Use of bait stations for possum and feral cat control

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D.A Wright and M.D. Thomas

Part 1. Optimising the use of bait stations for possum control in native forest

Abstract

Possum control in native forest is essential to reduce damage to native flora and fauna, so the development of more efficient control methods is a high priority. We investigated methods to improve control efficiency using toxic bait fed from bait stations. Results showed that by using the recommended bait station spacing grid of 150 m, and baits containing 0.15% 1080, a mean possum kill of 83% could be achieved after 3 weeks of prefeeding with non-toxic baits. With no prefeeding a mean kill of 68% was achieved. Prefeeding gave a 70% increase in the amount of 1080 baits being taken from the bait stations on the first night of baiting, but with no prefeeding 1080 baits were taken gradually over a 50 day baiting period. Fewer 1080 baits were taken from bait stations that fed cheaper prefeeds (i.e., maize and barley) than those that prefed non-toxic RS5 cereal pellets. No difference in bait consumption or possum kill was recorded from baits that were kept fresh by weekly replacement compared to baits that were left to become damp in the bait stations. Prefeeding before using Talon® baits reduced Talon® consumption by 37%, but possum kills were 14% less than with continuous baiting with Talon®. When Talon® was used regularly in small reserves, possum numbers were maintained at low levels throughout the year. Regular Talon® baiting proved to be more effective at maintaining possums at low levels than annual leg-hold trapping. When Talon® followed 1080 baiting, there was no further reduction in possum numbers but rat numbers were reduced a further 23%.

1. Introduction

Manaki Whenua - Landcare Research, Lincoln, was contracted by the Department of Conservation (DoC) to evaluate and optimise the use of bait stations for DoC-specific pest control in native forest. The work commenced in July 1993 and finished in 1996.

2. Background

Possums (*Trichosurus vulpecula)* are a major conservation pest. They cause damage to forest ecosystems by defoliating trees (Cowan 1991) and by eating native invertebrates and the eggs and chicks of endangered birds (Brown *et al.* 1993). Possum populations need to be controlled to prevent or reduce this damage. There are a limited number of control options presently available, so the development of new technologies is a DoC priority.

Previous work indicated that bait stations were a potentially useful control technique in native forest (Thomas 1992). This resulted in DoC commissioning additional research to further develop the method. Bait stations were first used as a possum control method in exotic forests (Pracy 1964 unpubl. New Zealand Forest Service report) and have more recently been used to control possums on farms (Thomas and Hickling 1995). this report details trials designed to determine the optimal use of bait stations to control possums (and in one trial rats) by assessing:

1. the value of prefeeding non-toxic baits before using 1080 or Talon® baits;
2. patterns of bait consumption;
3. the need to feed undecayed baits; and
4. the relative efficacy of 1080 baits used alone compared to 1080 followed by Talon® baiting.

The report foes not investigate optimising bait station spacing which was undertaken in a separate study funded by DoC (see Thomas and Fitzgerald 1994).

3. Objectives

- To compare 1080 bait consumption and possum kills using bait stations with and without prefeeding.
- To investigate the use of maize and barley as cheaper prefeeding options to RS5 cereal pellets.
- To measure the effect of prefeeding on patterns of 1080 bait consumption through time.
- To measure the efficacy of fresh baits with baits allowed to decay in the bait stations.
- To compare Talon® bait consumption and possum kills using bait stations with and without prefeeding.
- To examine the feasibility of maintaining low possums numbers in small forest reserves with the regular use of Talon® baiting.
- To determine the efficacy of 1080 baits followed with Talon® baits in bait stations to control possums and rats.

4. Methods

4.1 STUDY AREAS AND ASSESSMENT OF POSSUM KILLS

Trials investigating the use of prefeeding (i.e., feeding non-toxic baits before using toxic baits), the consumption of 1080 baits through time, and 1080 baiting followed by Talon® baiting were conducted in podocarp forest at Pureora Forest Park during the summers of 1993/94, 1994/95, and 1995/96. Study sites were approximately 100 ha each. Trials investigating regular use of Talon® were conducted in small forest reserves in Hawke's Bay, and trials investigating prefeeding before using Talon® were conducted in two 20 ha pine plantations in central Canterbury.

