Progressing the Possum Pied Piper Project

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Abstract: Improving vertebrate pest control operations relies on increasing pest animal interactions with control devices (e.g., bait stations, bait bags, and/or traps). Interactions are encouraged using a variety of baits and lures that stimulate an animal's visual, olfactory, or auditory sense, orientating the target species towards a control device. On a generalised spatial scale of conspicuousness, an auditory lure will function over a greater distance for mammals in forested ecosystems than both visual and olfactory lures, suggesting auditory lures could have the greatest luring potential. In New Zealand, there is an overabundance of the introduced Australian brushtail possum that is the subject of ongoing control. Ground-based control operations typically use visual (e.g., a flour blaze), and to a lesser extent olfactory (e.g., cinnamon) lures for attracting possums to control devices. However, the potential for an auditory stimulus remains largely unexamined and underutilised. Research presented here expands on previous studies with captive animals and examines the development and field testing of an audio lure for possum control. The results from three preliminary field trials show that possums found audio-lured devices sooner than un-lured devices, and that a greater proportion of lured devices were located over time. In addition, possums were recorded investigating lured sites at a higher rate compared to un-lured sites, suggesting that possums were more likely to interact with a control device if it has an audio-lure than if it does not.

Key Words: audio lure, pest control, possum, *Trichosaurus vulpecula*, New Zealand

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INTRODUCTION

The efficiency and effectiveness of pest control operations is improved by increasing the level of interaction that the targeted pest animal has with control devices. To achieve greater pest animal interactions, researchers and wildlife managers employ a variety of natural and synthetic attractants to increase the attractiveness and conspicuousness of control devices for the targeted pest (Clapperton et al. 1994a,b; Morgan et al. 1995, Dilks and Lawrence 2000). These attractants typically stimulate an animal's visual, olfactory, or auditory senses and encourage interaction with control devices resulting in more captures, higher kill rates, and thus a more efficient control program (King and Edgar 1977, Veitch 1985, Carey et al. 1997, Warburton and Yockney 2009). The natural and synthetic attractants described above include both lures (materials containing visual, auditory, and/or olfactory [including social and food/gustatory related odours] sensory cues) and palatable baits (edible materials likely to have a visual and/or olfactory luring effect) that are consumed by the target animal. On a spatial scale, olfactory cues are considered to function as a lure over the smallest distance, usually <5 m (Clapperton et al. 1994b, Morgan et al. 1995). Visual lures are known to draw animals in from greater distances than olfactory cues (Pracey and Kean 1969, Kavermann 2004, Warburton and Yockney 2009) and conceptually are the second most attractive lure spatially. Audio lures are considered the most conspicuous, being detectable over large distances, particularly in heavily-vegetated landscapes (Jefferson and Curry 1996, Carey et al. 1997). As such, audio lures may be more effective at attracting pests than visual or olfactory cues in such landscapes (typical for possum control operations in New Zealand). The hypothesised olfactory < visual < audio spatial hierarchy sequence of lures has also been indirectly described by Algar et al. (2004).

Within New Zealand, olfactory and visual attractants are used extensively to lure the Australian brushtail possum (*Trichosaurus vulpecula*), an introduced marsupial that has established itself as a major agricultural and ecological pest (Morgan et al. 1995, Todd et al. 1998, Caley et al. 1999, Payton 2000). The usual visual and olfactory lure used for attracting possums is a flour blaze, a 5:1 mix of plain white flour and icing sugar (powdered sugar) often scented with an essential oil (e.g., cinnamon) spread on tree trunks (Cowan 1987, Ogilvie et al. 2006, NPCA 2008, Warburton and Yockney 2009). Unfortunately, the long-term effectiveness of the flour blaze is limited because of environmental degradation (Spurr 1999, Ogilvie et al. 2006). In addition, the distance from which a flour blaze can attract possums is further limited by the distance from which the flour or scented oil can be seen or smelt (Carey et al. 1997). Auditory lures on the other hand offer a longer-lasting alternative method of attraction (Robbins and McCreery 2003, Moseby et al. 2004, Schwarzkopf and Alford 2007).

