratio of sightings per pellet presence was approximately the same for both blocks, the difference between these two ratios suggests survival in the no-repellent block was only 41% of that in the repellent block.

Of the c. 300 sacks deployed in each block, 17% were found during the second survey of the repellent block and 11% in the no-repellent block. The difference partly reflected the larger size of the latter block, but higher visibility of sacks in the repellent block (Table 2) will also have contributed.

Table 2 Animals seen, heard alive or found dead during 5 days of searching effort after the July-August 2005 baiting operations for each of two blocks. Also shown, the number of paper bags (simulated deer carcasses) distributed in the first 2.5 days in each block, the number and percentage of those found during the second 2.5 days searching in each block, and average visibility of bags.

		1080 + repellent	**1080 no repellent**
No. of sacks deployed		308	304
No. of sacks found		53	34
Percent found (95% CI[1])		17.2% (13.2 – 21.9%)	11.2% (7.9 – 15.2%)
Average visibility		6.8 m	5.1 m
Deer	No. seen alive	30	7
	No. found dead	0	12
Pigs	No. seen alive	0	3
	No. found dead	0	1
Possums	No. found dead	55	23
Rats	No. found dead	2	1
Mice	No. found dead	1	0
Blackbird	No. found dead	4	7
Chaffinch	No. found dead	0	2
Hedgesparrow	No. found dead	0	1
Tomtit	No. found dead	2	0

[1] exact 95% CI, from Collet (1991)

For the no-repellent block, the probability of finding a sack during the second survey was 0.112 (Table 2), so we estimate the joint probability of finding a carcass across both surveys was 0.21 (95% CI = 0.172–0.255). Treating this as an estimate of the proportion of the area searched, we estimate 57 deer were killed in this block (95% CI = 47–70). Nine deer carcasses were found during the first survey of this block, of which one (11.1%) was 'recaptured' during the second survey, indicating the recapture rate for deer carcasses was similar to that for sacks. Of the 313 sacks and carcasses available to be re-located during the second survey, 35 were 'recaptured' but only three new deer carcasses were found for the first time. This suggests a total sack and carcass population (Lincoln Index) of 339 ± 29. Subtracting the known number of sacks suggests there were 35 ± 29 dead deer though poor precision of this estimator means little weight can be placed on it.

For the repellent block, the probability of finding a sack during both surveys was 0.31. Assuming the same probability of detection for deer carcasses, there is only a 5% likelihood of finding no dead deer if eight or fewer carcasses were actually present; i.e. we can be 95% confident that there were no more than eight deer killed in the repellent block.

To calculate an approximate percent kill for both blocks, we assume near-zero kill in the repellent block. The 59% lower relative survival estimated above then translates directly to a 59% kill for the no-repellent block. Combined with the estimate of 57 dead deer, this indicates a pre-control population of 97 deer for that block (6.7 deer/km^2). Using the pellet frequency data as a calibration, this in turn indicates a population of 132 deer for the repellent block (12.3 deer/km^2). Using the upper 95% CL of eight dead deer calculated in the preceding paragraph, this gives 95% confidence the deer kill in the repellent block was below 6%, with a best estimate of zero.

5.3 Other non-target kills

Pigs

No or very few pigs were present in the repellent block at the time of control (Table 1).
One dead pig was found (approximately 15 kg live weight) in the no-repellent block, suggesting c. 5 pigs were killed in total (95% CI = 3.9–5.8). Three were seen alive during the surveys, and the much lower dead:alive ratio for pigs (1:3) than for deer (12:7) in this block suggests the baiting had a lesser effect on pigs than on deer. Consistent with that fresh pig sign (rooting and tracking) was commonly seen during the post-control surveys in the no-repellent block.

Rodents

Three rodent carcasses (two ship rats and one mouse) were found in the repellent block, and one in the no-repellent block. Some of the baits found during the surveys in the repellent block had had the outer repellent layer eaten, but not the remainder of the bait, presumably by rodents. There is no indication in this sparse data that the palatability to rodents of cereal bait is any different with and without repellent.

Birds

There were six and ten birds found dead in the repellent and no-repellent blocks, respectively (Table 2), with no indication of significantly more bird mortality in the repellent block. All birds contained 1080 residues (Table 3). The majority of birds (87.5%) found were introduced species: blackbird (*Turdus merula*), chaffinch (*Fringilla coelebs*), and hedgesparrow (*Prunella modularis*). Two native tomtits (*Petroica macrocephala*) were found, both in the repellent block. Neither of the dead tomtits were found on the 2356 pellet plots searched so the best estimate of tomtit deaths from these plots is zero, another indication that the number killed was low. Live tomtits were sighted on a daily basis by field staff during the post-control surveys in this trial.

