Development and evaluation of baits for feral cat control

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ABSTRACT

Feral cats (*Felis catus*) are important predators of native birds in New Zealand. Programmes to protect nesting colonies from cats often rely on toxic 1080 bait, but few data exist to determine which baits are most effective at attracting and killing cats. This study compared the palatability and efficacy of two 1080 baits to feral cats under pen and field conditions. In the first pen trial, two groups of 12 cats were offered either 100 g of a dry, polymer-coated bait (Bait-Tek), or 100 g of a dry protein meal bait (Landcare Research), both containing 0.1% 1080. In the second pen trial, 20 cats were offered 100 g each of both types of bait. Average consumption of the Landcare Research bait (30.4 ± 6.4 g) was greater than consumption of the Bait-Tek bait (19.6 ± 5.7 g) in the first trial ($p < 0.05$). Efficacy was 92% for both baits. In the second trial, mean consumption of the Landcare Research bait (34.8 ± 8.1 g) was also greater than the Bait-Tek bait (1.3 ± 1.1 g). A field trial was initiated on two study sites in the Kaiangaroa forest. Ten cats were live-trapped on one study site (Bait-Tek), and 11 cats on the other (Landcare Research). Cats were fitted with mortality-sensing radio transmitters, and monitored daily for 1 week. Ten bait stations, each containing 100 g of bait, were located in areas of regular use within each cat's home range. Daily monitoring of cat movement continued for 2 weeks. All 21 cats were located within the study sites at the onset of poisoning, and most cats were confirmed around bait stations throughout the 2-week exposure period. However, only two cats were found dead in the Landcare Research site, and one cat in the Bait-Tek site. Natural food was abundant, and may have deterred cats from going to bait stations.

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1. Introduction

The relative palatability and efficacy of two different toxic 1080 baits to feral cats was assessed by Landcare Research for the Department of Conservation (DOC) in a series of pen trials conducted in 1997/98. Relative efficacy was further evaluated in field trials using radio-collared cats. These studies were conducted to assist DOC predator control staff in the selection of bait types for control of feral cats around nesting colonies of native birds.

1.2 BACKGROUND

Department of Conservation statistics indicate that predation by introduced mammals is an important factor in the ongoing decline of at least 18 of 30 vertebrate and 18 of 26 invertebrate category A (highest priority) threatened species in New Zealand (DOC Science and Research Predator Research Strategy 1997–2002, draft document, E. Murphy pers. comm.). Feral cats (*Felis catus*) are considered to be a major predator of concern for many of these native birds (Karl and Best 1982, Fitzgerald and Veitch 1985, Veitch 1985, Pierce 1986), bats (Daniel and Williams 1984), reptiles (Fitzgerald 1990), and invertebrates (Fitzgerald 1990).

Active programmes are currently in place to protect nesting colonies of several threatened birds, including black stilts (*Himantopus novaezealandiae*) and New Zealand dotterels (*Charadrius obscurus*), by controlling feral cats and other predators around nest sites. These programmes rely in large part on the use of toxic bait containing sodium monofluoroacetate (1080). Numerous different bait types have been used by DOC staff in recent years, but few data exist to determine which baits are most effective at attracting and killing feral cats.

DOC has previously funded cat bait development projects by Landcare Research, including studies to evaluate various scent attractants, flavour enhancers, and masking agents (Eason et al. 1992; Clapperton et al. 1994), investigations of predator-baiting strategies (Morgan 1993; Morgan et al. 1994), and the initial development of a fishmeal-based pelleted bait containing 1080 (Eason and Frampton 1991; Eason et al. 1992). Although quite palatable, the fishmeal bait suffered from a relatively short field-life, due to its susceptibility to bacterial and / or fungal degradation. In 1995/96, Landcare Research, with funding from Animal Control Products, developed a new, dry, protein meal cat bait that was as palatable to captive feral cats as commercial cat food (Go Cat®), and significantly more palatable than the fishmeal product. In 1996/97, DOC provided funding to enhance the shelf- and field-life of this new protein meal matrix by incorporation of binding agents, antioxidants, bactericides, mould inhibitors, and water repellents. Results of pen trials demonstrated that the final toxic bait formulation (containing 1080 at 0.1%) remained highly palatable to captive feral cats. Tests of shelf- and field-life demonstrated that the combination of preservatives and water-repellent coating significantly reduced oxidation and degradation, and increased stability under storage and simulated field conditions (Wickstrom and Henderson 1997).

Following initial evaluation of this new 1080 bait, DOC extended funding in 1997/98 to compare the palatability and efficacy of this product with a standard cat bait in use for several years in New Zealand. This latter bait, manufactured by Bait-Tek (formerly Dupont) (Texas, USA) is a polymer-coated, fish-flavoured pellet containing 1080 at 0.1%. The principal advantage usually cited for this bait is durability under adverse weather conditions, such as may be encountered in Fiordland, Stewart Island, or other offshore islands. However, although long field-life is desirable from logistic and economic standpoints, feral cats are notoriously neophobic feeders, and are difficult to attract to bait unless natural food is very scarce. Therefore, in order to effectively control cats in the field, bait palatability must also be high.

