Animal Health Board Project No. R-10697

Monitoring the Impact of Aerially Sown 1080 EDR Cereal Bait on Fallow Deer in the Blue Mountains, Otago

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Landcare Research
Manaaki Whenua

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DATE: October 2008

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Landcare Research Contract Report: LC0809/032

DOI: https://doi.org/ 10.7931/hxrn-j403

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Summary

Project and Client

The number of fallow deer killed incidentally in the Blue Mountains, Otago, during an aerial 1080 possum baiting operation using cereal bait coated with a proprietary deer repellent (EDR) was measured. Landcare Research conducted this work for the Animal Health Board (Project R-10697), between July and October 2008.

Objective

- Estimate the number of fallow deer in part of the Blue Mountains, Otago, killed during possum control using aerial application of 1080 cereal pellet baits coated with EDR (deer repellent).

Methods

- Four independent 121-ha blocks (Tramway, Clarks, Packers, and Armstrong) in the Blue Mountains were selected as study sites. All blocks were within a 6444-ha operational area that was aerially baited with cereal bait containing 0.15% 1080 and surface-coated with EDR (2 kg/ha). A pre-feeding application of non-toxic cereal bait surface-coated with EDR (2 kg/ha) was made 3 weeks before toxic bait application.
- Three weeks after the application of toxic baits, up to six expert hunters searched each block consecutively on set transects for 2 or 3 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, and birds encountered while hunters moved to and from, or on, transects.
- Faecal pellet surveys were carried out during the first two searches in each block, using two 1.14-m-diameter plots (centred 2.5 m on either side of the transect) at 100 m spacing along the transects. These plots were searched for deer, possum and pig faecal pellets and their presence or absence was recorded. A third survey was carried out in two of the blocks where ground cover was more dense.
- During the first survey of each block, deer-sized brown paper bags were placed on plots at 100-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 surveys 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 with historical data to assess relative deer abundance and to estimate percentage kill.
- Muscle samples from dead deer and birds were analysed to confirm exposure to 1080 and indicate whether this was the likely cause of death.

Results

- Thirty-three fallow deer and one pig were encountered live in the four blocks searched. Fresh deer tracks were observed on 28% of the 100-m segments of the transects, but some fresh tracking would have been washed away in the consistently wet weather of the search period.

- The animals found dead after bait application comprised 6 fallow deer (3 adult does and 3 fawns), 3 pigs (weaners), 34 possums, 7 blackbirds, and 1 kererū.
- On average, 26% of the sacks deployed in the first search were found in the second search, indicating that each search covered about a quarter of the block.
- The overall percent kill of fallow deer in the three beech-forest-dominated western blocks (Armstrong, Clarks, and Packers) appears to have been less than 10%.
- For the Tramway block, where c. 25 deer/km^2 were killed in 2001, the kill may have been as high as 30% although the high tracking rate strongly suggests this is an overestimate.
- Presence of fresh rooting suggested pigs were present and alive following poisoning in all four blocks searched.
- All deer, pig, and blackbird muscle analysed contained 1080 residue (0.008–28.4 mg/kg) suggesting all had been poisoned by 1080. No detectable 1080 was found in the kererū muscle.
- There was no evidence of a large deer kill in a parallel operation at Mt Stalker, North Otago, that was aerially poisoned using the same EDR-coated cereal 1080 bait in June 2008. Though no formal mammal non-target monitoring was done, at least 10 live red deer and one pig were observed by possum monitoring staff during 10 h of helicopter travel in the area 6 weeks after toxic baits were applied.

Conclusions

- The use of EDR-coated cereal bait is likely to substantially reduce incidental kill of fallow deer.
- Though three weaner pigs were found dead and contained 1080 residues it is likely there has been minimal impact on the resident pig population.
- Recovery of bird carcasses during transect searches did not suggest significant mortality of native birds. Incidental sightings of 31 live kererū and 25 tomtits were recorded, along with sightings of New Zealand falcon, brown creeper, fantail, bellbird, waxeye, and grey warbler.

Recommendations

- The process of registering EDR-coated cereal bait should continue, and the AHB should consider its use in situations where hunter opposition to possum control by aerial 1080 baiting impedes the ability of Vector Managers to mange Tb cost-effectively.
- Trend monitoring and mopping up of any foci of possum survivors should be carried out in Tramway Block to maximise the probability of Tb elimination.

