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Short Report

The selfie trap: A novel camera trap design for accurate small mammal identification

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Summary

Camera traps are a popular tool for monitoring wildlife though they can fail to capture enough morphological detail for accurate small mammal species identification. Camera trapping small mammals is often limited by the inability of camera models to: (i) record at close distances; and (ii) provide standardised photos. This study aims to provide a camera trapping method that captures standardised images of the faces of small mammals for accurate species identification, with further potential for individual identification. A novel camera trap design coined the 'selfie trap' was developed. The selfie trap is a camera contained within an enclosed PVC pipe with a modified lens that produces standardised close images of small mammal species encountered in this study, including: Brown Antechinus (*Antechinus stuartii*), Bush Rat (*Rattus fuscipes*) and Sugar Glider (*Petaurus breviceps*). Individual identification was tested on the common arboreal Sugar Glider. Five individual Sugar Gliders were identified based on unique head stripe pelage. The selfie trap is an accurate camera trapping method for capturing detailed and standardised images of small mammal species. The design described may be useful for wildlife management as a reliable method for surveying small mammal species. However, intraspecies individual identification using the selfie trap requires further testing.

Introduction

The camera trapping of small mammal species has proved problematic because of limited focus ranges resulting in low resolution images, which can result in false-positive identification of species (Meek *et al.* 2013). In one report, camera trapping performed as part of a survey for threatened Squirrel Glider (*Petaurus norfolcensis*) presence, required for a proposed development, found that it was difficult to distinguish their possible presence from the common Sugar Glider (Mitchell *et al.* 2016). Meek and Vernes (2016) found that accurate identification of the endangered Hastings River Mouse (*Pseudomys oralis*) from camera trap images by experts was difficult, and it was recommended that a new camera trapping method and associated automated methods be developed.

The use of camera trapping to estimate demographics of a species is readily achieved for species that display unique pelage patterns, and as such can be individually identified (e.g. Tiger *Panthera tigris*, Karanth 1995; Jaguar *Panthera onca*, Silver *et al.* 2004; Northern Quoll *Dasyurus hallucatus*, Hohnen *et al.* 2013). However, individual recognition can be hindered by highly variable photos. Therefore, there is a need for camera trapping methodologies that allow for standardised photos that can be reliably analysed, particularly for use in emerging technologies such as artificial intelligence (AI). In addition to AI, geometric morphometrics could be used to identify different individuals, but this process requires highly robust and standardised photos (Zelditch *et al.* 2004). In camera trapping studies, such images could be obtained via camera trap design modifications.

To improve small mammal camera trapping for accurate species and individual identification, there is a need for standardised photography. The selfie trap was designed and tested on small mammal species encountered in this study, to collect detailed and standardised images of these animals.

Materials and Methods

Camera trap and trial design

The selfie trap design was arrived at after multiple prior prototypes informally trialled widths of the PVC pipe, focal length of lens and camera flash type (Infrared (IR) or white incandescent flash). The favoured design of the trap formally trialled and reported here involves the use of a 500 mm length of 150 mm diameter PVC piping. This creates consistent photographic conditions (lighting and infrared flash exposure). By being enclosed it reduces the number of false triggers (McCleery *et al.* 2014). An IR camera (in this trial a generic RD1000 camera) was positioned inside the PVC pipe, secured to the 150 mm PVC cap with hooks or to the pipe itself using a small piece of threaded rod. Using a simple and low-cost adjustment on our cameras, we changed the focus range (originally fixed at approximately 1.5 m) to between 200 and 250 mm. A 200–250 mm focus range lens is fixed over the camera lens (+4 magnification lens from a pair of non-prescription reading glasses; Fig. 1). The cameras were set to video record for 30 seconds with a 30-second delay between triggers.

A 3-D printed plastic bait holder (using a Me3D Printer) was created so that it would: (i) allow for limited access to bait (thereby increasing time spent in front of camera and its general expiry in the field); (ii) not obscure the cameras vision; and (iii) so that animals only interacted in the 50 mm area that is in the focus range of the camera (Fig. 1). See Appendix S1 for access to this 3-D bait holder model. Bait was the standard small mammal mix of honey, peanut butter and rolled oats.

Five selfie traps were placed on trees at heights of 2 m and five selfie traps were placed on the ground, at private properties in the Illawarra region of New South Wales, Australia. Trees and surrounding vegetation were sprayed with a diluted attractant of honey and water. Cameras recorded for 10–30 days before batteries were depleted.

Image quality analysis

To evaluate the success of the selfie trap, photos of animals interacting with the bait were defined as target or non-target images. Target images were defined as: (i) individuals in focus; and (ii) displaying the anterior or lateral face profile. Non-target images were defined as either: (i) un-focused; (ii) having highly angular variations of the face; or (iii) the posterior of the individual.

