

FEEDING BY CAPTIVE RARE BIRDS ON BAITS USED IN POISONING OPERATIONS FOR CONTROL OF BRUSHTAIL POSSUMS

Summary: Non-toxic plain and cinnamon-flavoured carrots and cereal-based baits used in poisoning operations for control of the brushtail possum (*Trichosurus vulpecula*) were offered to seven species of captive rare birds at Mt Bruce National Wildlife Centre. Some individuals of all species ate plain baits. Antipodes Island parakeets (*Cyanoramphus unicolor*) preferred carrot to cereal-based baits, North Island kokako (*Callaeas cinerea wilsoni*) and North Island saddlebacks (*Philesturnus carunculatus rufusater*) preferred cereal-based baits to carrots, but the other species showed no bait preference. Most baits eaten were greater than 2 g. Some individuals of all species also ate cinnamon-flavoured baits. However, cinnamon deterred North Island kaka (*Nestor meridionalis septentrionalis*), Antipodes Island parakeets, and kokako from feeding on baits the first day offered, though not subsequently. Insufficient baits were eaten by North Island weka (*Gallirallus australis greyi*), red-crowned parakeets (*Cyanoramphus novaeseelandiae novaeseelandiae*), and Reischek's parakeets (*Cyanoramphus n. hochstetteri*) to determine whether they were also deterred by cinnamon. Only saddlebacks were definitely not deterred. All species except red-crowned and Reischek's parakeets probably ate sufficient to receive a lethal dose if the baits had been toxic. Baits may be made less acceptable to birds by increasing the strength or slowing the release of cinnamon, or by using a more repellent flavour. Because baits may always be acceptable to some birds, wildlife managers need to know the chances of wild rare birds feeding on baits before approving poisoning operations in areas where they occur.

Keywords: Birds; baits; sodium monofluoroacetate; brodifacoum; pindone; poisoning of non-target species; repellents; Mt Bruce National Wildlife Centre.

Introduction

Carrot baits used as carriers of the poison sodium monofluoroacetate (1080) and cereal-based baits used as carriers of 1080, brodifacoum, and pindone for control of the brushtail possum (*Trichosurus vulpecula* Kerr) are also eaten by some birds. The kea (*Nestor notabilis*)¹, whitehead (*Mohoua albigilva*), and silvereye (*Zosterops lateralis*) have been seen feeding on carrot baits, and carrot has been found in the gizzards of blackbirds (*Turdus merula*) and chaffinches (*Fringilla coelebs*) (Spurr, 1979). North Island brown kiwi (*Apteryx australis mantelli*) ate non-toxic cereal-based baits containing Rhodamine B that marked their faeces (Pierce and Montgomery, 1992). Western weka (*Gallirallus australis australis*), North Island weka (*Gallirallus australis greyi*), and North Island robins (*Petroica australis longipes*) have been seen eating cereal-based baits. In addition, 1080 has been identified from carcasses of the North Island weka, North Island robin, and North Island kaka (*Nestor*

meridionalis septentrionalis), although it is not known whether these birds fed directly on poisoned baits or indirectly on poisoned prey (Spurr, 1979). Many captive native birds are fed carrots and cereal-based pellets (normally fed to poultry) and probably would feed on similar materials used as baits for possum control.

Populations of common native birds such as the whitehead and silvereye can withstand the additional mortality imposed by pest poisoning operations (Forest Research Institute, 1981; Spurr, 1991). However, there is insufficient information about the effects of such operations on the rarer native birds. This was highlighted in 1985, when the Ministry of Agriculture and Fisheries requested the New Zealand Forest Service to undertake aerial 1080-poisoning for the control of possums in North Island kokako (*Callaeas cinerea wilsoni*) habitat bordering farmland to prevent the spread of bovine tuberculosis in the central North Island. Kokako habitat had been poisoned in the past; e.g., at Rotoehu Forest (several times since 1959) and Horohoro Forest (several times since 1968). Kokako populations in both forests had declined

¹ Bird nomenclature follows Turbott (1990)

markedly, although there was no evidence that this had resulted from 1080-poisoning (Crook, 1978). Rather, the decline was attributed to the reduction in area of forests (Imboden, 1978) and the continuing alteration of forests by browsing mammals (Leathwick, Hay and Fitzgerald, 1983). Nevertheless, the New Zealand Forest Service banned aerial 1080-poisoning in kokako habitat in 1978 until further research clarified the risk to non-target birds.