1. Introduction

The number of fallow deer killed incidentally in the Blue Mountains, Otago, during an aerial 1080 possum baiting operation using cereal bait coated with a proprietary deer repellent (EDR) was measured. Landcare Research conducted this work for the Animal Health Board (Project R-10697), between July and October 2008.

2. Background

In 2001 an estimated 500 fallow deer were incidentally killed in a 6400-ha area in the Blue Mountains, Otago, during an aerial 1080 poisoning operation aimed at reducing possum densities (Nugent & Yockney 2004). Many hunters were displeased with this outcome, contributing further to nationwide opposition by hunters to aerial 1080 poisoning.

Ongoing opposition from deer hunters to aerial application of 1080 prompted development of a deer repellent, hereafter referred to as EDR (Epro deer repellent), aimed at deterring deer from eating baits intended for possums (Forsyth 2002). Subsequent field trials have shown that EDR successfully reduces red and sika deer by-kill during possum control operations when used with carrot and cereal baits (Lorigan et al. 2002; Nugent et al. 2004; Speedy 2004; Morriss et al. 2005). Anecdotal evidence following operational use of EDR-coated 1080 bait (c. 200 000 ha treated during 2001–2007, including the field trials above) reinforces these findings, as few dead deer have been reported (Morriss 2007). Fallow deer were present in one operation, which covered 2000 ha of the Te Tapui Scenic Reserve, Cambridge. Local hunters looked for, but did not find any dead deer after application of EDR 1080 carrot bait (Roger Lorigan, pers. comm.), but the amount of search effort is unknown.

EDR is currently registered for use on 1080 carrot baits, but not yet for use on cereal baits. This project was initiated by AHB (and Epro) to obtain efficacy data needed to support registration of commercially produced EDR cereal baits. A possum control operation planned for the Blue Mountains in winter 2008 provided an opportunity to obtain such data, and demonstrate to local hunters whether EDR was effective in reducing fallow deer by-kill to well below the level reported in 2001 by Nugent & Yockney (2004).

3. Objective

- Estimate the number of fallow deer in part of the Blue Mountains, Otago, killed during possum control using aerial application of 1080 cereal pellet baits coated with EDR (deer repellent).

4. Methods

4.1 Design

In previous trials (Nugent et al. 2004; Morriss et al. 2005) we have compared numbers of deer killed in an area poisoned with EDR-coated 1080 bait with those in a nearby area poisoned with non-repellent 1080 bait, but no such 'non-treatment' area was available for the work reported here. This design weakness was partly overcome by ensuring that the 2008 operation closely mimicked the 2001 operation, except for the use of EDR-coated bait. Thus data on deer by-kill from the 2001 operation was used as a reference, in lieu of a concurrent non-treatment experimental control block. We acknowledge that the robustness of this comparison is reduced because of likely differences in deer densities and other factors in the operational area between 2001 and 2008.

The primary aim was (as in 2001) to estimate the number of deer killed by searching for carcasses. For this we used the same 'repeated search of sample area' design used to monitor the 2001 Blue Mountains operation, but increased precision of the estimate of search efficiency by deploying and re-locating deer-sized objects (paper sacks emulating deer carcasses; Morriss et al. 2005).

To provide some indication of the effect of any deer by-kill on population size, we also measured two indices of deer abundance while searching for carcasses. We measured deer faecal pellet abundance and the abundance of fresh deer tracks about 3 weeks after poisoning. Because faecal pellets take several months to disappear (Nugent 1990), most of the pellets recorded were expected to have been deposited before poisoning, and so provided a proxy measure of pre-poisoning deer abundance. In contrast, fresh tracks are only a few days old so provided a proxy measure of post-poisoning deer abundance. Although the different indices cannot be directly compared against each other (because they measure different things) we assume that each is somehow consistently correlated to deer abundance (i.e.; that the index can be used to predict deer abundance by some constant but unknown regression equation). If so, then in the ratios of the two indices, the relationship between the regression coefficients is constant across any comparison.

4.2 Study areas and field procedures

Four 121-ha blocks (designated by the hunting blocks in which they were present: Packers, Armstrong, Clarks, and Tramway) were selected (Appendix 1a), all covering at least one of the eight c. 50-ha areas searched in 2001.

