Sensitivity of audio-lured versus silent chew-track-cards and WaxTags to the presence of brushtail possums (*Trichosurus vulpecula*)

Matthew J. Kavermann[1] Adrian M. Paterson[1], & James G. Ross[1,2]

[1]Ecology Department, PO Box 84, Lincoln University, Lincoln 7647, New Zealand
[2]Corresponding author's email: James.Ross@lincoln.ac.nz

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Abstract

Accurately identifying the changes in relative abundance (performance-based monitoring) or distribution (surveillance-based monitoring) of the brushtail possum (*Trichosurus vulpecula*) within the landscape, is a fundamental component of possum control programmes. For surveillance-based monitoring, sensitive monitoring tools are required. Interference-based detection devices, including chew-track-cards (CTCs) and WaxTags (WTs), are considered more sensitive than leg-hold traps as they are smaller and lighter, allowing for a greater number of devices to be deployed over large areas. Our study indicated that CTCs were more sensitive to possum presence than WTs over the time frame of the study, which was attributed to the stimuli of the peanut-butter lure incorporated into the CTCs thus encouraging the possums to interact with detection devices. The addition of audio lures increased the sensitivity of both detection devices and made WTs equally as sensitive as CTCs with 75% of noisy monitoring sites detecting possum presence. As possum populations are reduced to increasingly lower densities in an attempt to locally eradicate bovine tuberculosis, the use of audio lures may become a greater part of possum surveillance monitoring in New Zealand.

Key words: Possum, *Trichosurus vulpecula* monitoring, chew-track-card, WaxTag

Introduction

Accurately identifying changes in the relative abundance or distribution of invasive pest species populations can only be achieved through standardised monitoring techniques repeated over time (Ogilvie et al. 2006). In New Zealand (NZ), population monitoring is a fundamental aspect of many brushtail possum (*Trichosurus vulpecula*) control programmes. Possum monitoring in NZ can typically be described as either performance-based (determining relative abundance) or, more recently, surveillance-based (determining the distribution of control survivors). Performance-based monitoring is a measure often used to calculate relative possum abundance following possum control operations (Warburton et al. 2004). The primary accepted technique for performance-based monitoring follows a nationally standardised protocol using leg-hold traps. With this method, a residual trap-catch index (RTCI) is calculated from the percentage of traps capturing possums along trap-catch lines set over a period of three fine nights (NPCA 2008a; Sweetapple & Nugent 2011). Whilst leg-hold trapping enables the calculation of population reductions by comparing pre-and-post control estimates, it is thought that the sensitivity of leg-hold trapping is low when possums numbers are also very low (Ramsey 2005). In direct response to this issue, interference-based detection devices, including chew-track-cards (CTCs, Connovation Ltd, Auckland, New Zealand) and WaxTags (WTs, Pest Control Research Limited, Christchurch, New Zealand) have been developed. WTs and CTCs detect and record possum (and other species) presence via bite marks left by animals interacting with the devices (Sweetapple & Nugent 2011)

Following the development of CTCs and WTs, surveillance monitoring of larger areas have become more commonplace as many devices can be quickly deployed. Systematic surveillance monitoring is undertaken to detect the presence of possums remaining after control operations in an attempt to identify any 'hotspot' areas that can be targeted using local elimination approaches (e.g. traps or toxins) to remove the last few survivors (Nugent et al. 2007; Sweetapple & Nugent 2011). However, to detect a possum, the possum must first encounter and then physically interact with the monitoring device. Generally, where surveillance monitoring is undertaken possums occur at low- to very-low densities across the landscape and very sensitive monitoring tools are required to reliably detect possum presence (Sweetapple & Nugent 2011). A detection device with increased detection probability (i.e., one that is more easily encountered and interfered with), should, therefore, improve the likelihood of a possum interacting with the device.

At present, possums must use sight to locate monitoring devices, or in the case of CTCs, smell, when in close proximity. Internationally, the detection of secretive and cryptic species that exist at low densities has been improved using audio lures (see Gibbs & Melvin 1993; Robbins & McCreery 2003). Recent research using audio lures within a low-density possum population also indicated that animals interacted more with audio-lured control devices than "silent" devices and also located them sooner (Kavermann 2013). These findings suggest that audio-lured detection devices should be more readily found by possums and likely result in interference with a monitoring device. Based on the above, the aim of this trial was to assess if audio lures associated with WTs or CTCs increased the detection rates in a low-to-medium density possum population. The trial also aimed to investigate if auditory combined with olfactory and gustatory stimuli (incorporated in the CTCs) further helped to improve detection probabilities. All research was conducted under permission of the Lincoln University Animal Ethics Committee (AEC #420).

