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Determining if White-Flash and Infrared-Flash Camera Traps Have Different Capture Rates at Bait Stations for the Brushtail Possum, *Trichosurus vulpecula*

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ABSTRACT: The use of infrared-flash camera traps has increased dramatically over the past ten years particularly for capture-recapture population studies of distinctly-marked species. However, to use capture-recapture with the more inconspicuous species, high-quality colour imaging (and therefore white flash) is required. A potential problem with white flash is that it may negatively affect behaviour, in this case at bait stations, therefore causing results that do not truly represent possum activity. Possums were used in this study to compare two different types of camera trap: infrared and white flash. Camera traps were placed to take images of possums visiting bait stations, and the number of possum visits was used to determine if white-flash cameras gave different results to infrared-flash cameras. The white-flash cameras had slightly higher possum visits than infrared-flash cameras but the difference was not significant (P=0.437). Over time, the number of possum events (P=0.62) and the amount of time possums spent at the stations did not differ significantly (P=0.81). There was also no difference in the amount of bait taken by possums at white flash compared to infrared stations (P=0.61). Results show possums are not likely to be affected by white-flash cameras compared to infrared-flash cameras. This study therefore showed that there is unlikely to be any behavioural disadvantage in using white flash over infrared, allowing white-flash cameras to be investigated for their potential in identifying individual possums, and as a monitoring tool in control operations.

KEY WORDS: brushtail possum, camera traps, infrared flash, monitoring techniques, New Zealand, *Trichosurus vulpecula*, white flash

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INTRODUCTION

Studies using camera traps have increased dramatically over the last ten years (Rowcliffe et al. 2008) in parallel with camera technological advancement. Camera traps have the benefit of being used remotely without the need for direct contact with animals. In particular, camera trap research has been shown to provide excellent results in discovering and monitoring rare and cryptic species (Rowcliffe and Carbone 2008, Cutler and Swann 1999). Camera traps have traditionally used infrared flash. Many studies involving different species, and comparative evaluations with other indirect monitoring techniques, show that infrared cameras have minimal impact on species behaviour (Silveira et al. 2003, Carbone et al. 2001, Stevens and Serfass 2008, Rowcliffe et al. 2008). Although camera traps have increased in use, monitoring the number of individuals in a population has been restricted to species that have individually-distinctive markings, such as tigers (*Panthera tigris*). Although recent studies show that it may be possible to estimate populations without the need for identifying individuals, research is still required to validate these theories (Rowcliffe et al. 2008, Royle et al. 2008). Being able to identify individuals from camera images allows capture-recapture studies; however, to identify individuals it is important to have clear, high-resolution images both during the day and at night. For species such as tigers, infrared-flash cameras give adequate image quality for individual identification (Karanth et al. 2004, Kelly et al. 2008). However, using camera traps to identify the more inconspicuous species there is a need for high resolution coloured images. White-flash cameras are available which give the quality required to identify small unique markers on more generic-appearing species. New Zealand's introduced mammalian pests such as brushtail possums (*Trichosurus vulpecula*) are relatively generic-looking; however, high-resolution images allow us to magnify specific anatomical features. From this it may be possible to identify individuals using small markers, such as ear veins and permanent scarring, or a combination of these markers. This would enable us to use the camera traps as a monitoring device in control operations and other population studies.

A potential problem with white-flash cameras is that they emit a sudden burst of bright white light, thus raising the possibility of target animals modifying their behavior, such as moving away from the area. There have been studies comparing video surveillance with different camera trap types such as passive or active infrared-flash cameras (Jackson et al. 2006, Stevens and Serfass 2008). However, there has not been a study looking at the potential effects of white-flash cameras. If animals are scared by white flash, it will modify their normal behaviour and so bias the results of any behavioural studies. Possums are arguably New Zealand's most persistent mammalian pest; therefore, possums were used as the target animal in this study, with other species planned in the future. The objective of this study was to determine whether white-flash cameras give the same number of possum events at bait stations compared with the infrared-flash cameras. With this objective, the amount of time possums spent at the station during the event and the amount of bait possums consumed at the two different camera type stations was compared.