Approximately 3 weeks after application of EDR-1080 baits, two or three searches were conducted in each block, using 4–6 observers for each search (total of 52 person days) travelling along parallel fixed-bearing transects. Transects used for the second search of each block were at right angles to those used for the first search. In the two blocks with the densest ground cover (Packers and Tramway), a third search was conducted on transects halfway between but on the same bearing as those used for the second search.

In all searches, observers recorded the details (age class, sex, and location) of each deer or pig found dead, and collected jawbones for more precise ageing and muscle samples (50 g) to

analyse for residual 1080 concentration. The number of dead possums seen was recorded, as was the species and number of dead birds (bird carcasses were collected whole for 1080 analysis). The muscle samples and bird carcasses were frozen on the afternoon they were collected and submitted for analysis at the Landcare Toxicology Laboratory at the completion of fieldwork.

During the first searches, individually numbered deer-sized brown paper bags filled with leaf litter were placed at 100-m intervals along transects, to imitate deer carcasses. The percentage of sacks found during subsequent searches was used to estimate the percentage of each block that was effectively searched. That percentage was then combined with the number of dead deer found to estimate the total number of dead deer in each block.

In addition to searching for carcasses, observers recorded the presence or absence of fresh tracking by deer and pigs for every 100-m segment along each transect, as an indication of the relative abundance of survivors. A total of 1033 100-m-long segments were scored (Armstrong 191, Clarks 230, Packers 293, and Tramway 319).

At 100-m intervals along each transect, observers also searched two 1.14-m-diameter plots (centred 2.5 m on either side of the transect) and recorded the presence or absence of intact faecal pellets of deer, pigs, and possums. For deer this data provided an indication of differences between blocks in the relative abundance of deer before control. For pigs and possums the data also provided measures of relative abundance and were collected as background information. A total of 2282 plots were searched for pellets (Armstrong 424, Clarks 504, Packers 652, and Tramway 702). This presence/absence method was chosen simply because it enabled direct comparison with the available historical data on deer abundance (Nugent 1988, 1990).

Observers also recorded the number and location of live deer, pigs, kererū, and tomtits seen. Sightings of some other native bird species were also opportunistically recorded.

Muscle samples from deer, pigs, and bird carcasses were analysed to determine 1080 concentration, using Toxicology Laboratory Method TLM 005 (with a method detection limit of 0.001 mg/kg), at the Landcare Research Toxicology Laboratory.

4.3 Data analyses

As we expected to find few, if any, dead deer, we used our ability to find sacks as a proxy for estimating dead deer detection probabilities. We assumed that the probability of detecting a deer carcass in the first search (D_1) was the same as in the second search (D_2), and used the proportion of the sacks found during the second as a proxy for both probabilities (i.e. $D_1 = D_2 = S_2/S_1$, where S_1 is the number of sacks deployed during the first search, and S_2 is the number of those found during the second search). If so, the joint probability of a deer carcass being found in any of the searches (D_{Total}) can be calculated as follows: $D_{Total} = 1 - [(1 - S_2/S_1)(1 - S_{23}/S_1)]$, where S_{23} is the number of unique sacks found in the second and third searches combined. The total number of deer carcasses in each block was then calculated as follows: Total number of carcasses = Number of carcasses found / D_{Total}.

Confidence limits for the deer carcass estimates were estimated by combining the appropriate binomial confidence intervals for the proportion of sacks *not* found in the respective searches.

5. Results

5.1 Baiting operation

The operation was carried out in June–July 2008. A total of 6444 ha (flight lines shown in Appendix 1b) was first treated with 2 kg/ha of helicopter-sown non-toxic EDR-coated Wanganui #7 cinnamon-lured 12-g cereal baits on 18 June 2008, followed 21 days (on 9 July) later by EDR-coated 0.15% 1080 Wanganui #7 cinnamon-lured 12-g cereal baits.

Operational monitoring (16–25 July 2008) indicated a good (nominally100%) kill, as no possums were caught in 30 standard (NPCA 2005) 10-trap traplines set for three fine nights (Southern Pest Management, unpubl. data). This compares with five possums being caught after the 2001 operation on 25 traplines set for three fine nights (0.7% Residual Trap Catch Index (RTCI)).