This study compared the palatability and efficacy of these two 1080 baits to feral cats in a series of pen trials. Relative efficacy was further evaluated in field trials using radio-collared cats. Our offer to evaluate in these comparative studies 'Pussoff', the prototype semi-moist cat bait developed by Applied Biotechnologies (Victoria, Australia) was declined by the manufacturer.

Our specific objectives were to compare the relative:

- Palatability and efficacy of the Landcare Research protein meal 1080 bait with the polymer Bait-Tek 1080 coated bait to captive feral cats.
- Efficacy of these two 1080 baits against free-ranging feral cats under field conditions.

2. Methods

2.1 PEN TRIALS

Feral cats were captured using box traps baited with rabbit meat, and were acclimatised in individual 4 m × 5 m wire-netting pens for a minimum of 1 week at the Landcare Research animal facility. Captive cats were maintained on a diet of horse meat, with fresh water available *ad libitum*.

2.1.1 No-choice assessment

In the first pen trial, 24 feral cats were randomly divided into two groups of 12 each. Following acclimatisation, cats were offered either 100 g of the polymer-coated bait manufactured by Bait-Tek, or 100 g of the dry protein meal bait developed by Landcare Research, along with half of their normal maintenance ration of horse meat. Cats were 'half-fasted' in order to simulate a field situation in which partially satiated animals encounter toxic bait while hunting. Both baits were dyed green and loaded with 1080 at 0.1%. The amount of each bait type eaten in 24 h was measured, and cats were monitored to determine time to death and percent mortality in each group. Bait intake in each group was compared using Student's *t* test.

2.1.2 Choice assessment

In the second pen trial, 20 acclimatised cats were offered 100 g each of both types of toxic bait simultaneously, along with half of their normal maintenance ration of horse meat. The amount of each bait type eaten in 24 h was measured, and cats were monitored to determine time to death and percent mortality in each group. Bait intake in each group was compared using Student's *t* test.

2.2 FIELD TRIALS

The first field trial to compare the relative attractiveness and efficacy of the two 1080 baits was initiated in late winter (August), in order to evaluate the baits under conditions of restricted natural prey availability. After consultation with DOC staff, a study site was selected in Central Otago, along the western shore of Lake Pukaki and the eastern shore of Lake Ohau: it was characterised by mixed, semi-arid, upland grass and scrubland. Selection criteria included areas with historic high cat populations that were sufficiently isolated to preclude cat movement between treatment sites, but well matched with regard to dominant vegetative communities, the presence and abundance of key prey species, and (estimated) cat densities.

Cats were captured using Victor No.12 Soft-Catch traps at 100 m spacing, baited with fresh rabbit or fish. Trapped cats were anaesthetised by intramuscular (IM) injection of Domitor® (medetomidine) at 0.1 mg/kg, and fitted with mortality-sensing radio transmitters attached to leather collars (Titley Inc., Australia). The transmitters had an expected battery life of 9 months. Anaesthesia was reversed by IM injection of Antisedan® (atipamezol) at 0.5 mg/kg. Unfortunately, this first study had to be terminated due to inadequate numbers of feral cats on the study sites. Only 4 cats were captured after 2000 trap nights during late winter / spring.

A second field trial was initiated in February 1998 in Kaiangaroa Forest to compare bait efficacy under conditions of high prey availability. The study site was selected based on the same criteria as above, after consultation with a local pest control contractor. This study area was characterised by commercial *Pinus radiata* forests in various stages of maturity. Two, geographically separated study sites, 1400 ha each, with a similar range of habitat types were identified within the forest boundaries. Cats were captured using Victor No.12 Soft-Catch traps at 100 m spacing along tracks and baited with fresh rabbit meat, anaesthetised, and fitted with radio collars as described above. A total of 10 cats were live trapped on one of the study sites, and 11 cats on the other, after 2190 trap nights during summer.

These cats were monitored daily for 1 week after the completion of live trapping, to determine approximate range of movement. Tracking was done using a hand-held receiver and 3-element Yagi aerial (Sirtrack Inc, New Zealand). After the location of all 21 cats was established, 10 Kilmore bait stations (Wright and Thomas 1996) were placed near to where each cat was last located, in areas of regular use to maximize contact with the bait. On 10 March 1998, stations on one study site were filled with Bait-Tek bait containing 0.1% 1080, while stations on the other site were filled with the Landcare Research 1080 bait (100 g each). Daily monitoring of cat movement continued for 2 weeks after initiation of poison baiting. Bait stations were checked every second day and refilled as necessary. The proportion of radio-collared cats killed on each treatment site was compared, as an indication of relative bait attractiveness and efficacy under these specific field conditions.