METHODS

The study area was a 700-hectare pine plantation consisting mainly of radiata pine, *Pinus radiata*, situated in Glenroy, Selwyn District, Canterbury, New Zealand (43°29.5255S, 171°45.215E). The trees were approximately 25 years old, situated on undulating to steep ground. The plantation was intermittently broken up by small stands of native beech (*Nothofagus* spp.). Preliminary monitoring with WaxTags (www.pestcontrol research.co.nz) before the trial indicated that possums were present in the study area.

A total of 30 cameras were deployed throughout the pine plantation: 15 with infrared flash and 15 with white flash. Camera traps were Pixcontroller Digital Eye 7.2 (www.pixcontroller.com). The cameras consisted of a Sony W55 digital camera attached to a control board which contained a passive infrared sensor. When the sensor is triggered by heat and movement, the camera is activated to take an image. All cameras were configured to 'trail' mode, which means they took images at the quickest rate possible (about one image every 3 seconds) for the entire time an animal was moving in front of the camera. The two camera traps types were deployed in alternating sequence, with a minimum spacing of 200 m, in randomly-selected areas of the study site. It was assumed that the large spacing between the cameras resulted in independent sampling units. A pair of Kilmore bait stations (www.pestcontrolresearch.co.nz) were attached to a tree within the field of view of each camera trap. Approximately 800 g of cereal bait was placed in each bait station, and the actual weight of bait was measured at the start and finish of each trial period.

There was a total of 30 camera sites used; however, these were deployed in sets of 10 stations. A total of 10 cameras were used: 5 infrared, and 5 white flash. The 10 cameras were deployed for 6 nights at a time. After each period of 6 nights, all 10 cameras (with their bait station pair) were moved to a new set of 10 sites, independent of the last.

Cameras and bait were checked every second day and if the bait was low it was replaced with new bait, giving a constant supply of bait to the possum. Camera batteries and memory cards were also replaced every second day.

For every camera, the number of possum encounter events was counted. Because of the large number of images that were taken of the one individual at any one bait station and the variability of the camera image timing, the number of events was used to reduce replications of the same individual. One event constituted one individual entering and exiting the field of view of the camera. Images that were empty of animals, or that displayed species other than possums, were disregarded. Given that we could not accurately identify individual animals, each individual camera was considered to be the sampling unit. Accordingly, data was collated for each camera each night (over the 6-night period) and the mean or the total count of events per night (per camera) was used in the statistical analysis. The mean total number of events for each camera (for the two camera types) were statistically compared using a two-sample Students *t*-test. The number of events was then broken down into a count of the number of events per night, and this was analysed by a generalised linear model using a negative binomial error distribution. The amount of time each individual event took was gathered from the exchangeable image file (exif data); the start and finish of each event was noted and event length was taken from subtracting the finish time from the start time. Time spent at the two different camera stations was analysed with a generalised linear mixed model with a normal error distribution. The fixed effects used in the model were camera flash type and night of observation. The random effects were the camera number and camera number-night interaction.

Bait take by possums from the stations was measured by weighing the bait in each station at the start and end of each 6-night period. A two-sample Students *t*-test was then used to compare mean bait take at infrared cameras to that at white-flash camera stations. All statistical analysis was conducted using GenStat version 12 (VSN International, Hemel Hempstead, UK).

RESULTS

Of the 30 camera stations, 22 had possum events (12 white-flash cameras and 10 infrared-flash cameras); therefore, only the data from these 22 cameras was analysed. Over the 6-night period there were 260 possum events: 105 infrared-flash camera events and 155 white-flash camera events. Although there were more possum activity events for the white-flash cameras (Figure 1), it was not found to be significantly different (t=2.10,df=20, P=0.437). The number of events per night remained fairly constant over time, suggesting there were a consistent number of possums visiting each camera station every night.

