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Acute Toxicity of Sodium Monofluoroacetate (1080) Baits to Feral Cats

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Abstract

Feral cat populations have had a devastating effect on many native wildlife species. As part of a program to evaluate improved predator control, feral cats were observed after they had ingested a polymer bait loaded with 0·4–1·6 mg sodium monofluoracetate (1080) per 1-g bait, equivalent to doses of 0·1–1·3 mg per kg body weight. Deaths occurred with 0·6 mg per bait and all higher doses. With the highest dose all animals died within 24 h. An approximate oral LD_{50} of 0·28 mg per kg (0·07–0·49) and LD_{90} of 0·35 mg per kg (0·14–0·56) were calculated (with 95% confidence limits). Main symptoms were disorientation and lethargy, followed by death. A dose of 2 mg 1080 per bait is recommended as a humane and lethal poison for feral cats.

Introduction

Feral cats (*Felis catus*) have altered ecosystems and depleted populations of indigenous lizards and birds on the mainland of both Australia and New Zealand and on numerous island habitats throughout the world (Jones 1977; Dilks 1979; Karl and Best 1982; Apps 1983; Rauzon 1985; Veitch 1985*a*; van Rensburg and Basher 1988; Fitzgerald 1990). Eradication of cats from some New Zealand islands has allowed their native bird populations to increase in number (Veitch 1985*b*) and has increased the potential of such islands for relocation of endangered and indigenous animals. The development of improved control methods for feral cats is an essential part of such conservation programs. Although shooting can be effective in open terrain (Berruti 1986), hunters have failed to eradicate cats on some New Zealand islands (e.g. Raoul I.; Veitch and Bell 1990). Poisoning and trapping are therefore important control methods (Veitch 1985*b*).

In New Zealand, compound 1080 (sodium monofluoroacetate) in fresh fish bait is the only poison that has been used as a control agent for cats (Veitch 1982). The bait is usually injected with 1080 and laid by hand. This is potentially hazardous to the operators, time-consuming, and the bait remains palatable for only a short time. Although there is no doubt that 1080 can effectively kill cats (Dubois 1948), information on the minimum amount required, or the humaneness of the toxin for this species, is limited.

Acute toxicity experiments in the 1940s gave LD_{50} values of 0·2, 0·3, and 0·35 mg per kg after intravenous injection, intraperitoneal injection and oral dosing, respectively (Ward 1946; Ward and Spencer 1947; Dubois 1948). However, as only a minimal amount of experimental details, such as animal numbers, weight, sex or age, were provided with these studies their general application is limited. Symptoms after poisoning, and the humaneness of 1080 for cat control, were not addressed.

In a more recent study an oral LD_{50} value of 0·40 mg per kg was determined for immature cats (mean weight 1 kg) after gastric intubation (McIlroy 1981*a*). Only general

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symptoms of intoxication for a number of different species were given, with no clear information on the humaneness of 1080 for feral cat control. The use of only immature animals may reduce the value of the toxicity results for cat control purposes. Furthermore, as 1080 acute toxicity data derived after oral intubation have been shown to differ markedly from results obtained with administration on baits in other species (O'Brien 1988), we felt it important to re-evaluate the toxicity of 1080 in a mixed-age cat population using palatable bait as the vehicle for 1080. This approach avoids the stress associated with oral intubation, which has been related to the variable response of wild animals to toxins (McIlroy 1981*b*). The objectives of our experiment were (1) to define the minimum amount of 1080 required to kill feral cats; (2) to assess the humaneness of 1080 use in cat control; and (3) to assess the acceptance and toxicity of 'cat baits' surface-'loaded' with 1080.

Materials and Methods

Feral cats trapped in Central Otago, Stewart I., and Northland as part of the New Zealand Department of Conservation's predator control program were transferred to large open pens at the Forest Research Institute animal facility at Rangiora. They were inoculated against feline panleucopenia virus and provided with raw meat daily (mince, hare, rabbit) and water *ad libitum*. A total of 48 cats were allocated to seven groups. All the cats were weighed and sexed. After acclimatisation for at least 2 months, individually housed cats were presented with a 1-g polymer bait (Du Pont Polymer Research, Texas, USA) containing fish meal, fish oil, and a polymer to prevent rapid degradation by rainfall. Animals were allocated to groups so that a large proportion received doses believed to be between the LD_{50} and LD_{90} levels (Table 1). The non-toxic baits had proved palatable to cats in earlier work (D. Morgan, unpublished data). Baits were surface-loaded at the Forest Research Institute with 1080 solution to give 0·4, 0·6, 0·8, 1·0, 1·2, 1·4 or 1·6 mg 1080 per bait, and were dried before use.

Table 1. The acute toxicity of 1080 in wild cats

Dose (mg per kg)	Number of cats eating baits	Number died	Mortality (%)
0·10–0·19	5	0	0·0
0·20–0·29	10	4	40·0
0·30–0·39	8	5	62·5
0·40–0·49	10	10	100·0
0·50–0·59	1	1	100·0
0·60–0·69	2	2	100·0
0·70–1·4	2	2	100·0

Each cat was acclimatised in an individual pen for 24–48 h before being presented with the baits. On the day before dosing, the cats were fed approximately half their usual ration of meat. A portion of meat (approximately 2–5 g) was offered at the same time as the toxic bait, the two items being placed 20–30 cm apart. During the course of the study the air temperature ranged from a mean of 4·2°C (±3·8 s.d.) at night to a mean of 15°C (±5·6 s.d.) during the day. In all the pens there was adequate shelter so that the cats avoided the sun during the day and were sheltered at night.