Table 3. Concentration of 1080 in muscle samples from deer and birds collected in both trial blocks.

Treatment	Identification	Species	Sex	Age class (adult : sub-adult)	Muscle residue (mg/kg)
No-repellent	0049	Deer	Female	Adult	0.63
No-repellent	0070	Deer	Female	Adult	2.80
No-repellent	0055	Deer	Female	Sub-adult	0.25
No-repellent	0022	Deer	Female	Adult	1.20
No-repellent	0028	Deer	Female	Sub-adult	4.30
No-repellent	3675	Deer	Female	Adult	1.20
No-repellent	3686	Deer	?	Adult	NA[1]
No-repellent	2907	Deer	Male	Adult	2.30
No-repellent	0042	Deer	Female	Sub-adult	2.00
No-repellent	0087	Deer	Female	Sub-adult	4.40
No-repellent	0085	Deer	Male	Sub-adult	0.28
No-repellent	3657	Deer	Male	Sub-adult	3.10
No-repellent	0013	Pig	Male	Sub-adult	0.46
No-repellent	1028	Blackbird	Male	Adult	12.00
No-repellent	0062	Blackbird	Male	Adult	6.90
No-repellent	3659	Blackbird	Male	Adult	8.90
No-repellent	3666	Blackbird	Male	Adult	7.20
No-repellent	6000	Blackbird	Female	Adult	10.00
No-repellent	3676	Blackbird	Male	Adult	7.50
No-repellent	0106	Blackbird	Male	Adult	8.50
Repellent	3685	Blackbird	Male	Adult	12.00
Repellent	3643	Blackbird	Male	Adult	15.00
Repellent	0019	Blackbird	Female	Adult	32.00
Repellent	1028	Blackbird	Male	Adult	12.00
No-repellent	2905	Chaffinch	Male	Adult	1.40
No-repellent	1042	Chaffinch	Female	Adult	5.80
No-repellent	3691	Hedgesparrow	?	Adult	1.70
Repellent	0046	Tomtit	Male	Adult	0.75
Repellent	3663	Tomtit	Male	Adult	0.23

[1]No tissue sample was collected and sex could not be determined because the carcass had been thoroughly scavenged by pigs.

Both trial blocks appeared to have healthy forest bird populations with sightings of less common species in both blocks. Blue duck (*Hymenolaimus malacorhynchos*) were sighted regularly in the repellent block, and kākā (*Nestor meridionalis*) were heard or sighted in both blocks. Whitehead (*Mohoua albicilla*), robin (*Petroica australis longipes*) and tomtit were observed regularly by field staff in both blocks.

5.4 Possum kill

Possum pellet frequency was 62% lower in the no-repellent block than in the repellent block (Table 1), while the number of possum carcasses found was 58% lower (Table 2). Because possum pellets decay and disappear far more rapidly than deer pellets (G. Nugent, unpubl. data) the difference in pellet frequency will be biased high by the longer period between control and survey for the no-repellent block, but offsetting that is better visibility of carcasses in the repellent block (Table 2). Together these data suggest there was no major difference in the percentage of possums killed in each block.

No possums were caught in 390 and 360 trap nights monitored in the no-repellent and repellent blocks respectively. This equates to 0.00% RTCI being achieved for both bait types.

6. Conclusions

6.1 Deer kill

The significant difference in the number of deer carcasses found compared to that expected indicates that the deer repellent reduced the by-kill of red deer in the repellent block, possibly to zero. In contrast, it appears that almost two-thirds of the deer in the no-repellent block were killed. Tracks, faecal pellet counts, and live sightings all indicated that there were about twice as many deer in the repellent block compared to the no-repellent block, so the reduction in by-kill was achieved in spite of presumably greater competition for food in the repellent block.

6.2 Kill of other species

There was no indication that either possum kill or residual density was measurably affected by addition of the deer repellent.

A few pigs were also killed, but the estimated total number killed in both poisoned blocks was low (4–6), and live pigs were seen afterwards. Pigs have a rapid rate of increase and populations can recover quickly, especially if the pigs killed tended to be the smaller younger ones, as anecdotal evidence from other areas suggests.

Even though 1080 poisoning operations can routinely kill most rats (Innes et al. 1995) few rodents were found dead, presumably because they die underground or are not easily seen amongst ground cover. The extremely limited data obtained provide no indication rats are deterred by the repellent. Incidental observation by several different observers on different days of baits that had the outer repellent coating extensively chewed but the inside of the bait left untouched suggests the possibility that the repellent coating may be more attractive to mice or rats than the cereal bait alone. This warrants further investigation.