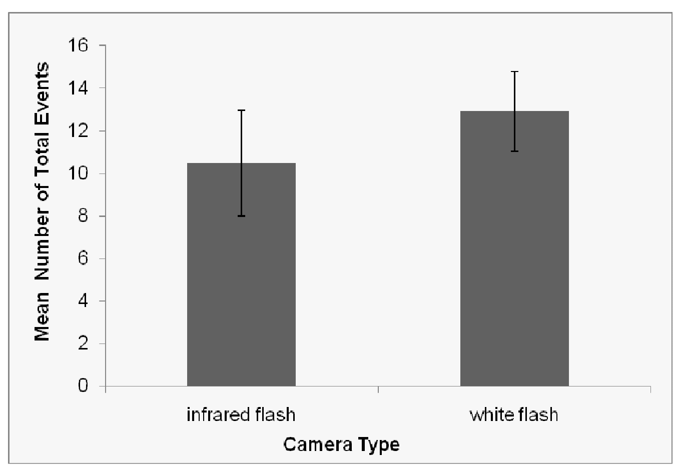

Figure 1. Mean number of possum events per camera for the two camera types (±SEM).

Over time, with the exception of night four, the average number of events was slightly higher for the white-flash cameras (Figure 2); however, no statistically significant difference was found (χ^2=0.921, df=1, P=0.337). The amount of time spent at each of the two different camera types (Figure 3) did not show any significant difference ($F_{5,248}$=0.46; P=0.809). The amount of bait taken by possums was also found to be insignificantly different between the two camera types (t=2.09, df=18, P=0.61) (Figure 4).

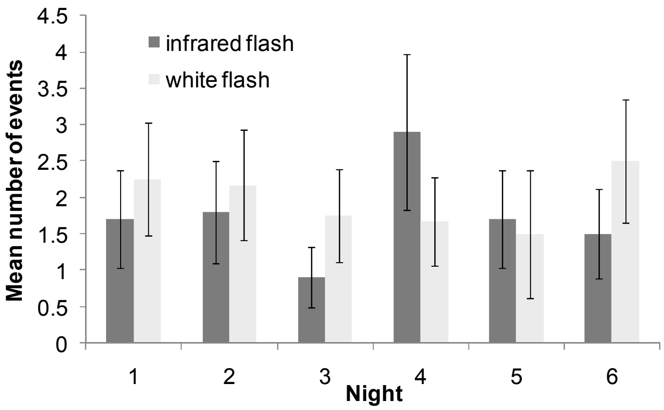

Figure 2. Mean number of possum events per night with the two camera types (infrared flash and white flash) ±SEM.

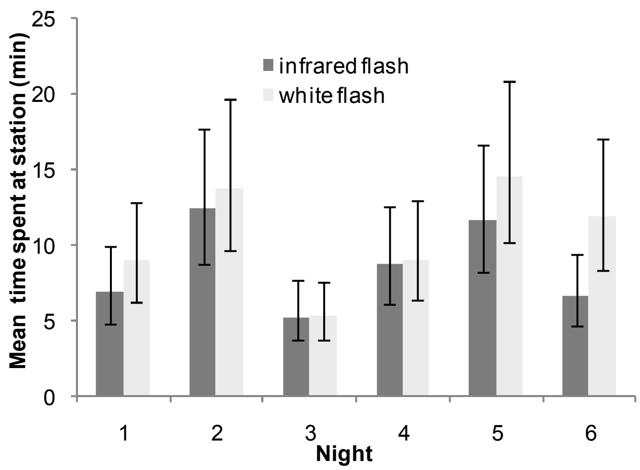

Figure 3. Mean amount of time possum spent during events over time for the two different camera types (±SEM).

