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Consumption of non-toxic baits by grand (*Oligosoma grande*) and Otago (*O. otagense*) skinks

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ABSTRACT

Three bait types that are commonly used in pest mammal control programmes were tested for their attractiveness to wild grand (*Oligosoma grande*) and Otago (*O. otagense*) skinks, and their potential prey. This was assessed through observations and video recordings in the skinks' natural habitat in north Otago, New Zealand. Both skink species have been assigned a threat status of Nationally Critical. Non-toxic samples of RS5 cereal baits, carrot and FeraCol paste (peanut butter flavoured) were presented in two sizes to free-ranging animals during late March 2006; cereal baits were also presented wet or dry. All bait types were sampled (licked, nudged or bitten) by both species of skink, but large baits (both wet and dry) appeared to be less attractive and were not consumed. Both species of these threatened skinks were observed consuming small pieces of wet cereal baits and FeraCol paste. Of the potential prey species, one McCann's skink (*O. maccanni*) was observed consuming a small piece of carrot, and one worm, ground weta (*Hemidrus* sp.) and flies consumed wet and dry cereal baits.

Keywords: *Oligosoma grande*, *Oligosoma otagense*, grand skink, Otago skink, geckos, invertebrates, non-toxic baits, vertebrate pests, toxins

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1. Introduction

Grand (*Oligosoma grande*) and Otago (*O. ottagense*) skinks have been assigned a threat status of Nationally Critical (Hitchmough et al. 2007) and exist in the wild only in Otago, New Zealand. An essential part of the conservation management of lizard populations and their habitat in Otago is the control of mammalian pests such as hedgehogs (*Erinaceus europeus occidentalis*), cats (*Felis catus*) and stoats (*Mustela erminea*). Predation of grand and Otago skinks by these introduced pests and exposure to toxic baits during pest-control programmes have been identified as threats to the skinks' survival (Whitaker et al. 2002). However, it was not known whether grand and Otago skinks or their prey species, which include smaller skinks and geckos, and invertebrates, would consume the toxic baits used in pest-control programmes.

Baits that are regularly used in pest mammal control operations include RS5 cereal baits, carrots and FeraCol paste. Some bait assessment trials using wild-captured animals have previously been conducted in New Zealand. It was found that spotted skinks (*O. lineocellatum*) consumed neither FeraCol paste nor cereal (Booth et al. 2004) and McCann's skinks (*O. maccanni*) were more attracted to moist baits of both RS5 and AgTech Pindone cereal baits (Freeman et al. 1997). Amongst the potential invertebrate prey items of grand and Otago skinks, Eason et al. (2000) found no mortality in ground weta (*Hemiandrus* sp.), earthworms or snails when orally dosed with the active ingredient of Feracol bait (Cholecalciferol). However, ground and cave (*Rhaphidophoridae* sp.) weta readily ingest toxic and non-toxic RS5 and carrot 1080 (sodium monofluoracetate) baits (Lloyd & McQueen 2000). Although some ants will take lethal doses of 1080 presented in cereal bait, the risk appears small, as the toxin is either not well absorbed or not very palatable (Booth & Wickstrom 1999).

This study assessed the consumption by grand and Otago skinks of three bait types that are often used in vertebrate pest control operations, as well as consumption of the baits by their potential prey species (both vertebrate and invertebrate). Since behavioural responses of lizards to experimental conditions *ex situ* will not necessarily predict behaviours in their natural habitat (Merton 1987), and environmental conditions may affect bait condition, this investigation was conducted with wild skinks in the field at Redbank Conservation Area, Macraes Flat, north Otago. The study was carried out during early autumn in order to not only coincide with the usual timing of most mammal pest control operations using toxins (winter), but also to be at a time when the weather was warm enough for skinks to be active on most days.