Efficacy of the different treatments was determined by measuring possum kills. Possum kills were estimated from the percent reduction in capture rates using Victor No.1 leg-hold traps set before and after poisoning (Warburton 1996). Traps were located at 20 m intervals and were set for 1–3 nights. In addition to the percent reduction in trap catch, the efficacy of 1080 followed by Talon® was estimated using the percent reduction in possum bites on orange lured wax-blocks located at 20 m intervals during one night before and after poisoning (Thomas and Meenken 1995). Rat bites in the wax-blocks were also recorded providing an estimate of the rat kill. The amount of toxic bait taken from bait stations was also used as an indication of bait station use by possums and rats.

4.2 BAIT TYPES, BAIT STATIONS AND BAIT STATION SPACING

All non-toxic prefeed and 1080 baits used in the trials were 1.5 g 'RS5 pellets' manufactured by Animal Control Products Ltd, Waimate. The Talon® baits were 1.5 g 'Agtech pellets' (manufactured by ICI Cropcare Ltd). The 1080 baits are registered as containing 0.15% wt/wt 1080 and the Talon® baits are registered as containing 0.002% wt/wt brodifacoum. Bait stations used in the trials were either 'Kilmore' or 'Philproof' types which held 1.5–2 kg of baits and were supplied by Pest Management Services, Waikanae. When bait stations were used in forests they were located at approximately 150 m intervals (0.44/ha) in a grid pattern as recommended for greatest efficiency by Thomas and Fitzgerald (1994). In small forest reserves and small pine plantations, bait stations were located at 100 m intervals (1/ha) as recommended by Henderson *et al.* (1994).

4.3 EVALUATING PREFEEDING

4.3.1 Prefeeding for 1080 use

Three paired trials were undertaken in native forest at Pureora to compare possum kills and 1080 bait consumption with and without prefeeding. In the first paired trial, prefeeding was conducted by filling each bait station four times over a 3 week period, i.e., once per week for the first 2 weeks and then twice for the third week. In the remaining two trials the bait stations were filled once per week for 3 weeks. In non-prefed areas toxic baits were left in bait stations for approximately 2 months.

4.3.2 Maize and barley as prefeeds for 1080

The suitability of using whole grains of either maize or barley as cheaper prefeeding options to RS5 baits ($400–$600/tonne cf. $1600/tonne) was examined by prefeeding maize, barley or RS5 baits alternately from 97 bait stations over a period of 6 weeks. After prefeeding, the bait stations were filled with 600 g of 1080 bait and left for 1 week. The baits remaining were then weighed and the mean consumption of 1080 baits per bait stations was calculated. Significant differences between treatments were determined using ANOVA to indicate which prefeeding type was preferred.

4.3.3 Effect of prefeeding on patterns of 1080 bait consumption over time

Nightly consumption of 1080 bait was recorded at one study site for 3 nights to determine the pattern of bait consumption after possums had been prefed. At four other study sites where possums were not prefed patterns of bait consumption were recorded at intervals throughout a 50 day period. To determine if it would be advantageous to waterproof baits (i.e., to keep them fresh). Bait consumption from these sites was compared with consumption at the other two sites where the baits were left in the bait stations for 50 days. This allowed them to absorb atmospheric moisture which increases bait decay.

4.4 PREFEEDING FOR TALON® USE

A comparison of Talon® bait consumption and possum kill with and without prefeeding was undertaken at a paired study site in Canterbury. In the prefeed site, possums were prefed for 15 days, followed by 30 days of Talon® baiting. In the non-prefeed area, possums were fed Talon® baits continuously for 120 days. The prefeeding time period was determined from previous field trials, which showed that 15 days of prefeeding was adequate for most possums to discover and use the bait stations when spaced at 1/ha. The 30 day Talon® baiting period was considered adequate for most possums to consume a lethal amount of Talon® baits (R. Henderson unpubl. data). The 120 day Talon® baiting period at the non-prefeeding site was based on previous field trials that showed that this time period was necessary to achieve a > 90% possum kill (Henderson *et al.* 1994). The post-poison trap-catch estimates were undertaken 3 weeks after the final feeding of Talon® bait so that lethally poisoned possums had sufficient time to die.