Audio lures are widely used for conservation purposes, such as census sampling (Ogutu and Dublin 1998, Reid et al. 1999, Pinchuk and Karlionova 2006); anchoring species (Molles et al. 2008, Bradley et al. 2011); mapping species territories (e.g., *Canis lupus*) (Reid et al. 1999, McGregor et al. 2000); minimising marine mammal interactions with fisheries equipment (Jefferson and Curry 1996, Barlow and Cameron 2003); and limiting non-target interactions or captures with control devices (Shivik and Gruver 2002). Recently, the use of audio lures for pest control purposes has begun to receive some investigation. In Australia, researchers demonstrated that incorporating a Field Attracting Phonic (FAP) playing feline audio cues at trap sites combined with an olfactory lure ('Pongo', a mixture of cat urine and faeces) were three times more successful at catching cats (*Felis catus*) and foxes (*Vulpes*

vulpes) than sites without (Moseby et al. 2004). FAPs are now often used for cat control in Australia and internationally (e.g., Algar et al. 2004, Robley et al. 2008, Hanson et al. 2010). In a similar example, traps for catching cane toads (*Bufo marinus*) were three times as successful where an anuran chorusing audio lure was used (Schwarzkopf and Alford 2007).

While the audio lures identified above use the bioacoustics of conspecifics, New Zealand researchers have found that novel noises can also encourage possum interaction. In their studies, Carey et al. (1997) presented possums with two boxes, one of which emanated a 300-Hz beeping sound. The approach rate was not significantly different between the boxes but the number of possums entering the beeping box was. Possums appear to be naturally curious and will investigate novel stimuli in their environment (Russell and Pearce 1971). Moreover, auditory stimuli could be used to lure possums to, and encourage greater interaction with, control devices, increasing the likelihood of capturing the curious animal.

Despite the apparent success of the preliminary audio lure research in New Zealand and other anecdotal evidence for the use of audio lure for attracting possums (Kenworthy 1996), there has been no formal/rigorous scientific field trial to evaluate any auditory lure for possum control. In this study, we aimed to determine if the increased conspicuousness of Noisy control devices would mean that possums would find audio-lured devices sooner, and if possums would find more audio lured devices over time. In addition, we looked to determine if more possums would interact with audio-lured capture devices.

METHODS

Three separate trials were completed using three methods for detecting possum presence at sites with and without audio lures. Initially, digital cameras were used to detect possum activity around bait stations. However, we became concerned that individual possums may have been photographed on multiple occasions, artificially inflating the results. A trapping trial (using live-capture traps) was completed to remove individual possums and thus avoid unnecessary replication of possum captures at each site over consecutive nights. Finally, a third trial was then undertaken to remove multiple possums at each site on each night using encapsulated cyanide 'death balls'. All research was conducted under the auspices of the Lincoln University Animal Ethics Committee (AEC #420)

Manaia Camera Trapping Trial

The Manaia trial site was located near the Coromandel township on the western side of the Coromandel Peninsula, New Zealand. The site was a mix of podocarp/broadleaf species with large numbers of pururi (*Vitex lucens*) and nikau palm (*Palmae rhopalostylis*) present. Although irregular possum control occurs at Manaia (S. Ogilvie, Environmental Risk Management Authority, New Zealand, pers. commun.,), previous research by another Lincoln University Ph.D. research student indicated that possums were present in high density (Sam 2011).