2. Methods

Schist tors both within and outside the area of Redbank Conservation Area, which has been fenced to exclude mammalian predators, were searched (using binoculars) for grand and Otago skinks on six fine days between 17 and 30 March 2006. Baits were left on rock tors within 1 m of any detected skinks, so that the activities of the skinks in response to the baits could be observed from a distance. Responses to the baits were separated into three categories, as follows:

- An approach: the animal comes within 100 mm of the bait sample
- Sampling: licking, nudging or biting the bait sample
- Consumption: the animal consumes the bait sample

The duration of each of these responses was recorded. If an individual failed to approach the baits after 30 min, the observation session was abandoned. Individual rock tors were only sampled once to avoid including the same animal twice.

Video recordings were also taken during eight afternoons and nights (3.00 p.m. to 7.00 a.m.) over the same time period as well as over two dates in early May. The cameras were secured on tors within the fenced enclosures to avoid stock interference. The cameras were positioned to focus on a selection of bait types that had been placed within 50 mm of each other, on the tors or on the edges of tors at ground level. Image recording was continuous over an 8-15-h period. This allowed both diurnal and nocturnal prey species investigating and/or consuming the bait samples to be identified. As the video images provided poor visual definition of the responses shown by both the vertebrate and invertebrate animals recorded, in some cases only the duration of the approach (as defined above) was recorded.

Three non-toxic baits were used: RS5 cereal bait and fresh carrots, each dyed with Bayer V200 green dye powder that contained an odiferous cinnamon extract, and FeraCol paste containing green dye. Baits were offered in two sizes: small pieces that were no larger than 6 mm in any dimension, and large baits, which were whole cereal baits and chunks of FeraCol paste (c. 15 × 15 × 40 mm), and whole rounds of sliced carrot (c. 20 × 20 × 5 mm). Both sizes of cereal baits were presented as dry or wet, the latter having been soaked in water for at least 5 min. During the field observations, each bait type was either placed separately or in combination with one other bait type (four pieces at a time), depending upon how much suitable space was available. During the video recording, four types of bait were presented simultaneously.

3. Results

Grand and Otago skinks spent 23% of the total observation time within 100 mm of the bait samples. A greater proportion of grand skinks sampled baits than Otago skinks (Table 1): almost half of the 28 grand skinks sampled a bait type and two consumed bait (Fig. 1A), whereas 20% of the 39 Otago skinks sampled a bait type and four consumed bait (Fig. 1B).

All bait types were sampled by at least one animal to which they had been offered, but the small pieces of baits were all sampled more often than the large pieces (Fig. 2). No animals attempted to consume large pieces of bait. Of the ten grand skinks and 20 Otago skinks that were presented with small, wet cereal baits, one grand and three Otago skinks consumed them. Of the four Otago and three grand skinks that were offered FeraCol paste, one of each species consumed it (Fig. 2). Carrot baits were offered to five grand and three Otago skinks, mostly at the same time as cereal baits. Although carrot baits were sampled, none were consumed.

3.1 VIDEO RECORDINGS

In total, 117h of video footage were recorded intermittently over a period of 7 days; this included c.235.3 min of animal-bait interaction (Table 2). At no time during the 3h of observation time did the nocturnal gecko *Hoplodactylus maculatus* approach any bait type. The ground weta spent equal amounts of time feeding on wet and dry cereal baits of both sizes, as did flies. During the recording, grand skinks showed a brief period of sampling (licking) small carrot and small dry cereal bait, but consumed only one small piece of FeraCol paste. McCann's skinks were recorded sampling small dry cereal baits for 20s and small carrot baits for 10s.

TABLE 1. DURATION AND NUMBER OF RESPONSES TO ALL BAIT TYPES PRESENTED TO GRAND (*Oligosoma grande*) AND OTAGO (*O. ottagense*) SKINKS DURING FIELD TRIALS.

| SPECIES | DURATION (min) | | | | NUMBER | | |
|-------------|----------------|----------|----------|---------|------------------|----------|---------|
| | OBSERVATION | APPROACH | SAMPLING | FEEDING | ANIMALS OBSERVED | SAMPLING | FEEDING |
| Grand skink | 417 | 64 | 14 | 3 | 28 | 13 | 2 |
| Otago skink | 680 | 191 | 5 | 5 | 39 | 8 | 4 |
| Total | 1097 | 255 | 19 | 8 | 67 | 21 | 6 |



Figure 1. A. Grand (*Oligosoma grande*) and B. Otago (*O. otagense*) skinks eating small wet cereal baits. Note green dye around mouth.