4.5 TALON® POISONING IN SMALL FOREST RESERVES

The feasibility of regular Talon® baiting as a means to maintain possums at low levels in small forest reserves was evaluated from possum kills measured three times over 2 years (summer 1992/93 to summer 1994/95). The trials were conducted in four forest reserves ranging in size from 14 to 135 ha. In the summer of 1992/93, bait stations were filled twice with 1 kg of baits in the first week, and then once every month thereafter for 12 months (1993–94). During 1994–1995, bait consumption decreased and the amount fed per bait station was reduced to 300 g every 8 weeks. The ability of the Talon® poisoning to maintain the possum population at low levels was compared to annual trapping conducted before the Talon® baiting during the summers of 1990/91 and 1991/92.

4.6 EFFICACY OF 1080 BAITS FOLLOWED WITH TALON® BAITS

Bait-shyness, caused by possums eating sub-lethal amounts of 1080 baits, has been identified in a wild possum population (Ogilvie *et al.* 1996). Methods to prevent or overcome shyness are an important aspect of any baiting strategy and a method to successfully control bait shy rodent populations (Prakash 1988) is to follow baiting with an acute toxin (e.g., 1080) with a chronic toxin, (e.g., Talon®). This technique was evaluated for possum and rat control in Pureora Forest in the summer of 1995/96. Prefeeding was undertaken three times (a total of 6 kg/bait station) over 3 weeks, and followed by baiting with 700 g of 1080 baits/bait station for 2 weeks. Baiting with 1 kg of Talon® baits per bait station was then undertaken for a 6 week period.

5. Results and discussion

5.1 EVALUATING PREFEEDING

5.1.1 Prefeeding for 1080 bait use

In all three trials significantly more 1080 baits were eaten after possums had been prefed ($P<0.05$, Table 1) and in the first two trials possum kills were significantly higher ($P< 0.05$, Table 2).

For trial 3 (Table 2) there was a slightly lower kill in the prefed area than the non-prefed area despite larger amounts of 1080 baits being eaten from the prefed bait stations. This anomaly may have been due to rapid reinvasion of possums because of the smaller size of this study site.

Preliminary costings indicate that it may be more cost-effective to use a bait station grid spacing of 100 m and not prefeed rather than use a grid spacing of 150 m and prefeed (Thomas *et al.* 1996). Successful possum control was

TABLE 1. MEAN 1080 BAIT CONSUMPTION (g) PER BAIT STATION WITH AND WITHOUT PREFEEDING, (NUMBERS OF BAIT STATIONS AND PERCENT PRE-POISON CATCH RATES ARE IN PARENTHESES)

	PREFED	NOT PREFED
Trial 1	265 (99, 29%)	90 (82, 39%)
Trial 2	95 (27, 3%)	26 (20, 8%)
Trial 3	247 (47, 18%)	42 (46, 28%)
Mean	202 (173, 17%)	53 (148, 25%)

TABLE 2. PERCENT REDUCTIONS IN LEG-HOLD TRAP-CATCH AFTER POSSUM POISONING USING 1080 BAITS WITH AND WITHOUT PREFEEDING, (NUMBERS OF TRAP NIGHTS ARE IN PARENTHESIS).

	PERCENT REDUCTION WITH PREFEEDING	PERCENT REDUCTION WITHOUT PREFEEDING
Trial 1	98 (300)	75 (300)
Trial 2	100 (100)	75 (100)
Trial 3	50 (98)	54 (101)
Mean	83 (498)	68 (501)

demonstrated in two previous trials in small pine plantations using a bait station spacing of 100 m with no prefeeding. These trials achieved a mean possum kill of 95% (Henderson and Morriss 1996).

5.1.2 Maize and barley as prefeed options

Significantly less 1080 bait was eaten after prefeeding with maize or barley compared to prefeeding with non-toxic baits ($P<0.05$ and $P< 0.001$) for maize and barley, respectively (Table 3). However, the three prefeed types were presented in alternate bait stations at the same time and it is possible that possums were attracted to bait stations containing the more palatable RS5 pellets. Further trials where maize and barley are used independently and possum kills are monitored are required to determine if grains would be a viable prefeed option. If grains were suitable cost savings of approximately $2/ha could be realised.

TABLE 3. MEAN CONSUMPTION OF 1080 BAITS FROM BAIT STATIONS AFTER FEEDING POSSUMS WITH NON-TOXIC BAITS, MAIZE OR BARLEY.