For the Manaia camera trapping trial, 20 bait stations were established at approximately 150-m intervals (to be statistically independent based on environmental sound profiles of the audio lure) along or adjacent to an established network of tracks within the site. Audio-lured bait stations consisted of a standard Killmore bait station (Pest Control Research Ltd, Christchurch, New Zealand), either modified to contain the audio lure device (treatment n=10; hereafter referred to as 'Noisy') or un-modified (control n=10; hereafter referred to as 'Quiet'), secured to a tree 500 mm above ground level. The Noisy treatment stations were programmed to play a series of ten 300 Hz-beeps played at ~85 dB every 15 minutes for 5 days. Under each bait station, a single standard WaxTag for possum monitoring (Pest Control Research Ltd, Christchurch, New Zealand) was secured 300 mm above the ground. Approximately 2-3 m opposite the audio lure station/WaxTag arrangement, a DigitalEye 12.1 Trail camera (PixController Ltd, Murrysville, PA, USA) with a Sony digital camera (Sony W55) attached to a control board containing a passive infrared sensor, was set to capture possum movement around the audio-lure bait station and interference with the WaxTag. Twelve white flash (WF) and 8 infra-red (IR) cameras were used but were randomly selected to give a completely randomised block design (6 WF : 4 IR for each audio lure treatment). All bait station sites were checked daily to determine if they had detected possums via photographs or bites in the WaxTags.

Orton Bradley Park Live-Capture Trapping Trial

Orton Bradley Park is a private farm park located in Lyttelton Harbour, Banks Peninsula, New Zealand. The park contains a number of mature conifer (mainly *Pinus radiata*) and Eucalyptus stands with a network of remnant/secondary growth native bush and scrub, dominated by kanuka (*Kunzea ericoides*), kowhai (*Sophora microphylla*), and mahoe (*Melicytus ramiflorus*), within the park's valleys. Irregularly-occurring pest control has been completed throughout the park and no consistent possum control has been undertaken for a number of years. As such, it was expected that possum would be present in very high densities.

For the trapping trial, 30 live-capture traps (Victor leghold traps, Philproof Pest Control Products, Hamilton, New Zealand) were set at sites at 150-m intervals within a network of bush and scrub in the valleys of the park. Traps were lured with standard flour blaze (see above) that was refreshed daily. Traps were divided into 10 blocks and were randomly assigned to either a Noisy treatment (as described for the Manaia trial but with the leg-hold trap replacing the trail camera), Quiet treatment (same as the Noisy treatment but emitting no noise), and Trap treatment (live capture leg-hold trap without the bait station/WaxTag arrangement). The Trap treatment was used in case the bait station or WaxTag also had a luring effect for possums. Sites were trapped for 15 fine nights (i.e., no rain within 4 hours of darkness (NPCA 2008). All sites were checked daily for possum captures or detection of possums via bite marks on WaxTags. Where both devices indicated possum presences, the trapped possum was considered responsible for the bitten WaxTag.

Magnet Bay Acute Toxic Bait Trial

Magnet Bay is a Scenic Reserve located within Magnet Bay Valley near the southwest crest of Banks Peninsula, Canterbury, New Zealand. The reserve comprises of secondary growth mahoe (*Melicytus ramiflorus*), dominated by mixed broadleaved forest with scattered podocarps, intermixed with kanuka shrubland and silver tussock (*Poa cita*) grassland surrounded by modified pastoral grasslands. Irregularly-occurring pest control has taken place in the reserve, as is evidenced by the presence of a variety of possum bait stations on the perimeter fence of the reserve.

For the toxic baiting trial, 20 bait stations (10 Noisy:10 Quiet) were alternated at 150 m intervals and secured to fence posts on the perimeter of the reserve approximately 500 mm above ground level. WaxTags were placed under each bait station approximately 300 mm above ground level. Bait stations were baited with eight 10-g non-toxic Ferafeed 213 (Connovation Ltd, Auckland, New Zealand) bait balls dyed green, and four 10-g "death balls" (Ferafeed 213 dyed blue containing a single Feratox [475 g/kg potassium cyanide] capsule, Connovation Ltd, Auckland, New Zealand). Non-toxic bait balls, death balls, and WaxTags were checked and replenished daily as needed for the first 7 days. All bait and WaxTags were checked and collected and bait stations removed on after the 10th night. Possum detection was recorded via bites on WaxTags, interference with baits, or via dead poisoned possums. Dead possums were collected, aged, sexed, and females checked for pouch young.

