SHORT COMMUNICATION

Rabbit bait-take from plastic bait stations

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Abstract: Plastic bait stations were trialled to assess their usefulness as a rabbit control tool. Non-toxic cereal baits were applied at two 171 ha Mackenzie Basin sites, at one site in stations and at the other site spread directly on the ground. Bait-take at each site was measured. Rhodamine-dyed baits were also used to determine the proportion of rabbits at each site that took bait. Bait-take, and the proportion of shot rabbits with stomachs containing dye, were both significantly lower ($P \leq 0.0001$) at the bait station site. The bait station design used in this trial is unlikely to prove an effective rabbit control tool. Alternative bait station designs should be tested if bait stations are to be used for rabbit control.

Keywords: bait stations; pindone; predator control; rabbits.

Introduction

Rabbits (*Oryctolagus cuniculus)* are important agricultural and conservation pests in New Zealand (Gibb and Williams, 1990; Norbury, 1996). Rabbit control can provide positive conservation gains by reducing predation by rabbits on native vegetation. Reduced rabbit numbers can also lead to declines in predator numbers, caused directly by reduced availability of primary prey, and/or through secondary poisoning of predators after eating poisoned rabbits. Sustained reductions in predator abundance below ecological damage thresholds (Moller, 1989) would benefit native animal populations by allowing a net gain in productivity.

Ideally, both rabbits and predators such as ferrets (*Mustela furo*) should be controlled in order to benefit native plants and animals. Some landholders are reluctant to provide access for predator trapping operations because they believe that, as a result of predator removal, rabbit abundance will increase. Cost-effective techniques that target both rabbits and predators could help resolve landholders' concerns and protect more conservation values. Poisoning rabbits with toxins that result in secondary poisoning of predators (when they eat poisoned prey) may be one such technique (Alterio, 1996; Short *et al*., 1997; Murphy *et al*., 1999). Circumstantial evidence suggests that rabbit control with pindone provides effective control of ferrets, but not necessarily of feral cats (*Felis catus*) (Brown and Keedwell, 1998).

Pindone pellets are usually applied to the ground to control rabbits but cannot be used in this way where there is a risk of poisoning stock. An alternative control tool might be bait stations that exclude stock from bait. Stations would also make bait available for longer periods, because they protect baits from the weather. They would also be more environmentally friendly because uneaten bait could easily be removed at the end of a poisoning operation. Bait stations have proven effective for poisoning ship rats (*Rattus rattus*) and possums (*Trichosurus vulpecula*) (Innes *et al*., 1999) but ineffective for dama wallabies (*Macropus eugenii*) (Williams, 1997). It is not known whether wild rabbits feed from bait stations, so the main aim of this study was to determine what proportion of a rabbit population would take cereal pellet bait from Philproof bait stations (Philproof Feeders, Taupiri, N.Z.).

Methods

The trial was conducted at the Tekapo Scientific Reserve (1058 ha), situated at the southern boundary of Lake Tekapo township, New Zealand, between State Highway 8 and the Tekapo River (NZMS 260 I37: 090845). The reserve is about 700 m above mean sea level with a flat to rolling topography of fluvioglacial outwash terraces,

morainic surfaces, and shallow sandy and stony soils. The vegetation is dominated by hawkweeds (*Hieracium* spp.), browntop (*Agrostis capillaris*) and *Poa maniototo*. The area receives an average rainfall of 600 mm per annum (range = 400-850 mm) (Anon, 1992; Espie, 1992).

Philproof rabbit bait stations were chosen because they were the only commercially available rabbit bait station in New Zealand at the time of the trial. Philproof rabbit bait stations are identical to the widely used Philproof possum bait stations except the sides and top of entrances have been widened by 20 mm. Two hundred and one plastic Philproof rabbit bait stations containing non-toxic bait were attached to metal stakes and set out at the northern end of the Tekapo Scientific Reserve on a 100 m x 100 m grid. The base of each station was 5-10 cm above ground level. As a control, non-toxic baits were placed on the ground at the southern end of the reserve. Wooden stakes were used to mark out 200 'ground application stations' on a 100 m x 100 m grid. The wooden stakes were placed 5 m west of the bait so that rabbits would not be deterred by their presence. The sites containing bait stations and ground application stations were both approximately rectangular. Each covered 171 ha (approximately a sixth of the reserve). The two sites were 1 km apart.

On 22 April 1998, about 195 pellets (300g) of non-toxic RS5 pellet baits (Animal Control Products, Waimate, N.Z.) were placed in each bait station and on the ground at each ground application station. A grubber was used to turn turf at each station, in both sites, to attract rabbits to the bait. The ground application aimed to mimic a typical pindone poisoning operation (there is currently no standard operating procedure for such work).