5.2 Numbers of dead deer (and other species)

Six deer (3 fawns (7–8 months old) & 3 adult does) were found dead, as were 3 young pigs (all with an estimated liveweight of 10 kg), 34 possums, 7 blackbirds and 1 kererū (native pigeon) (Table 1). Analyses of 1080 concentration in muscle were completed for all of the deer and pigs, five of the blackbirds, and the kererū, and all but the kererū contained detectable concentrations of 1080 (Table 2). The stomach of the kererū was completely empty.

On average, 26% of the sacks deployed in the first search were found in the second search (Table 1), indicating that each search covered about a quarter of the block. Using this as the probability of detecting a carcass during a single search and factoring in the first search, we estimate that, for the blocks searched only twice (Armstrong and Clarks), that 63% and 37% respectively of these blocks were searched. We found no carcasses in either, indicating that few if any deer were killed in these two blocks. For the blocks searched three times (Packers and Tramway), we combined the percentage of sacks actually detected in the second and third searches combined (where done) with the predicted percentage for the first search to estimate that 43% and 54% respectively of these blocks were searched. From that we estimate that these two blocks contained a total of 12 dead deer. For the four blocks combined, the estimated density of dead deer (mean 2.5/km^2, range 0.0–6.3/km^2; Table 1) is 87% lower than in 2001 (mean 19.7/km^2, range 2.2–38.6/km^2; Nugent & Yockney 2004).

Table 1 Numbers of animals encountered alive or found dead during two or three searches of four blocks in the northern Blue Mountains following aerial application of EDR-coated cereal 1080 baits in 2008. Also shown are the number of paper bags (simulated deer carcasses) deployed in the first search of each block, the percentage of those found during subsequent searches, the percentage detection estimated from all searches (see section 4.3), the estimated total number and density of dead deer in each block, and the various tracking and pellet count indices recorded.

	Armstrong	Clarks	Packers	Tramway	All blocks
Area searched (km^2)	1.12[1]	1.21	1.21	1.21	4.75
No. of sacks deployed	94	121	117	131	463
% sacks found in the 2nd search	39.4	20.7	18.8	21.4	
% sacks found in the 2nd and 3rd searches	39.4	20.7	29.9	41.2	
% detection estimated for all searches	63.2	37.1	43.1	53.8	
No. of dead deer found	0	0	2	4	6
Estimated total dead deer (95% CI)	0.0	0.0	4.6 (3.7–6.0)	7.4 (6.4–9.0)	12.3 (11.1–13.7)
Density of dead deer (per km^2)	0.0	0.0	4.0	6.2	2.6
No. of live deer encountered	0	11	16	6	33
% of 100-m segments with fresh deer tracks (= post)	23.0	34.8	23.2	31.3	28.3
% of plots with deer pellets present (= pre)	25.0	26.8	31.7	21.1	26.1
Ratio of post (= % tracks) to pre (= % pellets)	92.1	129.8	73.2	148.6	108.3
No. of dead pigs found	1	0	2	0	3
% of plots with pig pellets	0.2	0.0	0.3	0.3	0.2
No. of live pigs seen	0	1	0	0	1
No. of dead possums found	0	2	1	31	34
% of plots with possum pellets	4.7	2.8	3.7	13.7	6.7
No. of introduced birds found dead[2]	2	3	1	1	7
No. of native birds found dead	0	1[3]	0	0	1[3]

[1] 9 ha designated to be searched was excluded because dense scrub precluded effective searches

[2] All blackbirds

[3] Kererū

Table 2 Concentration of 1080 in muscle samples from fallow deer, pigs, and birds collected in the northern Blue Mountains following aerial application of EDR-coated cereal 1080 baits in 2008 (MDL = method detection limit of 0.001 mg/kg).