As a result of subsequent research, cinnamon is now applied to both carrot and cereal-based baits used in 1080-poisoning operations, partly because of its supposed repellency to weka and kaka (Udy and Pracy, 1981; Pracy, Robertson and Udy, 1982) and partly because of its ability to mask the smell and taste of 1080 poison from possums (Forest Research Institute, 1985; Morgan, 1990). This study was set up to determine whether cinnamon-flavoured baits are less attractive than plain baits to seven species of rare wild-bred native birds (including weka, kaka, and kokako) held in captivity at Mt Bruce National Wildlife Centre. Secondary objectives were to compare bird preferences for carrot and cereal-based baits and different bait sizes.

Methods

Baits tested

The plain baits tested were freshly cut pieces of carrot, and cereal-based baits manufactured by Mintech NZ Ltd (Mapua, Nelson), without 1080. The baits were dyed with 0.02% Acid Brilliant Green, as in 1080-poisoning operations at the time (since replaced by the similar coloured Bayer V200 dye), to be within the colour range of 221-267 of the New Zealand Standard Specifications (Standards Act, 1965). The cinnamon-flavoured baits were coated with 0.1 % cinnamon oil, as recommended by the Forest Research Institute (1985) and Morgan (1990).

The birds were given either plain baits or cinnamon-flavoured baits in anyone trial. Carrots and cereal baits were given together; 20 of each, with equal numbers in four size-classes (0.5<1 g, 1<2 g, 2<4 g, 4<6 g) spanning the normal range of bait sizes. The baits were placed in feeding trays together with the birds' usual food. Baits were put out at about 0830 h and removed at about 1630 h. The same baits (i.e., those remaining) were put out for up to 7 days to simulate the aging of baits in a poisoning operation. Cinnamon was also added to dates, an item of the normal diet of captive kaka,

and its repellency was tested for 3 days (c.f. 1 day by Udy and Pracy, 1981).

Bird species tested

Two North Island weka of unknown sex were held in separate aviaries and fed Biscats (a commercially-available meat-based pellet). One was given plain baits and the other cinnamon-flavoured baits, for 7 days.

A pair of North Island kaka were fed a mixture of seeds (mainly sunflower), fresh vegetables (such as carrots and silverbeet), fresh fruit (such as apples), and dried fruit (such as dates). Water sweetened with honey and jam was also provided. The kaka were given plain baits for 5 days, then cinnamon-flavoured baits for 3 days.

Two flocks of 12 red-crowned parakeets (*Cyanoramphus novaezelandiae novaezelandiae*) were held in separate aviaries and fed a diet similar to that given to the North Island kaka. One flock was given plain baits and the other cinnamon-flavoured baits for 7 days.

A flock of four Antipodes Island parakeets (*Cyanoramphus unicolor*) and six Reischek's parakeets (*Cyanoramphus novaezelandiae hochstetteri*) were held in a single aviary and fed the same diet as red-crowned parakeets. They were given plain baits for 2 days, then cinnamon-flavoured baits for 5 days.

Four North Island kokako were held in three aviaries; a lone female, a lone male, and a pair. The birds were fed a wide range of foods including grated carrots and poultry pellets. They also ate the leaves of native shrubs such as mahoe (*Melicytus ramiflorus* J.R. et G. Forst.) which grew in the aviaries. The lone female was given plain baits for 2 days, and observed for a total of 6 h. She was then given cinnamon-flavoured baits for 3 days, and observed for 13.75 hours. The lone male was given only plain baits for 5 days, and observed for 16.5 hours. The pair was given only cinnamon-flavoured baits for 5 days, and observed for 18 hours.

Five North Island saddlebacks (*Philesturnus carunculatus rufusater*) were held in aviaries with the kokako (a pair with the lone female, another pair with the lone male, and a single bird with the kokako pair). They had access to the same foods and baits and were observed for the same times.

The tests were made in July 1985, at the time of year when aerial poisoning operations for possum control often take place. The responses of kokako and saddleback to baits and kaka to dates were directly observed. For other species, only the number of baits that were eaten or partly eaten were recorded.

Results

North Island weka

One plain and one cinnamon-flavoured bait were eaten the first day offered. Partly eaten baits were found on subsequent days. On average, about 5% of both plain and cinnamon-flavoured baits were eaten or partly eaten each day (table 1). Similar numbers of carrot and cereal baits were eaten (table 2). About 83% of baits eaten were greater than 2 g (table 3).