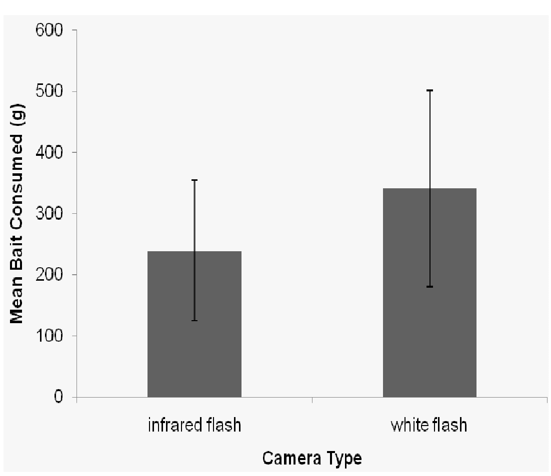

Figure 4. Mean amount of bait consumed by possums at the two camera types (±SEM).

DISCUSSION

The number of possum events 'captured' by the cameras did not change when using the white-flash camera: the number of times they visited the station, how long they spent at the station (Figures 2 and 3), or how much bait they consumed while at the station (Figure 4) were all insignificant when compared to the capture rate of the infrared-flash camera. If possums were wary of the white-flash camera, there would be an initial short visit, and possibly subsequent short visits, until the possum perceived no threat from the white flash or became conditioned to it. However, this was not the case. Possums in New Zealand are relatively unchallenged in their environment and therefore have the opportunity and disposition to explore and investigate novel objects. The new object in this case is the white flash of a camera going off and then subsequent constant flashing while the possum was at the station. A study involving the assessment of a possum population towards potential threats found them to have little change in feeding behaviour when a threat was presented to them (McDonald-Madden et al. 2000). It is therefore evident that when food is used as a lure, possums will readily approach a new object. Once the station had been initially explored with no negative consequences, it was likely the possum would not be bothered by the white flash, as shown by the lack of change in the number of events in this study (Figure 1).

When exposed to a negative experience, possums do have the capability to learn to quickly avoid that object. This is shown by possums eating toxic bait that produces sub-lethal effects: they will become 'bait shy' towards any bait, regardless of whether it is toxic or non-toxic (Morgan et al. 1996, Ross et al. 1997). Therefore, they have the capability of perceiving threats once they have been experienced and modify their behaviours accordingly. The possum population in this study had not been exposed to bait stations within the last 5 years, so did not have any bait shyness towards the station. Therefore, the possum population in this study would likely be bolder in initially approaching the stations than those possums that had been previously exposed to bait stations.

There have been a number of techniques explored for luring possums to a bait station, including smell, taste, sound, and visual stimuli (Ogilvie and Sakata 2006, Ogilvie et al. 2006, Warburton and Yockney 2009, Thomas and Maddigan 2004). Possums seem to be attracted to light; studies have shown that fluorescent lures beside wax bait interference devices will give higher number of bites than those without a fluorescent lure (Ogilvie et al. 2006). Another study using a box with white light indicated that possums will investigate the box more when there is white light present than without (Carey et al. 1997). There were slightly more possum events with the white-flash cameras in the present study, and it may be that possums are attracted to the bait stations by the white flash being activated. Although there was no significant increase in possum events over 6 nights, prolonged studies of this nature may see an increase in events, because other possums in the area are attracted to the stations.

Although possums are bolder in approaching new objects particularly when food is used as a lure, other species that perceive a higher predator threat may be wary of the white-flash camera and results may differ from the ones in this study. Some studies have shown species such as ferrets (*Mustela furo*) may avoid areas where infrared cameras were being used (Newbold 2007). Therefore, use of white-flash cameras should be trialled with other species to find any capture rate changes associated with the white flash as well as infrared flash.

In summary, the results of this study showed that white-flash cameras do not significantly modify possum capture rates compared to infrared cameras. For possums, white-flash cameras can therefore be used in the same manner as infrared, without fear of the white flash scaring individuals away. This information therefore opens new opportunities for using white flash to identify individual possums and progress into using cameras for monitoring bait efficiency in possum control operations and in the research of new control tools.

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