The cats were allowed up to 1 h to eat the bait; any uneaten or partly eaten bait was then removed. The time taken for the cat to eat the bait was noted and only those animals that ate the whole bait were included in the toxicity analysis. After ingestion of baits, all cats were regularly observed for symptoms, and the approximate time to death was recorded. During the trials all animals were treated humanely and were inspected by a veterinarian. This experiment had Animal Ethics Committee approval as part of a larger program to develop effective cat baits for use in predator control programs for the protection of endangered indigenous species.

Results

Bait Acceptance

Of the 48 cats presented with bait, 38 ate the bait within the 1-h observation period, and most of these ate the bait within 15 min. Of the remaining cats, one partially ate the bait

Table 2. Mortality data for feral cats given baits containing different amounts of 1080

n.a., not applicable (animal survived)

Dose group (mg per bait)	Body weight (kg)	Sex	Dose (mg per kg)	Approx. time to death (h)	Mortality per group
0·4	2·4	♂	0·17	n.a.	0/3
	3·2	♂	0·12	n.a.	
	2·0	♂	0·20	n.a.	
0·6	2·8	♂	0·21	n.a.	1/3
	2·5	♂	0·24	36	
	2·8	♂	0·21	n.a.	
0·8	1·7	♂	0·49	40	7/13
	2·1	♀	0·38	40	
	0·6	♂	1·33	40	
	0·7	♀	1·23	17	
	2·9	♂	0·28	n.a.	
	4·5	♂	0·18	n.a.	
	4·8	♂	0·17	n.a.	
	3·5	♀	0·23	28	
	2·7	♀	0·30	n.a.	
	3·5	♂	0·23	n.a.	
	2·5	♂	0·32	24	
	2·8	♂	0·28	70	
	4·4	♂	0·18	n.a.	
1·0	4·8	♂	0·21	n.a.	0/1
1·2	3·0	♀	0·40	22	6/8
	3·4	♂	0·36	22	
	2·8	♀	0·44	22	
	3·9	♂	0·31	n.a.	
	3·7	♂	0·32	21	
	4·1	♂	0·29	21	
	3·0	♀	0·40	18	
	4·0	♂	0·30	n.a.	
1·4	2·4	♀	0·58	16	2/2
	2·3	♀	0·61	16	
1·6	3·8	♂	0·42	11	8/8
	3·5	♂	0·46	11	
	3·5	♀	0·46	11	
	2·5	♀	0·64	22	
	3·6	♂	0·44	22	
	4·8	♂	0·33	22	
	3·8	♂	0·42	22	
	3·5	♂	0·46	7	

and the other nine did not eat the bait within the study period. Six of these nine did not eat the mince or the bait, indicating that they were probably either disturbed by the presence of an observer or were not hungry. There was no indication that 1080 on the surface of the bait deterred the cats. Those animals that did not eat the toxic baits were distributed across the different dose groups, and there was no correlation with age or sex.

Toxicity

An LD_{50} value of 0·28 mg 1080 per kg and an LD_{90} of 0·35 mg 1080 per kg, with 95% confidence limits of 0·07–0·49 and 0·14–0·56 respectively, were calculated using standard probit analysis (Finney 1971) (Table 1). At the lowest concentrations (0·4 and

0·6 mg per bait) only one of six cats died (Table 2). Six of the 13 cats dosed with 0·8 mg per bait survived, and those all weighed more than 2·5 kg. In the group receiving 1·2 mg 1080 per bait six out of eight cats died, and in the two highest dose groups (1·4 and 1·6 mg per bait) all 10 cats (including one animal weighing 4·8 kg) died after eating baits (Table 2).

Symptoms

Symptoms included disorientation, uncoordinated movements, and occasional vocalisation. The onset of symptoms was dose-dependent, occurring within 1–2 h, in those animals receiving the higher doses. Some animals vomited once or twice 2–6 h after eating bait. These symptoms were far less severe than was anticipated, as pronounced hyperactivity has been reported in carnivores (Egekeze and Oehme 1979). The cats became lethargic and immobile for several hours before death. As the onset of symptoms and time to death were dose-dependent, the highest dose of 1·6 mg 1080 per bait appears more humane. The different stages from disorientation to lethargy passed quickly at this dose and all cats died within 24 h, with four out of eight dying in less than 12 h (Table 2).

Discussion

Feral cats were slightly more susceptible to 1080 than was expected. The LD_{90} of 0·35 mg per kg obtained in this study was similar to most LD_{50} values reported for the cat, which range from 0·2 to 0·4 mg per kg (Ward 1946; Ward and Spencer 1947; Dubois 1948; McIlroy 1981*b*). It is important to minimise the amount of toxin used in bait to reduce the hazards to non-target species (McIlroy and King 1990), and our experiments define the minimum amount of 1080 required to kill a feral cat humanely. As 0·40 mg per kg will generally kill more than 90% of cats and most feral cats in New Zealand weigh less than 5 kg (the largest reported is about 5 kg; average weight of 3 kg—Veitch 1985*b*; Fitzgerald 1990), a bait containing 2 mg 1080 should be sufficient to kill all cats eating it.

The main symptoms of lethargy and disorientation experienced by cats seem unusual for carnivores (Egekeze and Oehme 1979), and these symptoms more closely resemble those seen in herbivores, such as brushtail possums (Morgan 1990). The dose of 2 mg per bait suggested above would prevent any unnecessary discomfort and ensure a swift kill as the highest dose tested (1·6 mg per bait) killed all cats within 24 h.

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