Some evidence that the repellent has little detrimental effect on rat kill is provided by data collected by the manager of the private reserve, from an area immediately adjacent to our trial blocks that was poisoned with repellent-coated 1080 carrot baits as part of the same overall operation (Peter Shaw; unpubl. data summarised in Appendix 2). In rodent and stoat tracking tunnels set for 1 night and baited with peanut butter, rat-tracking indices reduced from 38% (95% CI = 18–58%) immediately prior to poisoning to zero approximately 1 month after the operation, and from 52% (95% CI = 29–65%) to zero in the same tunnels set for a further 3 nights and baited with meat (to attract stoats). Stoat tracking rates were low (4% for both tracking treatments), but also reduced to zero after control. In contrast mouse-tracking rates were initially also low, but in the tunnels baited with meat and set for 3 nights increased markedly from 2.0% before control to 28% 1 month after control. The short period between pre- and post-monitoring indicates that this increase cannot reflect actual population increase. Instead, it adds weight to observations of Sweetapple and Nugent (2005) that mice can survive aerial 1080 poisoning even without repellent and that they become much more detectable when rats (and stoats and possums) are removed.

There was no evidence of any significant kill or major effect on the birds present in the trial areas. Although not quantified, observers reported a wide range of species present in both blocks during the surveys, and none believed there was any difference in the abundance or composition of bird populations in the two blocks after control. Most of the birds killed were introduced. Given that about a quarter of the total area was effectively searched for sack-sized objects, it is unlikely that many (if any) large-bodied birds (kererū, kākā) were killed but not found.

Although two tomtit carcasses were found in the repellent block, the data are too sparse to make any useful comparison between the treatments. The absence of dead tomtits on plots and the numerous sightings of live tomtits in both blocks during the surveys is consistent with the minimal impact on tomtits reported by Westbrooke and Powlesland (2005) when non-repellent cereal 1080 baits were used at several North Island forest sites. Although some tomtits are killed during 1080 baiting operations, it appears that subsequent high breeding success (as a result of reduced predation by mammals) quickly replaces and offsets those losses (Powlesland et al. 1998).

6.3 Trial design

In a preceding trial, testing the effectiveness of repellent with carrot bait, we attempted to use pre- and post-control assessments of deer sighting rates in repellent, no-repellent, and an unpoisoned block to directly compare changes in density as a result of poisoning (Nugent et al. 2004). However, the sighting data were too variable to be useful, and the greatest inferential power was provided by the results of carcass searches. The revised design used here therefore sought to maximise the proportion of survey effort dedicated to carcass search, whilst pellet counts were used instead of sighting rate to index pre-control deer density. The main risks in this design include confounding of results where the surveys are delayed (and pre-control faecal pellets begin to disappear) and the need for a complex series of calculations and assumptions to estimate percent kill. Its strength lies in robust estimation of the number of deer actually killed and their distribution relative to that expected from pellet counts.

Potential refinements to the design include increasing the number of faecal pellet plots and refining the index of tracking used to increase its specificity. For small non-target species, deployment of rodent-sized objects along the transects would increase the ability to estimate non-target kills of birds and rodents.

6.4 Summary

This trial showed that EDR deterred wild red deer from feeding on cereal 1080 bait, and reduced deer by-kill following aerial application of bait, to zero or near-zero levels. Without replication, generalization of this result to other populations is risky. However, when taken in conjunction with the repellency observed in previous pen and field trials (Forsyth 2002; Lorigan et al. 2002; Morriss et al. 2003; Speedy 2003; Nugent et al. 2004; Speedy 2004) and with qualitative observations made during unmonitored operations, the indications are that the repellent is likely to be effective regardless of bait type. Deer have been reported killed by 1080 bait coated with EDR in two trials to date. In one trial the species involved (sika) may have been more vulnerable because of their small relative body size, and also by the non-adherence of the repellent (Speedy 2003). In the second trial (Speedy 2004), the dead deer (1 red; 1 red/sika hybrid) may have eaten bait because of winter food supplies depleted by displaced deer (a fire appears to have caused a shift in the deer population in the trial block and concentrated them in an area where the dead deer were found).

Further evidence of the repellent being effective when used on 1080 cereal bait comes from a 998-ha possum control operation Epro carried out on Mount Tauhara near Taupo in March–April 2005. The post-operational RTCI assessed on 12 lines set to NPCA protocol was zero and there was no evidence of significant deer kill, though no formal deer monitoring was done.