Species	ID	Sex	Age class (adult : subadult)	Muscle 1080 concentration (mg/kg)
Deer	1895	Female	Adult	0.3
Deer	1648	Female	Adult	4.6
Deer	1901	Female	Adult	4.5
Deer	1032	Male	Fawn	4.1
Deer	1596	Male	Fawn	0.43
Deer	1918	Male	Fawn	0.91
Pig	1405	Not recorded	Juvenile	0.008
Pig	1904	Not recorded	Juvenile	0.19
Pig	1356	Not recorded	Juvenile	0.11
Blackbird	1896	Female	Adult	9.8
Blackbird	1905	Female	Adult	0.003
Blackbird	1917	Male	Adult	3.7
Blackbird	1035	Male	Adult	17.8
Blackbird	1899	Male	Adult	28.4
Kererū	1607	Not recorded	Adult	<MDL

5.3 Impact on deer abundance.

In 2001, eight deer were seen alive and 53 found dead in the 358 ha systematically searched (Nugent & Yockney 2004). In 2008, 33 live fallow deer were encountered (over five times more than the six found dead in 475 ha) and fresh deer tracks were observed on 28% of the 100-m segments along the transects (Table 1). This strongly suggests that greater numbers of deer survived the 2008 baiting.

Deer pellets were recorded on 26% of the 2282 plots searched, and the index of relative pre-control abundance did not vary greatly between blocks (range 21-32%). If the operation had no effect on the abundance of deer in the Armstrong and Clarks blocks, the significance of the greater number of deer found dead in Tramways and Packers blocks can be assessed by comparing the respective indices of post-control relative abundance (fresh tracking) and pre-control abundance (pellet frequency). The ratio between these two indices was the same in the two blocks in which dead deer were found (111%) in the two blocks where no dead deer were found (111%). There was therefore no indication that the percentage kill in the former was markedly higher than in the latter; i.e.; the number of deer killed was too small to have affected relative abundance.

The deer pellet frequencies recorded in indigenous forest in the Blue Mountains in 1990 averaged about 23%, some four times higher than in the exotic forest areas in the same region (Nugent 1990). The overall deer population at that time was estimated to be 2200, or 10 deer/km^2, with three-quarters of them (1600) concentrated in the c. 8000 ha of indigenous forest, suggesting that density there was of the order of 20 deer/km^2. Assuming from historical data that 23% pellet frequency equates to about 20 deer/km^2 the pellet frequency of 21–32% recorded in this survey suggest densities of the order 20–30 deer/km^2. Based on that it seems likely that, overall, less than 10% of the deer in the four blocks were killed, with up to almost 33% of those in the Tramway Block. The latter seems likely to be an overestimate as a result of by-chance sampling error, as the measure of fresh tracking (proxy for post-control abundance) in Tramway was the highest of any block (Table 1).

5.4 Other observations

For pigs, faecal pellet frequencies were much lower than for deer. There was only a single sighting after control, but fresh rooting observed in all four blocks indicated pigs were still present in all blocks. As the three pigs found were all juveniles, we infer few if any of the adult population was killed.

For possums the pellet counts suggested the relative abundance of possums in Tramway was much higher than the other three blocks. Supporting this there was a significant correlation between the pellet index and the number of possum carcasses found in each block ($R^2 = 0.96$, $p < 0.05$, df = 2).

Local hunters searched parts of the operational area for a total of 17 h and encountered five live deer, but found none dead (S. Murray; Blue Mountain Hunter Liaison Group, pers. comm.). They did find 11 possum carcasses, and one partly eaten dead bird (possibly a thrush).

The AHB-funded contractors carrying out post-control trap-catch monitoring of possums spent a total of 11 person days covering 30 0.2-km-long traplines, as well as travelling to and from the traplines. Assuming lateral visibility averaged 10 m they would have covered at least 132 ha around the traplines alone, but found no dead deer.

DOC-funded workers monitoring other mammals spent 14 person days in the area, but did not find any dead deer or birds (C. Bishop, DOC, pers. comm.). Possum interference rates with Wax Tags (Pest Control Research, Christchurch) declined from 40% before control to 0% afterward (32 lines of 10 tags), while tracking tunnel indices from 10 tunnels on 16 lines declined from 22% to 0% for mice, from 2% to 0% for rats, and were 0% both before and after control for stoats.

6. Discussion

6.1 Deer and pig kill

Despite the use of EDR-coated bait in 2008, some deer were killed, but far fewer than when non-repellent bait was used in 2001. There was no evidence of a major effect on deer

abundance even in the block where most of the dead deer were found. Comparing historical data on deer pellet frequencies and population size with the pellet frequencies we recorded suggests the deer densities in all four of the blocks surveyed exceeded 20 deer/km^2. If so, then the overall percent kill in the three beech-forest-dominated western blocks (Armstrong, Clarks, and Packers) would have been less than 10%.