Bait-take was estimated at weekly intervals for four weeks. Bait was replenished as necessary, with fresh turf turned over on each visit. Bait-take was scored as: low, < 65 pellets taken; medium, 65-130 pellets taken; high, > 130 pellets taken. The scoring system was chosen arbitrarily as a gross measure of bait-take.

To estimate the proportion of rabbits that had eaten bait at both sites, baits were removed on day 27 of the trial and replaced with 300 g of non-toxic, rhodamine-dyed bait (0.04%) at each ground and bait station. On the third night following distribution of the dyed bait, rabbits were shot within both sites. Two experienced hunters spent four hours at one site each, starting at the same time on the same night. Rabbit carcasses were examined under UV light (using a 50 black ray ultraviolet lamp from Ultra Violet Products Inc., San Gabriel, California, U.S.A.). The presence of rhodamine dye was used as an indicator to determine the proportion of rabbits that ate bait at each site [as detailed in Evans and Griffiths (1973)].

The rabbits that were shot were sexed and scored for condition as follows: 0 = no fat around kidneys; 1 = kidneys up to one quarter covered by fat; 2 = kidneys from one quarter to half covered by fat; 3 = kidneys from half to three quarters covered by fat; 4 = kidneys totally covered by fat.

Vegetation at each station (bait and ground) was assigned to one of two categories. Stations in the 'vegetated' category had ≥ 20% vegetative cover within a radius of 3 m, and stations with < 20% cover were categorized as 'bare'.

Counts of rabbits on sections of a spotlight route that crossed the treatment areas were used to establish whether rabbit numbers were similar in the two areas. On 20 and 21 April 1998, two days prior to the study's commencement, rabbits were counted from a truck travelling at 20 km/h and the land 50 m on either side of the route was surveyed for rabbits using a 75 watt spotlight.

Yates' corrected chi-square tests were used to compare the proportion of rabbits shot that contained rhodamine dye at the bait station and ground station sites; to compare bait-take between bait stations in vegetated and non-vegetated areas; and to compare bait-take between bare ground sites at the bait station and ground application sites. Fisher's exact tests were used to compare the proportion of male and female rabbits dyed with rhodamine. A Mann-Whitney U test was used to compare rabbit condition scores between the two treatment sites.

Results

Spotlight counts over two consecutive nights, and the numbers of rabbits shot at both sites, suggest that rabbit numbers were similar at both sites. Nine rabbits were seen on night one and 12 on night two during spotlight counts along 4 km at the bait station site (average = 2.6 rabbits/km). Seven rabbits were seen on night one and six on night two during spotlight counts along 3.5 km at the ground application site (average = 1.9 rabbits/

Table 1. Numbers of bait stations (n = 201) and ground application stations (n = 200) with low, medium and high bait-take at Tekapo Scientific Reserve, between 22 April and 18 May 1998.

Week	Bait station site			Ground application site		
	Low	Medium	High	Low	Medium	High
1	200	1	0	32	22	146
2	182	13	6	0	0	200
3	169	16	16	0	0	200
4	144	31	26	0	0	200

km). Later, 40 rabbits were shot at the bait station site and 37 at the ground application site for the same hunting effort. (Note that 37 rabbits were shot at the ground application site but only 36 are referred to in the analysis because one dead rabbit was lost in the field.)

Take at the bait stations was low initially and increased slowly over time, whereas at the ground application site bait-take was high within a week (Table 1). From two weeks onwards, all bait was consumed at the ground application site.

Significantly fewer rabbits shot at the bait station site contained dye (16 of 40) than at the ground application site (35 of 36) (χ^2 = 15.54, df = 1, P = 0.0001). Furthermore, those rabbits that were dyed at the bait station site had considerably less rhodamine dye in their stomachs than did the dyed rabbits from the ground application site, although this difference was not quantified (B. Glentworth, Canterbury Regional Council, Twizel, N.Z., *pers comm.)*.

The proportions of male and female rabbits that ate rhodamine bait were similar at both sites (bait station site = 9/21 males and 7/19 females, Fisher's exact P = 0.76; ground application site = 17/18 males and 18/18 females, Fisher's exact P = 1.0). No significant difference in rabbit condition was detected between sites (Mann-Whitney U test, P = 1.00).

The ground application site was poorly vegetated and all 200 of the stations there were on bare ground, whereas only 72 of 201 bait stations were on bare ground. Within the bait station site, bait take was significantly higher at bait stations on bare ground than at bait stations on vegetated ground (χ^2 = 6.78, df = 1, P = 0.0092). Nevertheless, by the fourth bait check only 24 of the 72 bait stations on bare ground had medium or high takes, whereas all 200 ground application stations (all of which were on bare ground) had at least medium takes (χ^2 = 161.9, df = 1, P < 0.0001).