PREFEED TYPE	MEAN 1080 BAIT CONSUMPTION/BAIT STATION (g) AFTER PREFEEDING	95% C.I.
Non-toxic baits	241	45
Maize	182	39
Barley	157	26

5.1.3 Effect of prefeeding on patterns of 1080 bait consumption over time

Nearly all of the toxic 1080 baits were consumed on the first night after the 21 days of prefeeding (Table 4). These results indicate that prefeeding attracts the possums to the bait stations so that they are there when the toxic bait is used. Advantages are that toxic baits only need to be left in the field for shorter periods, improving safety, and they will be fresh increasing the likelihood that a lethal amount will be eaten (Henderson and Morriss 1996). Without prefeeding possums took longer to locate the bait stations as 1080 baits were eaten throughout the 50 day trial period (Fig.1). This was similar to a previous non-prefeeding study where bait stations were spaced at 100 m spacings and toxic baits were eaten throughout a 40 day baiting period (Henderson *et al.* 1994).

TABLE 4. MEAN NIGHTLY 1080 BAIT CONSUMPTION/BAIT STATION (N=34) FOLLOWING PREFEEDING AT ONE STUDY SITE (PRE-POISON CATCH RATE WAS 24%).

	NIGHT 1	NIGHT 2	NIGHT 3
Bait consumption	141	8	0

FIGURE 1. MEAN CONSUMPTION OF 1080 BAITS PER BAIT STATION THAT WERE LEFT TO WEATHER COMPARED WITH BAITS THAT WERE REPLACED WEEKLY.

5.1.4 Fresh vs old baits

No difference was observed in the consumption of replaced (fresh) and non-replaced (old) 1080 baits in the trial (Fig 1) and no significant difference in possum kills were recorded (P= 0.68, Table 5). These results differ from previous pen and field trials, which showed that damp baits became 50% less palatable and killed fewer possums (Henderson and Morriss 1996). However these baits contained the toxicant cholecalciferol which may decay differently to 1080.

5.1.5 Prefeeding before using Talon® baits

When prefeeding preceded Talon® baiting, Talon® bait consumption was reduced by 37% compared to Talon® baiting without prefeeding. However, possum kill was lower in the prefed area (Table 6) but this may have been due to the shorter baiting period this prefed area. These results suggest that prefeeding could be a viable strategy for Talon® baiting and reducing the amount of Talon® used in baiting operations has advantages. The total costs are reduced because Talon® baits are more than twice the cost of non-toxic baits. Also, environmental safety is improved because Talon® is a persistent poison and can remain in possum liver tissue for at least 8 months (Eason *et al.* 1996). High levels of Talon® in possum carcasses, caused by excessive bait consumption, may also increase the risks of secondary and tertiary poisoning of non-target species (Eason and Spurr 1995).

TABLE 5. PERCENT REDUCTION IN LEG-HOLD TRAP CATCH RATES IN AREAS WHERE 1080 BAITS WERE REPLACED EVERY WEEK AND IN AREAS WHERE 1080 BAITS WERE NOT REPLACED (NUMBER OF TRAP NIGHTS ARE IN PARENTHESIS).

	PREFED	NOT PREFED
Trial 1	82 (96)	75 (106)
Trial 2	61 (97)	54 (101)
Mean	71 (193)	64 (207)

TABLE 6. MEAN BAIT CONSUMPTION/BAIT STATION (g) FOR POSSUMS PREFED NON-TOXIC BAITS FOR 15 DAYS FOLLOWED WITH TALON® FOR 30 DAYS, AND TALON® FED CONTINUOUSLY FOR 120 DAYS.

	PREFED NON-TOXIC BAITS (15 DAYS) FOLLOWED WITH TALON® BAITS (30 DAYS)	TALON® BAITS WITHOUT PREFEEDING (120 DAYS)
Prefeed consumption	2205	N.A.
Talon® consumption	1410	3040
Talon® consumption corrected by trap-catch	1913	3040
Pre-poison trat-catch	14%	19%
Reduction in trap-catch	80%	94%

5.2 TALON® POISONING IN SMALL FOREST RESERVES

Initial possum control using leg-hold trapping in summer 1990/91 reduced catch frequencies from a mean of 30% to 3% but in the following summer (1991/92) catch frequencies returned to similar catch rates (24%). This return was attributed to immigration rather than breeding as possums caught in summer 1991/92 were mainly adult. Repeated leg-hold trapping again reduced possum numbers to a catch frequency of 3% (Table 7). These data indicated

that annual leg-hold trapping was unable to consistently maintain possums at low levels in these small reserves.