North Island kaka

Plain baits were eaten the first day offered, but cinnamon-flavoured baits were not eaten until the second day. On average, 15% of both plain and cinnamon-flavoured baits were eaten or partly eaten each day (table 1). The numbers of carrot and cereal baits eaten or partly eaten were similar (table 2). About 59% of baits eaten were greater than 2 g (table 3).

Plain dates were eaten the first day offered. Cinnamon-flavoured dates were removed from the feeding trays the first day offered, but were dropped

uneaten on the ground below perches. However, on the third day after baits were offered, one kaka was seen removing the outside layer of a cinnamon-flavoured date, then eating the inside.

Red-crowned parakeet

No baits were eaten the first day, but partly eaten plain and cinnamon-flavoured baits were found on subsequent days. About 2.5% of both plain and cinnamon-flavoured baits (table 1) and similar numbers of carrot and cereal baits (table 2) were eaten or partly eaten each day. Baits of all sizes were eaten (table 3).

Reischek's parakeet and Antipodes Island parakeet

Reischek's parakeets were not seen eating baits, and it is possible that like the closely related red-crowned parakeets, they ate very few, if any. However, Antipodes Island parakeets were often seen feeding on baits. Plain baits were eaten the first day offered, but cinnamon-flavoured baits were not eaten until the second day. Significantly fewer

Table 1: Comparison of the number of plain and cinnamon-flavoured baits eaten or partly eaten by birds at Mt Bruce National Wildlife Centre. † Includes partly eaten baits. c Probabilities from X^2 contingency table of number of baits eaten X number of bait days (N.S. = not significant).

Bird species	Number days given		Number baits d ⁻¹ eaten †		Significance level ‡
	plain	cinnamon	plain	cinnamon	
North Island weka	7	7	1.9	2.3	>0.50 N.S.
North Island kaka	5	3	6.0	6.3	>0.75 N.S.
Red-crowned parakeet	7	7	0.9	1.1	>0.50 N.S.
Antipodes Island/Reischek's parakeet	2	5	21.5	2.0	<0.01
North Island kokako/saddleback	7	10	5.9	6.2	>0.75 N.S.

Table 2: Comparison of the number of carrot and cereal-based baits eaten or partly eaten by birds at Mt Bruce National Wildlife Centre. † Includes partly eaten baits. The averages are lower than in Table 1 because carrot and cereal-based baits were given at the same time, whereas plain and cinnamon-flavoured baits were given at different times. ‡ Probabilities from X^2 contingency table of number of baits eaten X number of bait days (N.S. = not significant).

Bird species	Number of days each bait given	Number baits d ⁻¹ eaten †		Significance level ‡
		carrot	cereal	
North Island weka	14	1.1	1.0	>0.75 N.S.
North Island kaka	8	2.8	3.4	>0.25 N.S.
Red-crowned parakeet	14	0.6	0.4	>0.50 N.S.
Antipodes Island/Reischek's parakeet	7	7.0	0.6	<0.01
North Island kokako/saddleback	17	2.2	4.0	<0.01

Table 3: Size distribution of baits eaten or partly eaten by birds at Mt Bruce National Wildlife Centre. † Includes partly eaten baits. ‡ Probabilities from: X^2 contingency table (- sample size too small to test, N.S. = not significant).

Bird species	Number of each size given	Number baits d ⁻¹ eaten †				Significance level ‡
		0.5 <1	1 <2	2 <4	4 <6g	
North Island weka	20	3	2	9	15	<0.01
North Island kaka	20	8	12	11	18	<0.05
Red-crowned parakeet	20	5	2	4	3	-
Antipodes Island/Reischek's parakeet	30	14	11	13	15	>0.75 N.S.
North Island kokako/saddleback	50	18	17	27	41	<0.01

cinnamon-flavoured baits were eaten than plain baits (Table 1). Also, significantly fewer cereal-based baits were eaten than carrot baits (Table 2). Baits of all sizes were eaten (Table 3).

North Island kokako

The lone female kokako ate plain baits the first day offered. She picked up some cinnamon-flavoured baits the first day but dropped them again. Cinnamon-flavoured baits were not eaten until the second day. The lone female ate significantly more cereal baits than carrot baits. None of the other kokako ate any baits. The pair of kokako ate the other foods offered, including grated carrots and cereal-based poultry pellets, but the lone male fed entirely on the leaves of shrubs growing in the aviary. The lone female kokako ate about 20% of the baits shown in Tables 1-3; the rest were eaten by saddlebacks (see below).