Discussion

This study confirms that some rabbits will take bait from Philproof bait stations. However, the proportion that did so was low and the amount of bait they ate was small. Consequently, these bait stations are unlikely to provide adequate control of rabbits. Pulsed ground application of baits is likely to provide far more effective control of rabbits, leading to better secondary control of predators, than use of Philproof bait stations.

The Department of Conservation (DOC) has been investigating the use of secondary poisoning (using brodifacoum) as a one-off predator eradication tool on offshore islands but does not recommend the technique for ongoing predator control on the New Zealand mainland (Craig Gillies, DOC, Hamilton. N.Z., *pers. comm.*). Brodifacoum has been severely restricted in its use on the mainland by DOC due to bio-accumulation in the food chain but this is not thought to be a significant issue with pindone (a first generation anticoagulant). Secondary poisoning becomes less effective once the primary prey source has been removed. The Department therefore favours alternative control tools that are not limited by primary prey abundance. Pindone could potentially be used as a predator control tool (alone or in association with other control techniques) if treatments were pulsed to ensure that sufficient primary prey (rabbits) were available.

Some rabbits are known to be neophobic (i.e. fearful of new objects) (Fraser, 1985; Sunnucks 1998) so will not take bait on the ground (Sunnucks, 1998). Rabbit populations that have been repeatedly exposed to control can contain a high proportion of such individuals (Bell, 1975). The rabbit population at Tekapo Scientific Reserve has been exposed to repeated and varied control activities, including 1080, pindone, fumigation and night shooting (N. Bolton, DOC, Twizel, N.Z., *pers comm*.) and therefore could contain a high proportion of wary rabbits. Despite this previous control, rabbits were not shy of bait on the ground, but neophobia may explain rabbits' reluctance to use bait stations.

The effectiveness of secondary poisoning as a predator control tool is dependent, in part, on the amount of toxin in prey (Brown, *et al.*, 1998; Heyward and Norbury, 1998). Rabbits shot at the bait station site contained less rhodamine dye than those shot at the ground application site, which suggests that they ate less bait. Eason and Jolly (1993) reported that seven daily doses of 1.0 mg/kg body mass killed 11 of 11 rabbits. Therefore, 5 to 6 pellets per day (containing 0.35 mg pindone/pellet) should kill a 1.8 kg rabbit when consumed over a seven day period. Rabbits may take considerably longer to die at bait station sites if they eat only small quantities of bait, and those that do die may be less likely to cause secondary poisoning among scavenging ferrets.

A possible explanation for the low takes at the bait stations might be that other food was more abundant there than at the bare-ground sites. However, there is little evidence for this, since the take from stations on bare ground was lower than the take of ground bait laid in equivalent habitat. Furthermore, similar numbers of rabbits were seen and shot at the two treatment sites, and rabbits from the two sites were in similar condition, suggesting no important difference in food availability between sites.

Other animals could have taken some bait, but the quantities taken are unlikely to have been significant. Possums (*Trichosurus vulpecula*), hedgehogs (*Erinaceus europaeus occidentalis*) and black-backed gulls (*Larus dominicanus*) are known to eat RS5 pellet baits. However, hedgehogs were hibernating at the time of the trial, no black-backed gulls were observed

eating bait despite numerous repeat visits and possum numbers were very low (B. Glentworth, Canterbury Regional Council, Twizel, N.Z., *pers comm*.). The lack of possum sign (i.e. fur and faeces) at all but a few stations, and frequency of rabbit sign at most feeding stations, strongly suggests that bait take was primarily by rabbits.

It seems likely that bait stations, rather than site factors, caused the observed differences in bait-take. The entrance to Philproof stations is 11 cm high and 9 cm wide and rabbits need to put their heads inside to feed. Such an enclosed space may be too confined (behaviourally) for most rabbits to feed at above ground. Tests elsewhere concluded that feral cats are reluctant to feed from Philproof feeders "probably due to the smaller and enclosed feeding hole" (Thomas *et al*., 1998) and dama wallabies are reluctant to feed from bait stations that "covered their eyes and ears" (Williams, 1997).

Alternative designs may be more suitable for use by rabbits. For example, rabbits are known to feed on bait within 20 cm diameter pipe (D. Robson, Otago Regional Council, Alexandra, N.Z., *pers comm*.) but the proportion of any given rabbit population that would use such stations is unknown. Bait stations that do not require rabbits to put their heads inside the station to feed may provide a more viable option. However, such stations would not be suitable where exclusion of stock and other non-target animals is required. An effective rabbit bait station would be a useful tool for controlling rabbits and, potentially, for controlling predators through secondary poisoning. Further research is required to identify an effective bait station design for rabbit control.

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