The data were analysed by fitting non-linear (exponential) curves to the cumulative detection rate (i.e., stations detecting possum presence) over the nights of the trial. We then fitted a group factor representing either Noisy, Quiet, or Trap to investigate the consistency of the non-linear relationship across the treatment groups. This is assessed from the accumulated analysis of variance table where we determined the significance of the group effect. All non-linear regression analysis was done using Genstat version 14 (VSN International, Hemel Hempstead, UK).

RESULTS

Analysis of the non-linear relationship indicated that fitting separate lines for each group significantly improved model fit for Mania ($F_{1,4}$ =54.28; P=0.002), Orton Bradley Park ($F_{2,36}$ =1389.95; <0.001), and Magnet Bay ($F_{1,8}$ =29.27; P<0.001). This means that the curves for each group are statistically different (Figures 1a,b,c).

Looking at the curves, the Manaia and Magnet Bay trials show that audio-lured sites tended to capture possum activity sooner within medium-to-high density populations (Figure 1a,c). The result was most pronounced at Manaia, where 60% of Noisy sites captured possum presence within the first two nights compared to only 10% of Quiet sites. In the very high density possum populations at Orton Bradley Park, possum interference saturated the majority of all sites within the first three nights (Figure 1b).

More Noisy sites detected possum activity at Manaia and Magnet Bay trials with 80% and 90% of Noisy sites capturing possum presence, respectively, compared to ≤50% of Quiet sites at the completion of both trials (Figure 1a,c). All Noisy and Quiet sites and 90% of Trap sites detecting possum presence at Orton Bradley Park, where possum densities were very high (Figure 1b).