The regular use of Talon® following the 1992/93 summer successfully maintained possum numbers at low levels shown by mean catch rates of 2% for winter 1993, 0% for summer 1994, and 1% for summer 1995 (Table 8). In Maraetotara, where no Talon® baits were applied, catch frequencies rose from 2% to 16% (Table 7 and 8) which is consistent with the increases recorded in the previous years when annual trapping was undertaken (see Table 5).

TABLE 7. PERCENT CATCH RATES BEFORE AND AFTER LEG-HOLD TRAPPING IN SUMMER 1990/91 AND SUMMER 1991/92 IN FIVE FOREST RESERVES IN HAWKES BAY.

	1990/91		1991/2	
RESERVE	BEFORE	AFTER	BEFORE	AFTER
William Hartree	42	7	27	5
Mohi Bush	22	3	23	3
Balls Clearing	24	1	26	3
Hutchinsons	47	1	22	3
Maraetotara	15	1	23	2

TABLE 8. PERCENT CATCH RATES DURING POSSUM CONTROL EMPLOYING REGULAR USE OF TALON® BAITS IN HAWKES BAY RESERVES.

RESERVE	WINTER 1993	SUMMER 1993/94	SUMMER 1994/95
William Hartree	1	0	1
Mohi Bush	2	0	1
Balls Clearing	3	0	1
Hutchinsons	3	Not trapped	2
Maraetotara (not treated)	16	-	-

5.3 EFFICACY OF 1080 BAITS FOLLOWED WITH TALON® BAITS

Possum numbers were reduced substantially using the initial 1080 baiting but no further reduction was observed with the follow-up Talon® baiting (Table 9). However, moderate amounts of Talon® bait were consumed, and it is likely that some possums were killed. Successful possum control using this baiting strategy has been demonstrated in a previous bait station field trial where a 59% possum kill achieved from 1080 baiting was increased a further 34% using follow-up Talon® baiting (R. Henderson, unpubl.data.).

Rat control was only partially achieved with the 1080 baiting alone but was improved considerably with follow-up Talon® baiting (Table 9). These results suggest that multi-species control could be a feasible option using this baiting strategy.

TABLE 9. PERCENT REDUCTIONS OF POSSUM CAPTURES IN LEG-HOLD TRAPS AND POSSUM AND RAT BITES IN WAX-BLOCKS AFTER PREFEEDING AND POISONING WITH 1080 BAITS (TWO WEEKS) FOLLOWED BY POISONING WITH TALON® BAITS (6 WEEKS).

	1080 BAITING		FOLLOW-UP TALON® BAITING	
	POSSUMS	RATS	POSSUMS	RATS
Percent pre-poison catch rate	10	N.A.	2	N.A.
Percent reduction (trap-catch method)	81	N.A.	71	N.A.
Percent reduction (wax-block method)	82	56	84	79

6. Conclusions

- Prefeeding significantly increased the amount of 1080 baits taken from bait stations and possum kills were significantly higher in two of the three studies.
- Bait stations spaced at 100 m intervals used without prefeeding could be a more cost-effective option than bait stations spaced at 150 m intervals used with prefeeding.
- Prefeeding with RS5 baits resulted in more 1080 baits being eaten compared to bait stations that prefed cheaper grains such as maize and barley. However trials need to be conducted using the different prefeed types in separate areas.
- Most 1080 baits were eaten on the first night of baiting after prefeeding compared to continuous consumption of 1080 baits over a 50 day period when no prefeeding was conducted.
- No difference was recorded in bait consumption and possum kills when baits were replaced every week compared to baits left in the bait stations to decay.
- Prefeeding before using Talon® bait appears to be a feasible method to reduce the amount of Talon® bait used in possum control operations.
- Regular Talon® poisoning was more effective than annual leg-hold trapping for maintaining possum populations at low levels in small forest reserves.
- Follow-up Talon® baiting after prefeeding 1080 baits did not increase possum kill but rat numbers showed a further reduction.