Results

Four species were recorded across all ten cameras (Brown Antechinus, Bush Rat, Common Brushtail Possum and Sugar

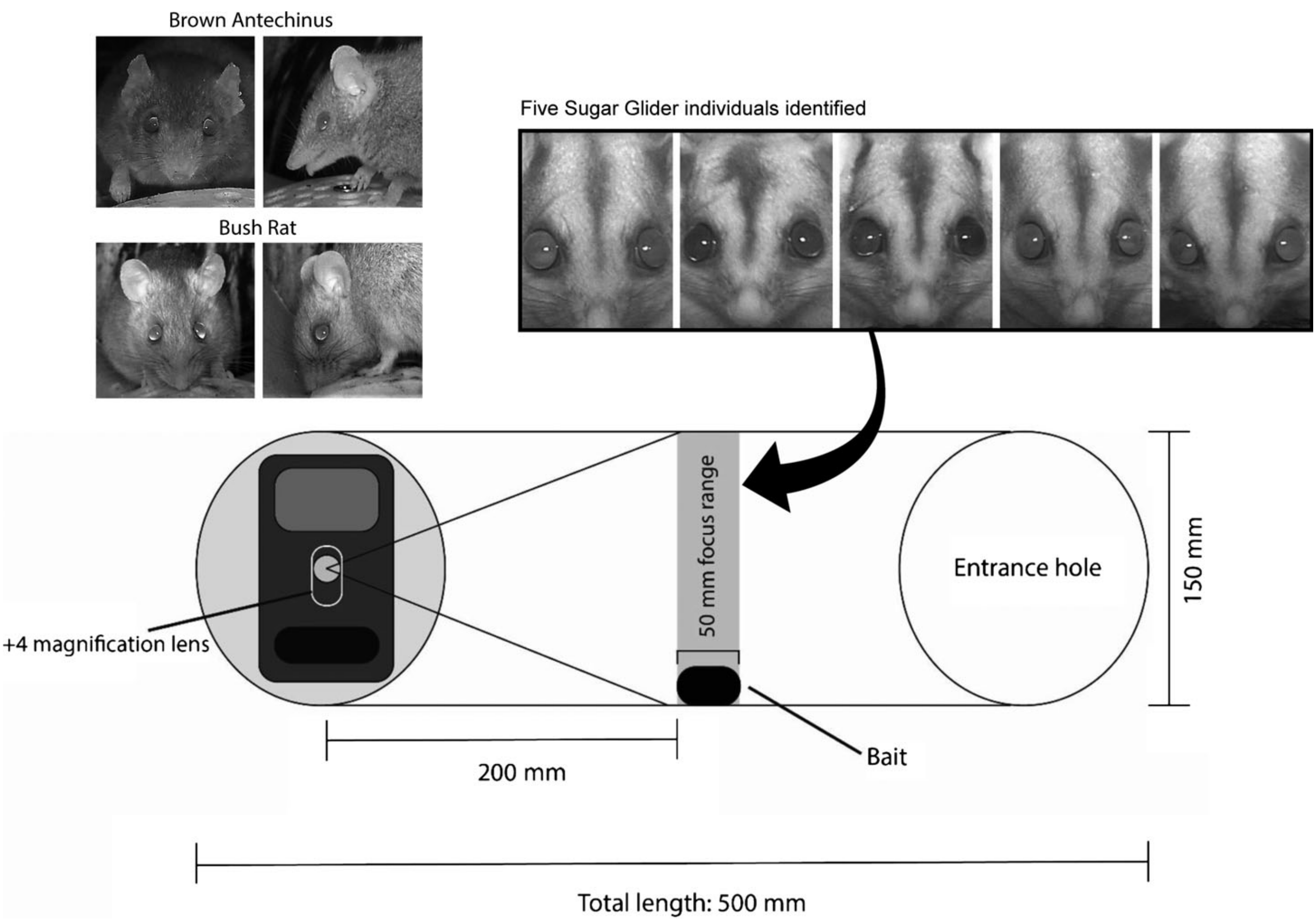

Figure 1. Selfie trap design: a 150 mm diameter white PVC pipe, with a camera fixed to a PVC pipe cap facing a bait station. A close focus lens is fixed on the camera lens, allowing focused images to be captured between 200–250 mm from the front of the camera. Five individual Sugar Gliders identified from a single selfie trap are shown. Example side and front photos of Brown Antechinus and Bush Rat are shown.

Glider). Across all selfie traps, there was a false trigger rate of 0.005% (3 false triggers across 622 triggers). The number of videos that contained target photos for each small mammal species were: 47% for Brown Antechinus (114/243), 41% for Bush Rat (50/122) and 61% for Sugar Glider (138/225). Despite a large proportion of videos deemed non-target (many animals interact with the bait with their backs to the cameras), the initial approach and interaction with the bait result in many of the visitors having a target photo taken. In one arboreal selfie trap alone across thirty trap nights; 125 videos of Sugar Gliders were recorded, and we identified five individuals at this site using target photos that clearly display unique pelage markings (Fig. 1).

Discussion

Despite many videos identified as 'non-target' these were still deemed useful, as a series of such videos in close succession provided a more holistic morphological inventory for species identification (whole body colouration, shape, tail morph and length, etc.). It is recommended that video recording is used to increase the probability that a target image is captured. The selfie trap could be applied to study other small mammal species of a similar nature, such as a range of rodent, small possum and glider species. The selfie trap can be used in presence/absence surveys in lieu of live trapping, as well as to obtain a non-intrusive measure of abundance of Sugar Gliders and distinguish them from Squirrel Gliders.

The selfie trap can obtain high resolution and standardised images that not only allow for accurate species identification, but also provide potential for individual identification of small mammal species. This is evident for species such as the Sugar Glider that have unique pelage patterns; however, species that lack unique markings could be analysed using image processing techniques such as geometric morphometrics or artificial intelligence platforms (Zelditch *et al.* 2004; Norouzzadeh *et al.* 2018). The application of the selfie trap with these techniques warrants further attention, which requires validation through live trapping results to confirm if it can accurately measure abundance in small mammal species that have similar appearance between individuals.

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The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1. Bait tube holder model for 3-D printing: https://figshare.com/s/b49dda517b1b0f4df71e