Methods

The trial was located in Nelson Lakes National Park, New Zealand at the south-eastern end of Lake Rotoiti in mixed beech (*Nothofagus* spp.) forest to the north of Lake Head hut (41° 56°S, 172° 49°E). Previous surveillance using WT monitoring suggested possum densities between 10–15% Bite Mark Index (NPCA 2008b, D. Chisnall, Department of Conservation, New Zealand, pers. comm. 2012), which is considered to be a low-to-medium density population.

For this trial, 48 monitoring sites were established on a grid at 150×150 m intervals. A monitoring site consisted of either a single un-lured WT (n=24) or a peanut-butter CTC (n=24) secured to a tree 300 mm above ground level. Half of the WT and CTC monitoring sites (n=12 each) were also lured with an audio device (hereafter referred to as 'noisy' sites). Audio lure devices consisted of a small black box (83×54×31 mm) which emitted a series of ten, 84 dB, 300 Hz beeps every 15 minutes during the hours of darkness. Audio lures were distributed amongst the WTs and CTCs so that each audio-lured monitoring site was separated by at least 300 m. The detection devices were then left in the field for ten nights and checked daily for any possum bite marks. Any detection devices recording possum presence were replaced during these daily checks.

Statistical analyses

The detection data (i.e., presence/absence of a bite mark) was analysed using a generalised linear mixed model (GLMM) with a Bernoulli error distribution to account for the non-normal distribution of the response variable. The fixed effects used in the model were the type of treatment (noisy or silent), the type of detection devices (WT or CTC) and night of the trial (1-10 nights). The random effect in the GLMM was the night*site interaction and was included to account for any temporal autocorrelation through time as individual possums may have continued to visit the same monitoring site over the consecutive nights. The significance of the fixed effects were assessed using WALD tests (Agresti 2002). All GLMM analyses were done using Genstat version 14 (VSN International).

Results

Overall the CTCs were significantly more sensitive at detecting possum presence than WTs ($F_{1,440} = 103.28$; $P<0.001$, Table 1). The addition of an audio lure further improved detection rates with significantly more noisy devices detecting possums over time than silent devices ($F_{1,440} = 179.04$; $P<0.001$). The audio result was most pronounced with the

Table 1. Total numbers of WaxTag (n=24) and Chew-track-cards (n=24) monitoring sites with (Noisy) and without (Silent) audio lures detecting possum presence at Lake Head Hut. The cumulative number of possum detections over the entire 10 nights is presented in parentheses

Treatment	WaxTag	chew-track-card
Silent	1 (2)	7 (29)
Noisy	9 (39)	9 (45)
Total	10 (41)	16 (74)

WTs where nine times as many possum interactions were detected at noisy sites compared to silent WT sites. This increase in detection success made the noisy WTs as efficient at detecting possums as noisy CTCs. Unfortunately, the sample sizes were not sufficient to statistically test the interaction between detection device type and presence of the audio lure.

The night of the trial also had a significant effect on the number of devices detecting possums with a general upwards trend over time ($F_{37,440}=4.19$; $P<0.001$; Figure 1). Noisy CTCs had the highest percentage of devices detecting possums on 6 out of 10 nights and silent WTs had the lowest percentage with no possum detections following the second night.

Discussion

Highly sensitive monitoring surveillance tools are required to detect residual possum survivors sparsely distributed in the landscape (Carey et al. 1997; Sweetapple & Nugent 2011). Our study shows that silent CTCs were more sensitive at detecting possum presence than silent WTs at this field site. Over the ten nights of the trial only one silent WT site (8%) recorded possum presence whereas seven silent CTC sites (58%) detected possums during the same time frame. In their study, Sweetapple and Nugent (2011) also found that CTCs detected possum presence more often than WTs, supporting the findings of our study.

One possible explanation for the results from this study is that CTCs contain a peanut-butter lure, a palatable olfactory and gustatory stimulus which is likely to encourage possums (and rodents) to physically interact with the device. WTs on the other hand were deliberately designed to be less palatable to reduce potential contagion (i.e. the same possum biting multiple devices) as they were originally developed for performance-based monitoring (M. Thomas, Pest Control Research, Christchurch, New Zealand, pers. comm. 2012). Our result suggests that the addition of an olfactory and gustatory lure make CTCs easier for possums to both encounter and interact with; however, video surveillance would be required to clearly establish the relationship between encounter and interaction rates. Possums certainly have a large olfactory bulb and well developed vomeronasal region with many scent glands indicating they have a developed olfactory sense (Russell 1987; Kerle 2001). However, other trials have