For the Tramway Block, where about 25 deer/km^2 were killed in 2001, the kill may have been as high as 30% although the high tracking rate strongly suggests this is an overestimate. Even at 30%, however, the kill would still have been less than the annual rate of increase previously estimated for this population (see Nugent 1990).

Some pigs were also killed, but no adults were found dead, suggesting that the operation had little short-term effect on the reproductive capability of the population.

There was no evidence of a large deer kill in a parallel operation in an area near Mt Stalker, Herbert, North Otago, that was aerially poisoned using EDR-coated cereal 1080 bait in June 2008. No systematic surveys were conducted, but four observers involved in post-control possum monitoring (15 RTCI trap lines) in August 2008 found no dead deer, and saw at least 10 live red deer and one pig during 10 h of helicopter travel in the area. The poisoning resulted in a possum RTCI of 0.44% (0.00–1.39 95% CI; B. Rohloff, Southern Pest Management, pers. comm.).

6.2 Kill of other species

It is clear that the 2008 Blue Mountains operation killed most possums, with none detected by either traps or WaxTags afterwards. There was also a total reduction in tracking tunnel detections of mice and rats. The use of EDR therefore does not appear to have affected possum or rodent kill.

The kererū that was found dead did not contain detectable concentrations of 1080, so is likely to have died from other causes. The other seven birds found poisoned were all introduced blackbirds. As in 2001, the predominance of introduced birds differs markedly from the ratio of six native to one introduced bird recorded alive in beech forest during the mid-1980s (Foord 1987). There was therefore no evidence of any major effect on native birds through by-kill. In line with that, we recorded incidental sightings of live kererū and tomtits on 31 and 25 occasions respectively during the 2008 searches, along with sightings of New Zealand falcon (one was observed swooping a live fallow doe in Packers), brown creeper, fantail, bellbird, waxeye, and grey warbler.

6.3 Impact on Tb

Both the 2001 and 2008 poisonings were conducted to reduce the likelihood of Tb persistence in possums (and spillover of Tb from possums to deer). Judging by the percentage of possum carcasses found in the Tramway Block (91% of the total found), pre-control possum densities appear to have been far higher there than in the other three blocks. That suggests a higher rate of survival of possums in Tramway during the 2001 poisoning. This possibly reflected localised failure of control caused by bait depletion by deer (given that an estimated 25 deer/km^2 were killed in part of the area). The 0.7% RTCI recorded during post-control trap-catch monitoring in 2001 (25 10-trap traplines, 750 trap nights; Nugent & Yockney 2004) provided little indication of any such localised failure of control. Regardless of the cause, it

seems clear that risk of Tb persistence would have been highest in the Tramway Block, especially since the only historical cases of Tb infection in possums or deer in the Blue Mountains have been from within or near the Tramway Block just prior to the 2001 operation. There is therefore also some risk of Tb still being present in the surviving deer in that block. That suggests that despite the apparently very good possum control in 2008, further monitoring (and control if necessary) of possum numbers in that block would be needed for at least a decade before freedom from Tb can be confidently declared.

Due to the imprecision of RTCI monitoring once possums are reduced to very low densities, we recommend that the distribution of survivors in Tramway Block is resurveyed using low-cost mapping devices (i.e. WaxTags or chew cards) and any foci of survivors detected are mopped up to maximise the probability of rapid Tb elimination in possums.

6.4 Conclusion

We conclude that use of EDR-coated cereal bait is likely to substantially reduce incidental kill of fallow deer, without adversely affecting possum or rodent kill, and without major harm to native birds (at least those that are common in the Blue Mountains).

7. Recommendations

- The process of registering EDR-coated cereal bait should continue, and the AHB should consider its use in situations where hunter opposition to possum control by aerial 1080 baiting impedes the ability of Vector Managers to mange Tb cost-effectively.
- Trend monitoring and mopping up of any foci of possum survivors should be carried out in Tramway Block to maximise the probability of Tb elimination.