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Part 2. Evaluation of possum bait stations for feral cat control

Abstract

Feral cat control using toxic baits delivered in bait stations has the potential to be more cost effective than traditional trapping, shooting and ground poisoning. However, no suitable bait stations for feral cats are commercially available at present. Because cats are anatomically similar to possums, we tested the feasibility of using the seven commercially available possum bait stations for feral cat control. These bait stations were first tested to see if they would hold small food pellets (Friskies Cat Meow®, seafood and chicken flavour) which are similar in size to the toxic pellets Animal Control Products intend manufacturing for feral cat control. Those bait stations that would hold the pellets were then tested using captive feral cats. The bait stations were left in pens containing pairs of cats of the same sex for 2–4 nights and the amount of food pellets eaten from each bait station was measured daily. Comparisons were then made of the pellet consumption recorded from each bait station type and also with a previously recommended bait station fabricated from a 4 litre bucket. Comparisons were also made with consumption from a plain 2 litre ice-cream container placed on the ground to determine whether cats disliked feeding from elevated bait stations. Results indicated that three of the possum bait stations are suitable for feeding captive feral cats, i.e., the Kilmore, Philproof I and Sentry brands. Consumption from these was similar to the previously recommended 4 litre bucket design and the 2 litre ice-cream container. The suitability of these bait stations for feeding feral cats in the wild now needs to be tested.

1. Introduction

Manaaki Whenua - Landcare Research, Lincoln, has been involved in optimising pest control using bait stations for the Department of Conservation (DoC). As part of this research, the effectiveness of commercially available possum bait stations in delivering poisoned baits for feral cat control was examined. Trials were conducted between December 1995 and February 1996.

2. Background

House cats (*Felis catus*) were introduced into New Zealand in the early 1800s, and within a short time were reported to be widespread (King 1984). Feral cats have been considered responsible for the extinction of at least six endemic bird species and over 70 localised avian subspecies (Eason *et al*. 1992). In addition, the decline of populations of indigenous lizards and invertebrates has been attributed to predation by feral cats (Veitch 1991).

Cat eradication programmes have been successful on several islands (Fitzgerald 1995), but control is often difficult as cats are usually solitary and sparsely distributed. The methods commonly used are trapping, shooting, and ground poisoning, but these are labour intensive, time-consuming, and expensive. For example, a cat eradication programme on Hauturu (Little Barrier Island, 3083 ha) required 128 people over a 4 year period to kill approximately 100 cats (Fitzgerald 1995).

The use of bait stations to deliver toxic pelleted baits may offer a more cost-effective method of cat control (Morgan *et al.* 1994). However, no suitable bait stations are commercially available for feral cat control. Previous research has indicated that a bait station made from a 4 litre plastic bucket (Morgan *et al.* 1994) is suitable for delivering poison baits to feral cats (Fig. 1, back of report). However, these stations are large and flimsy, and need to be fabricated by field staff. Cats and possums have similar anatomical characteristics and it is feasible that possum bait stations will also be suitable for feral cat control.

3. Objective

To determine the suitability of commercially available possum bait stations for feeding pelleted baits to feral cats.

4. Methods

4.1 SELECTION OF BAIT STATIONS

Seven bait stations are presently commercially available for possum control and all were evaluated in this trial (Fig. 1, back of report). The bait stations tested were the Pelifeed, CHH, Kilmore, Sentry, Philproof I (rotational moulded) Philproof II (injection moulded) and KBL brands. Both Philproof designs were tested because they had different feeding hole dimensions. In addition all stations were compared to the 4 litre bucket design proposed in the previous study. All bait stations were attached to wooden posts and raised 140 mm above ground level. A comparison was also made with pellet consumption from

a 2 litre plastic ice-cream container placed on the ground to determine whether cats disliked using elevated bait stations. Testing was conducted between December 1995 and February 1996.

4.2 ABILITY OF THE BAIT STATIONS TO HOLD PELLETS

Cats prefer small food pellets so those used in the trial were approximately 10–12 mm x 4–5 mm. This is the size that Animal Control Products Ltd propose to manufacture pellets for feral cat control (W. Simmons pers comm.). However, because commercial baits are not yet available, Friskies Cat Meow® (Seafood & Chicken flavoured) food pellets, which have similar dimensions, were used as a substitute.

Most of the possum bait stations were designed to hold large pellets so each bait station was filled with the cat food pellets in the laboratory to determine if they could hold them without excess spillage. Bait station designs that demonstrated excess spillage were removed from further trials.

4.3 USE OF THE BAIT STATIONS

Six feral cats were collected by cage trapping and were housed in sex-matched pairs (two pairs of males and one pair of females) to minimise the potential effects of dominant feeding behaviour. The pens were outdoors and were approximately 6 m^2 and located at the Landcare Research Animal Facility at Rangiora. The cats were given a settling in period of at least 3 weeks prior to the trials commencing and were fed fresh meat during this period.