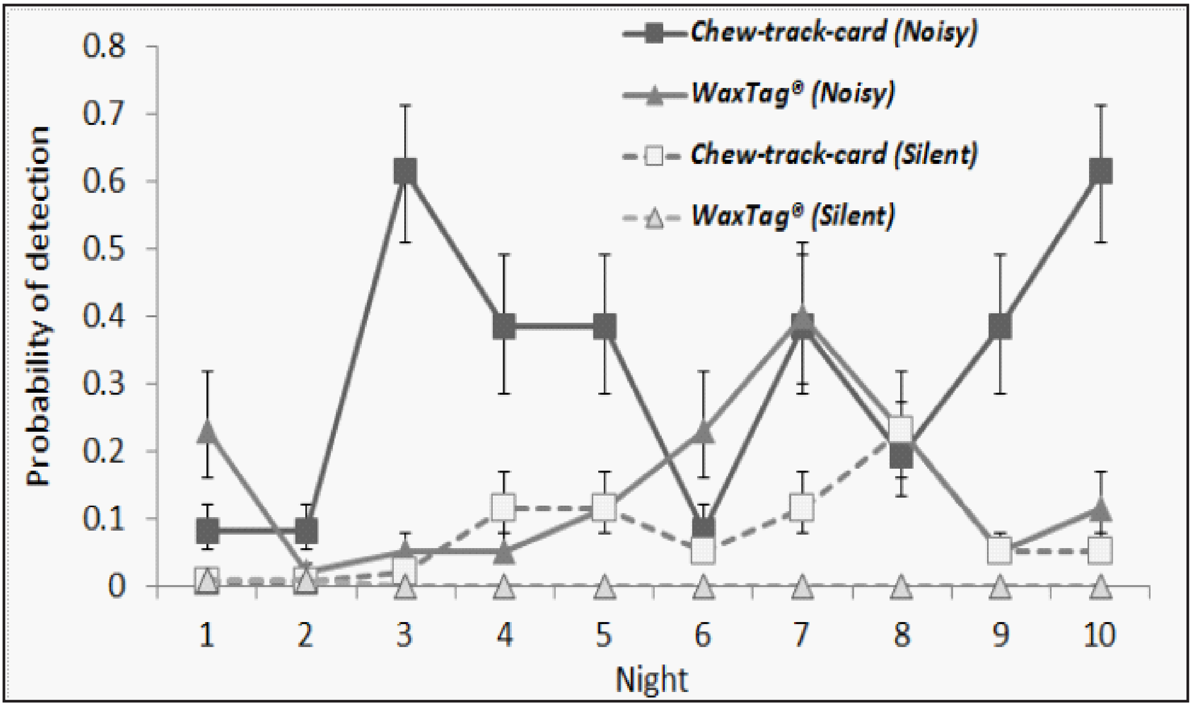

Figure 1. Detection probabilities for noisy and silent Chew-track-card and WaxTag sites at Lake Head Hut over ten nights. Error bars represent ± 1 S.E. and compare the effect of the audio lure and type of detection device on the detection probability (i.e. the number of each device interfered with each night).

shown that olfactory cues are unlikely to attract possums at distances beyond 5 m (Morgan et al. 1995), a distance at which both detection devices were likely to be visible in the open beech forest where the trials were conducted.

Whatever impact the peanut-butter lure may have had, this effect was nullified with the addition of the audio lures. While the audio lures increased the proportion of CTCs detecting possums by c. 30%, the result was far greater for noisy WT sites with an 800% improvement in possum detection rates. Noisy WT sites were as sensitive as noisy CTC sites with nine monitoring sites (75%) detecting possum presence. Audio lures encourage possums to investigate thoroughly devices in the field (Carey et al. 1997), which is then likely to result in more interactions. While it is likely that the audio devices increases both encounter and interaction rates, again video surveillance is required to confirm.

One assumption made during the research trial was that different possums were detected at each monitoring site. The spacing of the monitoring sites was expected to minimise any impact that noisy sites would have on neighbouring silent sites and likely helped to minimise any possible contagion between monitoring sites (Thomas & Fitzgerald 1995). Unfortunately, the distance between monitoring sites does not completely preclude individual possums from encountering more than one monitoring site. The challenges identified above have also been acknowledged by others. In their study, Sweetapple and Nugent (2011) found that twice as many possums were detected on CTCs than WTs although the authors were unsure if the result reflected the detection of more possums, a greater number of detections per possum (contagion) or a combination of both.

In conclusion, as possum populations continue to be controlled to increasingly lower densities, surveillance-based monitoring will become increasingly important and widespread. The results from this study suggest that audio lures increase detection rates for both CTCs and WTs and this should aid managers in accurately locating where residual possums remain following control. Identifying remnant populations will enable managers to concentrate resources in key areas and thus help to reduce the costs of subsequent maintenance control. A further benefit of audio devices is that they could be attached to DNA collection devices (Vargas et al. 2009), which would eventually allow the determination of the actual number of individuals remaining following control work. Such detailed information will allow managers to control population easier by clearly identifying hotspots areas where multiple animals are still residing.

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