3. Results

3.1 PEN TRIALS

3.1.1 No-choice assessment

Average consumption (mean ± SE) of the Landcare Research bait (30.4 ± 6.4 g) was greater than consumption of the Bait-Tek bait (19.6 ± 5.7 g) in the trial in which cats were only offered one bait type, plus half their maintenance diet ($t = 4.36$, d.f. = 22, $p < 0.05$). However, the lower palatability of the Bait-Tek bait did not affect efficacy, which was 92% for both bait types in this study.

3.1.2 Choice assessment

In the paired trial, in which cats were offered a choice of both toxic baits simultaneously, average consumption of the Landcare Research bait (34.8 ± 8.1 g) was also significantly greater than that of the Bait-Tek bait (1.3 ± 1.1 g) ($t = 10.62$, d.f. = 19, $p < 0.01$). Efficacy was 90%.

3.2 FIELD TRIALS

All 21 cats were located within the boundaries of the study sites at the onset of poison baiting, and all cats were confirmed within the immediate area of the bait stations (i.e. between bait stations) on at least 1 day during the 2-week exposure period. However, only two cats were found dead in the Landcare Research study site, and one cat in the Bait-Tek bait site. All three dead cats were located < 50 m from a bait station. These results do not permit any conclusions to be drawn regarding potential differences in efficacy between the two baits under field conditions.

TABLE 1 FATE OF RADIO-COLLARED CATS IN KAIANGAROA PLANTATION FOREST STUDY AREAS.

NO. OF CATS	BAIT TYPE	
	BAIT-TEK	LANDCARE RESEARCH
Radio-collared	10	11
Relocated alive within bait stations at some point during the 2-week exposure period	10	11
Killed within study area	1 (dead on day 2)	2 (both dead on day 3)
Relocated alive in study area at the end of the 2-week exposure period	7	5
Percentage kill	10%	18%

Natural food abundance may have been sufficiently great to deter cats from going to bait stations, in spite of the relatively high palatability of the Landcare Research bait in pen trials. Field trial results are summarised in Table 1. Field observations showed ground birds, especially quail, were abundant.

4. Conclusions and recommendations

Both pen trials demonstrated that the Landcare Research 1080 bait is significantly more palatable to feral cats than the Bait-Tek bait. However, in the trial in which cats were offered only one type of bait, the Bait-Tek product was equally efficacious (i.e. the same percentage of exposed cats was killed with both baits), since 2 g of bait at 0.1% is usually sufficient to deliver a lethal dose to the average cat (Eason et al. 1992).

Bait consumption is likely to be less in the field than in pen trials, so a more palatable bait may be preferred to decrease the probability of sublethal exposure, and consequent bait aversion. However, results of the Kaiangaroa Forest field trial demonstrated that primary poisoning, even with a highly palatable bait like the Landcare Research product, may be ineffective at controlling feral cats during periods of high prey abundance. This observation is consistent with the findings of researchers in Australia (pers. comm. N. Burroughs and D. Algar, Department of Conservation and Land Management, Western Australia). Hence the timing of cat control is likely to be critical. Equally, baiting strategies must be developed that guarantee all feral cats encounter baits. At present we have no information to verify whether the cats in the Kaiangaroa Forest study areas survived because they did not encounter baits or because they did encounter baits but did not eat them. In a recent control programme in Australia, feral cats were poisoned with carcasses of laboratory mice impregnated with 1080 (Short et al. 1997). At this stage it is impossible for us to determine the cause of the lack of success of the recent field trials and whether or not a fresh bait might be more effective than pellets.

It is becoming increasingly clear that successful feral cat control based on primary poisoning is going to require the development of highly effective olfactory lures, not only to bring the target animal to the bait, but to elicit investigative behaviour that leads to sampling. Preliminary studies in New Zealand (Clapperton et al. 1994) and Australia (Edwards et al. 1997) have identified several promising compounds, including plant-derived attractants (Clapperton et al. 1994), and food-based and scent-based lures (Edwards et al. 1997). The potential for these compounds to enhance the effectiveness of control programmes merits further study. However, before following this line of research, which will be protracted and costly, it will be most important to complete a series of field trials using pellet bait at different seasons and employing different baiting strategies, and comparing pellet baits with 'fresh bait' such as fish paste or mouse carcasses.

Recent studies have also demonstrated effective feral cat (Gillies and Pierce 1998) and stoat (Murphy et al. 1998) control by secondary poisoning following 1080 bait distribution for rodent and possum control. This may be the most rational and cost-effective approach to feral cat control where prey abundance is high.

The authors therefore make the following recommendations:

- Primary poisoning techniques need to be evaluated in replicated studies at different sites and seasons with different intensities of bait deployment. The most palatable pellet baits should be compared with fish paste baits or 1080 impregnated mouse carcasses.
- Efforts to identify and develop highly effective olfactory lures specific for feral cats should be prioritised if pellet baits or fish baits are less than 90% effective.
- The effectiveness of secondary 1080 poisoning as a tool for feral cat control when high prey abundance makes primary poisoning especially problematic should be confirmed in a variety of habitat types.
- Investigations of alternative, non-toxic forms of cat control should be considered (e.g. the use of dogs trained specifically to hunt cats).

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