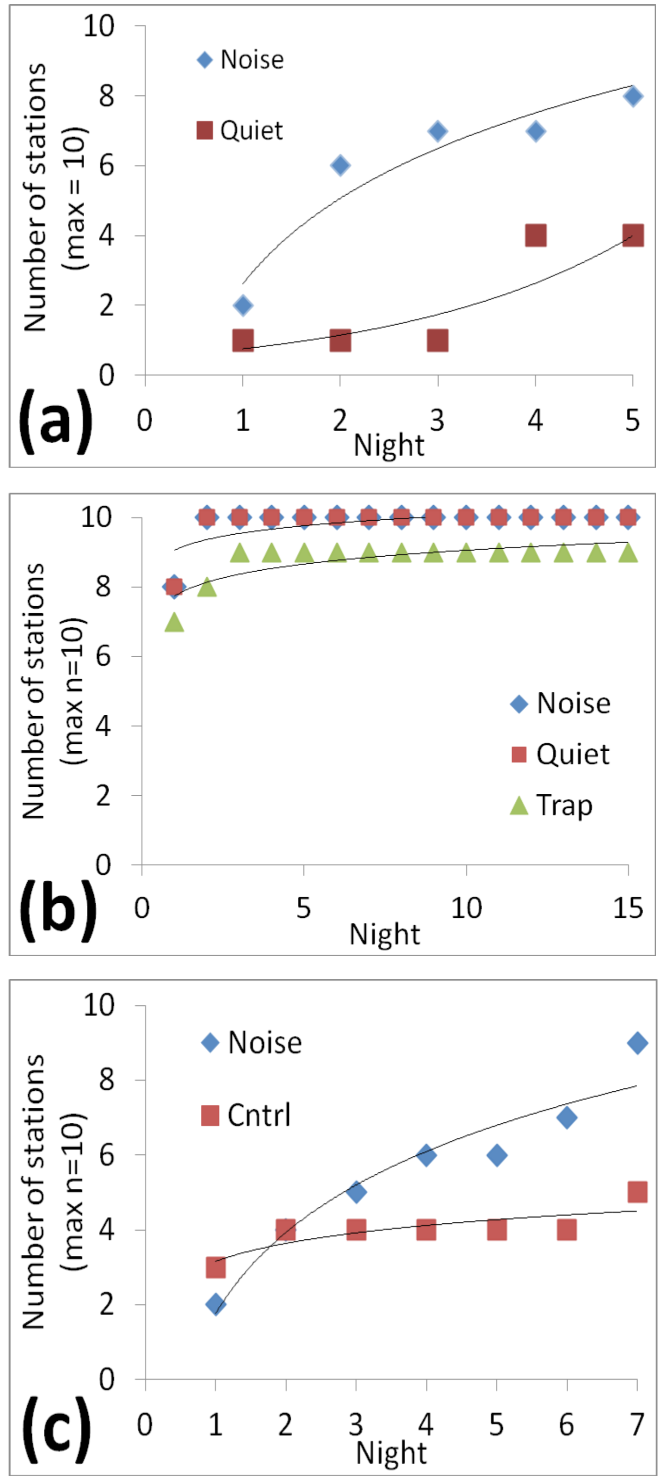

Figure 1: Cumulative number of Noisy, Quiet and Trap (Orton Bradley Park only) 'sites' detecting possum presence over time at Mania (a), Orton Bradley Park (b), and Magnet Bay (c) with fitted models shown.

DISCUSSION

Traditionally, pest control operations have used lures with palatable baits to draw animals in from a distance and/or focus their attention and movements towards control devices and thus improve control efficacy (Clapperton et al. 1994b, Algar et al. 2004, Warburton and Yockney 2009). Historically, the baits and lures used for possum control in New Zealand have focused on stimulating the visual and olfactory senses of the possum (Cowan 1987, Morgan et al. 1995, Ogilvie et al. 2006), and it is well established that these have increased the likelihood of possums interacting with control devices (Cowan 1987). Results presented here show that an auditory stimulus can, in some cases, also increase capture success and potentially improve possum control operations.

Results from two preliminary audio-lure trials have shown that possums in medium-to- high density populations were detected at Noisy sites sooner than Quiet sites. Possum are naturally curious and are known to investigate novel stimuli in their environment (Russell and Pearce 1971, Carey et al. 1997), which may explain why Noisy sites detected possums sooner. In addition, more Noisy sites detected possum presence over time. While curiosity is likely to have contributed to this result, it is more likely that the increased conspicuousness of Noisy sites made them easier for possums to find than Quiet sites. In addition, the audio lure emitting from the Noisy sites could potentially be detected over larger distances than the visual stimulus of the bait station or WaxTag could be seen (Merton et al. 1984, Carey et al. 1997), and so these had a greater opportunity to attract any possum to the Noisy site throughout the trial.

The results from the Manaia and Magnet Bay trials suggest that employing audio-lured devices could result in faster, more efficient pest control operations. However, at Orton Bradley Park, where possums were found to be at very high densities, the effect of an audio lure was less pronounced, with all but one site detecting possum presence within the first three days. Where possums are at very high densities (<5/ha), it is likely that at least one possum will interact with any device placed in the habitat, irrespective of the type of lure used. In these instances, it appears that traditional luring methods would be as effective as audio lures for attracting possums in the short term.

New Zealand is quickly moving towards a new paradigm in pest control to provide better protection for our biodiversity and agricultural assets for similar costs. New technology is required to replace traditional visual and olfactory lures and meet the needs of the next generation of pest control tools. A number of multi-kill traps with the potential to actively control possums (and other pests) for extended periods in-situ and unattended are becoming available in New Zealand. To be effective, these control devices will need long-life lures. The results presented here suggest that audio lures may play a part in the future of possum control in New Zealand.

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