Two nights before the start of the feeding trials, each pair of cats was pre-fed a handful of pellets on trays to introduce them to the new pelleted food. Following this, each pair was offered the pellets in one of the bait station types. Each bait station remained in the pen for 2–4 nights and then replaced with a different bait station until all suitable bait station types had been offered to all pairs of cats.

The bait stations were located randomly in the pens so that any behavioural conditioning that could occur, if they were offered in the same sequence, was avoided.

Each bait station was filled with 600 g of pellets each day, except for the Sentry which was filled to its maximum capacity of 160 g. Pellets were weighed daily to determine the amount eaten by the cats from each bait station type. Pellets spilt on the ground were also weighed to determine how well the bait stations prevented spillage.

4.4 CAT BEHAVIOUR AT THE BAIT STATIONS

A 12 hour time-lapse video was set up within one of the pens containing two males. The video was used to observe possible competition between cats for the use of the bait stations and to record any difficulties the cats had in using them. A ‘highlights’ video was produced from this film.

5. Results

5.1 ABILITY OF THE BAIT STATIONS TO HOLD PELLETS

The Pelifeed, KBL and CHH bait stations failed to retain the smaller pellets so they were not evaluated further. The Philproof I, Philproof II, Kilmore and Sentry were able to hold the smaller pellets without excess spillage and these were used in the feeding trials.

In the feeding trials the Philproof I had a mean pellet spillage of 25 g per 24 hrs which was primarily caused by spillage from gaps between the body and the base of the bait station. However, this did not occur using the Philproof II (mean spillage = 13 g), but an increased angle of the base within the bait station allowed pellets to spill more easily from the feeding hole. This occurred when fixing the bait station to the mounting post and when the cats were feeding.

The Kilmore and Sentry bait stations recorded no spillage but, as with all the bait stations, cats were observed pulling pellets out, dropping them, and then eating them from the ground.

5.2 USE OF THE BAIT STATIONS BY CAPTIVE FERAL CATS

Pellet consumption from the bait stations is summarised in Figure 2. The pellet consumption from the Sentry bait station is an underestimate because the bait station was completely emptied during four of 12 periods tested.

FIGURE 2. CONSUMPTION OF FOOD PELLETS FROM 4 COMMERCIALLY AVAILABLE BAIT STATIONS, A MODIFIED 4 LITRE BUCKET AND A 2 LITRE ICE CREAM CONTAINER. ERROR BARS ARE ± SEM.

The Kilmore and Philproof I (and perhaps the Sentry) stations proved to be a suitable alternative to the previously recommended 4 litre bucket. Pellet consumption from the ice cream container was no greater than from the bait stations with the highest pellet consumption indicating that suitable bait stations elevated from the ground do not deter cats from feeding from them.

5.3 CAT BEHAVIOUR

The cats fed freely from the small feeding areas of the commercially available bait stations with the exception of the Philproof II. When feeding from the Kilmore station the cats showed no fear in leaving their heads inside the feeding hole for long periods. This indicates that a large feeding hole, such as on the 4 litre bucket, is not essential for cats to eat large amounts of pellets.

No competition for use of the bait stations was observed between the two male cats. The non-feeding cat often sat close to the bait station waiting for the other cat to finish feeding. The non-feeding cat used the bait station only when the other cat had moved away. This behaviour was observed for both cats.

6. Conclusions

The Pelifeed, KBL and CHH bait stations spilt the small food pellets easily and would not be suitable for feral cat control using small sized toxic baits. Of the four remaining bait stations, the Kilmore, Philproof I, and Sentry were readily used by captive feral cats. The Philproof II was the least preferred, probably due to a smaller and more enclosed feeding hole. The Kilmore and Philproof I (and perhaps the Sentry) are as effective as the previously recommended modified 4 litre bucket, and an open container placed on the ground. These bait stations should be trialed in the field for feral cat control.

The amount of food pellets eaten by the cats from the bait stations was similar to quantities of non-toxic pellets eaten by possums from bait stations in the field (Hickling *et al.* 1990). A high percentage of possum populations can be killed using toxic bait fed from bait stations (Thomas 1994, Henderson *et al.* 1994) so it is feasible that similar proportions of feral cat populations would also be killed, provided a suitable toxic bait becomes available.

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