North Island saddleback

All saddlebacks ate both plain and cinnamon-flavoured baits the first day offered, showing interest immediately the baits were put in the aviaries. The two saddlebacks in the aviary with the lone female kokako each ate about the same number of baits as she did. In the other aviaries, only the saddlebacks ate baits. Similar numbers of plain and cinnamon-flavoured baits were eaten (Table 1). However, significantly more cereal baits than carrot baits were eaten (Table 2). About 66% of baits eaten were greater than 2 g (Table 3).

Discussion

From direct observations of birds and from the remains of baits, I obtained positive evidence of all

species except Reischek's parakeets feeding on both plain and cinnamon-flavoured carrot and cereal-based baits.

The birds ate baits of all sizes, but especially the larger baits. In contrast, Harrison (1978 a,b) showed that fewer birds were killed in trial 1080-poisoning operations when the smaller baits were screened out, implying that the birds preferred eating the smaller baits. The smaller baits were also more toxic than the larger baits. However, Harrison's results could also be interpreted as showing that fewer birds were killed when fewer baits were applied, because he used equal weights rather than equal numbers of small and large baits. Also, the birds killed in Harrison's trials were small passerines that may have preferred eating small baits. The larger birds tested at Mt Bruce preferred eating large baits, which they could hold in their claws.

Most birds ate only a few baits, and often ate only parts of baits. The weka preferred the meat-based pellets they were regularly offered, the kaka and red-crowned parakeets preferred seeds, and only one of the four kokako ate any baits. This indicates that the baits were not very attractive to these birds. The Antipodes Island parakeets ate all the plain carrot baits offered but not many of the cereal-based baits.

Although most birds ate only a few baits, they may have eaten enough for a lethal dose of 1080 if the baits had been toxic. For example, a weka can be killed by 8.1 mg 1080 per kg body weight (McIntosh *et al.*, 1966). This means that a weka weighing 1 kg would be killed by eating 5.4 g of bait (one or two average-sized baits) containing 0.15% 1080 (the recommended loading for possum control). The weka at Mt Bruce ate this amount of bait daily. No data are available for the other birds, but they are likely to be at least as sensitive to 1080 as weka, which have a higher tolerance to 1080 than most parrots and passerines (e.g., see McIlroy, 1984). These other birds, which are lighter than

weka, probably would need to eat less than 3 g of poisoned bait (i.e., less than one average-sized bait) to obtain a lethal dose of 1080. All species except red-crowned and Reischek's parakeets ate this amount daily.

The birds that fed on baits may have been more inquisitive than the others. The saddleback is a very inquisitive species. Within a species, some individuals are also more inquisitive than others, and therefore may be more prone to trying new foods. This may explain why only one of the four kokako ate baits.

The acceptance of cinnamon-flavoured baits by the pair of kaka and the lone female kokako may have been influenced by their being "pre-fed" with plain baits. However, weka, red-crowned parakeets, and saddlebacks all ate cinnamon-flavoured baits without previous exposure to plain baits. The parakeets had been exposed to whole carrots, and the saddlebacks to grated carrots and cereal-based poultry pellets, but these were not dyed green like the baits.

The delay in acceptance of cinnamon-flavoured baits indicates that fresh cinnamon had some repellent effect, but that the effect wore off quickly. I noticed that the smell of cinnamon on the baits waned after the first day; perhaps the taste did too. My results are consistent with those of Udy and Pracy (1981) and Pracy *et al.* (1982), assuming their tests were made with fresh baits.

The repellent effect of cinnamon may be prolonged by increasing its strength, or by putting cinnamon in the cereal-based bait mixture instead of applying it to the bait surface. Alternatively, it may be possible to find another flavour more repellent than cinnamon to birds, but still non-repellent to possums.

I believe that observations on the repellent effect of bait flavours to birds in captivity can validly be extrapolated to birds in the wild. However, the proportion of birds in captivity that fed on baits may be irrelevant in the wild. Baits may be less acceptable to wild birds not habituated to an artificial diet. On the other hand, baits may be more acceptable to wild birds faced with food shortages than to captive birds supplied with an excess of food. On the assumption that baits, cinnamon-flavoured or not, will always be acceptable to some birds, wildlife managers need to know what proportion of birds in a wild population would feed on baits, and also what would be their chances of doing so. Only if the chances are very low, and the need to poison (e.g., to protect the habitat of a bird such as the kokako) is very high, should poisoning operations be permitted in areas containing rare bird species.

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