Photos: T. Jewell.

Figure 2. Proportion of grand (*Oligosoma grande*) and Otago (*O. otagense*) skinks sampling the baits presented to them in the field. Ca = carrot, FC = FeraCol paste, Ce = Cereal; D = dry, W = wet; S = small, L = large.

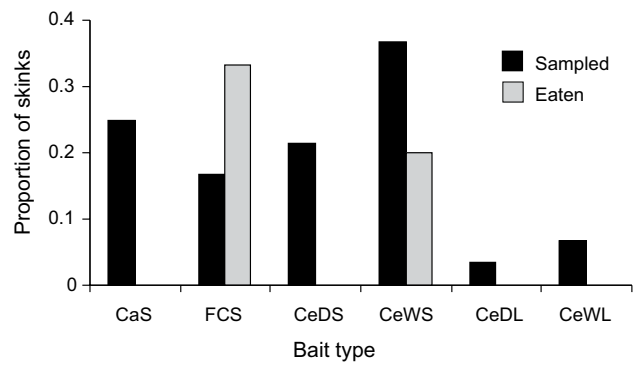


TABLE 2. THE DURATION OF RESPONSES TO NON-TOXIC BAITS BY SPECIES RECORDED ON VIDEO OVER 117 h OF RECORDING.

| SPECIES | ANIMAL-BAIT INTERACTIONS (min) | SAMPLING (min) | FEEDING (min) |
|---|--------------------------------|----------------|---------------|
| Common gecko (<i>Hoplodactylus maculatus</i>) | 180.0 | 0.0 | 0.0 |
| Ground weta (<i>Hemiandrus</i> sp.) | 20.0 | 0.0 | 18.0 |
| Worm | 0.3 | 0.0 | 0.0 |
| Grand skink (<i>Oligosoma grande</i>) | 26.0 | 0.3 | 1.0 |
| McCann's skink (<i>Oligosoma maccanni</i>) | 6.0 | 0.5 | 0.0 |
| Fly | 3.0 | 0.0 | 1.3 |

4. Discussion

All three bait types that were presented to the grand and Otago skinks were sampled (nudged, licked or bitten) and approximately one third of the skinks sampled at least one type of bait. The proportion of animals responding to the bait samples in this study was much lower than has previously been found in *ex-situ* trials with McCann's skinks (Freeman et al. 1997). In most instances during this study, once a bait had been sampled it was abandoned and no further interactions took place.

Grand and Otago skinks are generalist feeders; they consume a wide range of invertebrates, fruit and other lizards (Tocher 2003), and they will approach novel food items (Marshall 2006). Five of the grand and Otago skinks consumed small pieces of wet cereal bait. The propensity of skinks to sample wet cereal baits has been recorded previously (Merton 1987; Freeman et al. 1997). The risk of small pieces of cereal baits being broadcasted is considered to be small when the baits are sieved before application (Spurr & Powlesland 1997). However, baits can be broken during transport distribution, and moist cereal baits may break into smaller pieces over time.

Ground weta have previously been recorded consuming both toxic and non-toxic cereal and carrot baits (Lloyd & McQueen 2000), and were observed feeding on cereal baits in this study. Flies were also observed feeding on cereal baits during video recording.

In conclusion, there is some risk that grand and Otago skinks will consume pieces of the common bait types of cereal, FeraCol paste and carrots used in vertebrate pest control programmes. The risk is increased when the baits are small and/or, in the case of cereal baits, wet. Invertebrate species that are known to be prey items for grand and Otago skinks will also consume pest baits. Further observations should be carried out to determine the frequency of bait consumption by McCann's and common (*O. polychroma nigreplantare*) skinks. The physiological impacts on lizards of toxins used for pest control in New Zealand are not known and the results of this study suggest that this should be investigated.

5. Acknowledgements

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