The mode of action of EDR has not yet been formally investigated, but pen trials indicate that it is not effective when incorporated within, rather than coated on, cereal bait (Morriss et al. 2003). To date, EDR bait has been prepared by hand, but that imposes limitations on the amount of bait that can be prepared. Factory manufacture is therefore required, but raises the concern that differences in bait characteristics created by the manufacturing process may affect repellency.

The trial reported here provided no indications that EDR has adverse effects in terms of decreased efficacy of 1080 baits against possums or rodents, or undesired effects on non-target native birds.

7. Recommendations

- Where appropriate (in relation to high-level management goals and policies), the AHB should consider operational use of EDR on cereal 1080 bait where the risk of a large deer by-kill is a primary driver of opposition to the use of aerial 1080 poisoning as a possum control tool.
- Factory-manufactured EDR cereal 1080 baits should be field trialled, both to replicate the trial reported here and to determine whether factory bait-preparation processes affect repellency. Future field trials should include more intensive and quantitative assessment of impacts on non-target native species.
- The possibility that EDR enhances the palatability of cereal bait to rodents should be investigated in pen trials.

8. Acknowledgements

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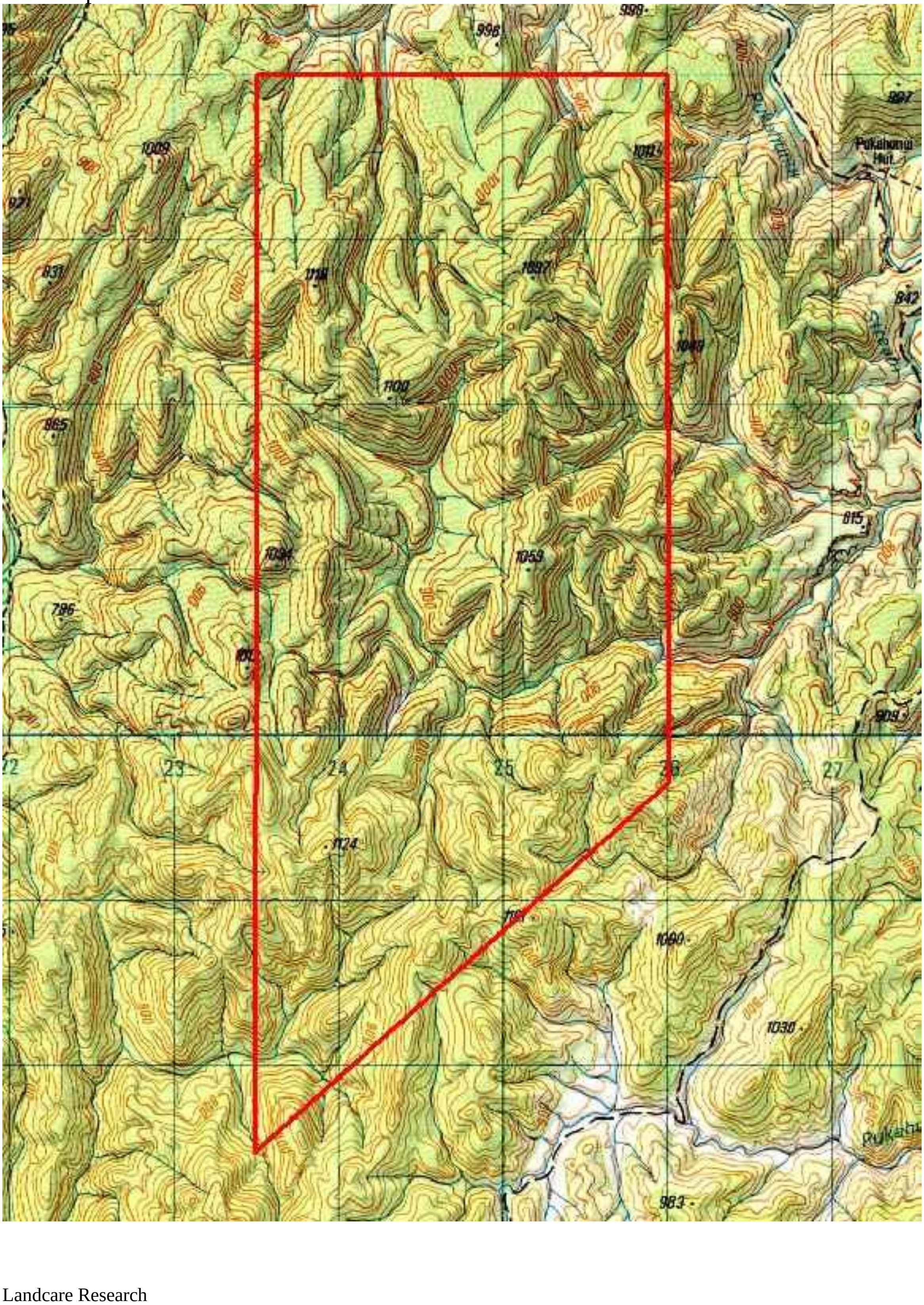
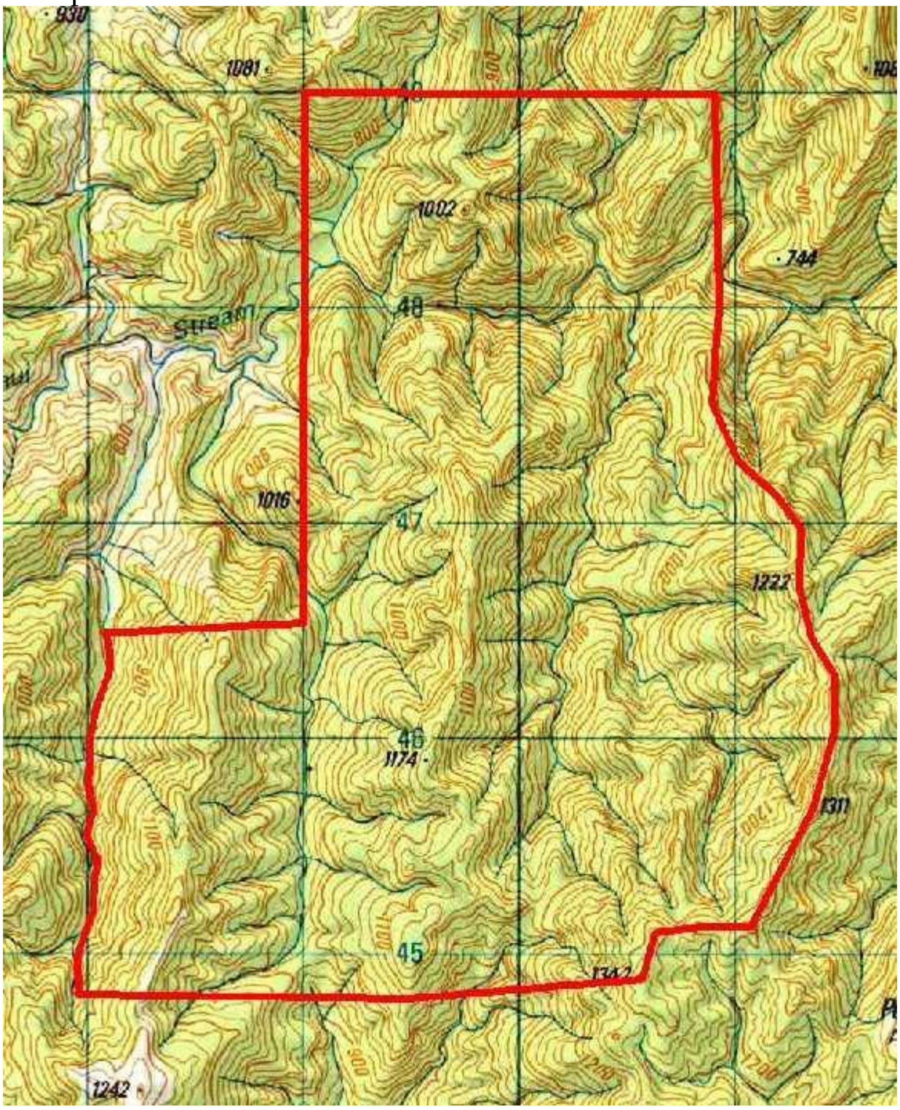
10. Appendices

Appendix 1 Maps of treatment blocks, Waipunga, Northern Hawke's Bay

a. No-repellent block



b. Repellent block



Appendix 2 Rodent and stoat monitoring results, Waipunga, Northern Hawke's Bay

Based on 10 lines of five tunnels assessing pre- and post-deer repellent 0.08% wt:wt 1080 carrot bait application (Prefeed 3 kg/ha; Toxic 5 kg/ha). Tunnels were baited with peanut butter (targeting rats) for 1 night and then a week later with meat for 3 nights (targeting stoats).

	Rats		Stoats		Mice	
	Mean (%)	±95%CL	Mean (%)	±95%CL	Mean (%)	±95%CL
Peanut butter						
Pre	38	20	4	5	6	9
Post	0	0	0	0	6	6
Meat						
Pre	52	23	4	5	2	4
Post	0	0	0	0	28	19