8. Acknowledgements

This study was contracted research, carried out for the Animal Health Board. Thanks to the hunters Raoul Thomas, Alan Grant, Andy Kinley, Robert Andrews, Brent Rohloff, Jim Cessford, and Kevin Mitchell for their efforts in the field. Mark Dean (Ernslaw One), Colin Bishop (DOC), and Joe Bayley (Southern Pest Management) provided access and/or background information. Thanks also to Garry Knowles and Penny Fisher for review of this report, and Christine Bezar for editing.

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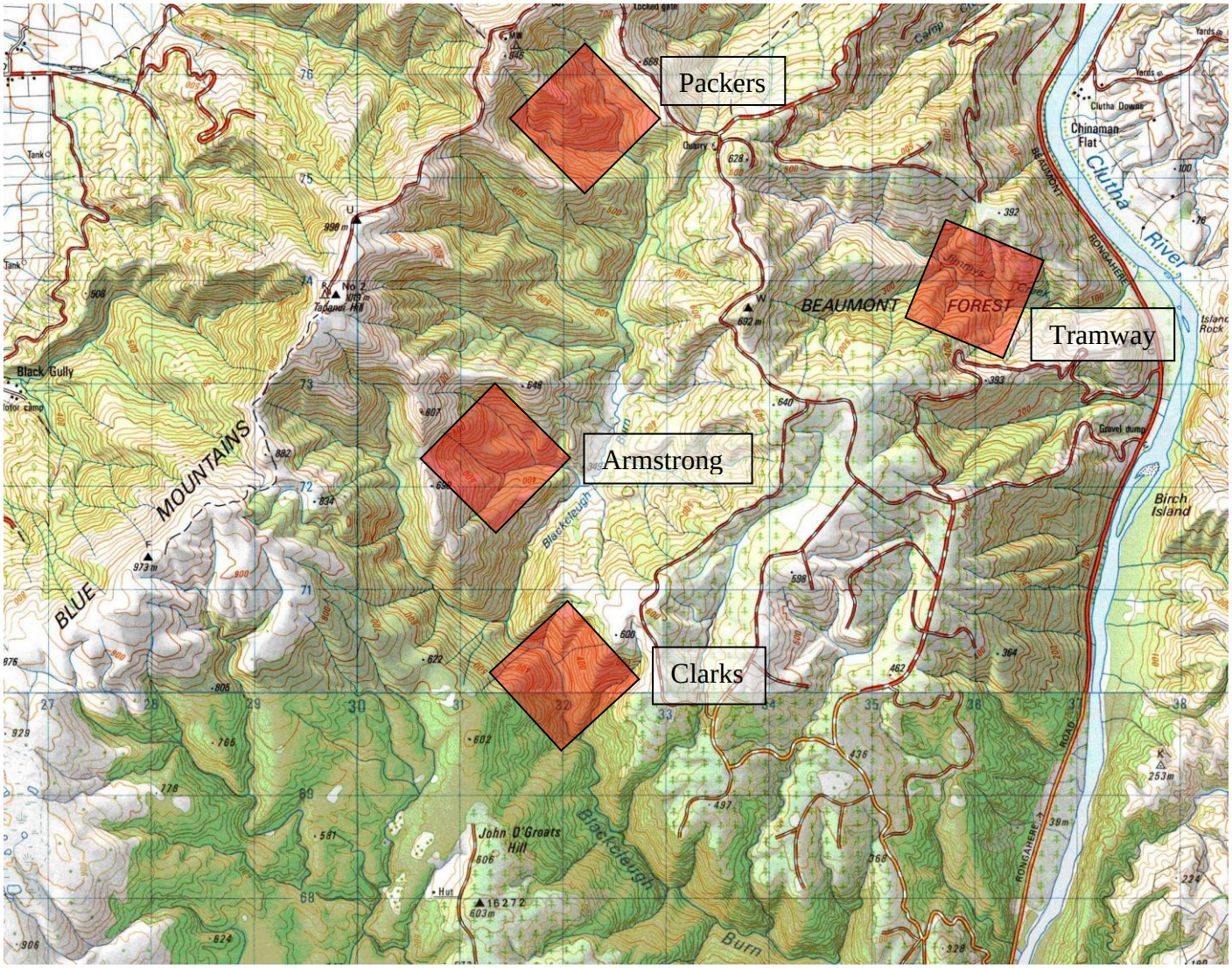
Appendix 1a Location of blocks searched



Appendix 1b Flight lines for northern Blue Mountains aerial 1080 possum control operation