Aerial detection of the presence of a burrowing marsupial, the greater bilby, using remotely piloted aircraft

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GOVERNMENT OF WESTERN AUSTRALIA

Fig 1. The greater bilby (*Macrotis lagotis*). *Photo - Jiri Lochman*

Introduction

Greater bilbies (Fig 1), a threatened burrowing marsupial (Fig 2), dig for food, turn over soil extensively (Fig 3), and have been described as ecosystem engineers[1]. They are nocturnal and cryptic and not easily observed or trapped, are sparsely distributed across large areas, and populations can move across the landscape[2,3], detection has therefore relied on sign, such as tracks, scats, diggings and burrows (Fig 3).

Remotely Piloted Aircraft (RPA) are fast becoming a cost-effective, alternative technology for fauna survey and monitoring[4]. Southgate *et al*[5] found aerial survey by helicopters to be an efficient technique for bilbies, however, costs of manned aircraft and associated logistics are high in remote areas. RPA transmitting a live video feed provides immediate information about an area whilst in the field, and can negate the need for lengthy post-processing of footage.

Aerial survey using RPA may be an efficient technique if the detectability of bilby sign from video imagery proves to be reliable. Our aim was to determine the effects of altitude, speed and camera angle on the detectability of bilby diggings.

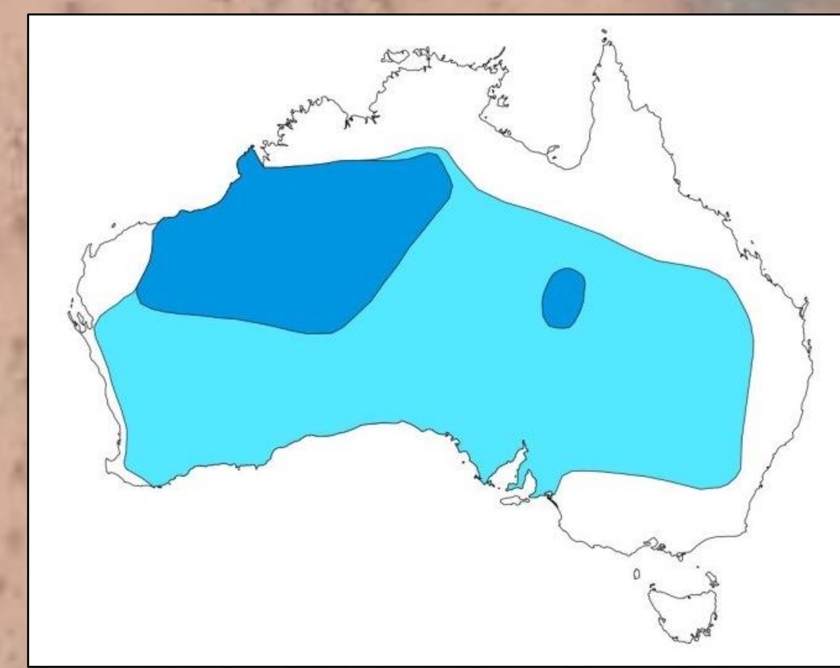

Fig 2. Historic (■) and present (■) distribution of the greater bilby in Australia.

Fig 3. Bilby diggings are often found at the base of *Acacia* spp. but may also be observed in the open.

Methods

A small multi-rotor DJI Phantom 4 RPA (Fig 4) was used to test 12 flight profiles over an area occupied by bilbies (Fig 5) in the Pilbara, north western Australia. Combinations of two altitudes (12 and 25 m), two camera angles (45° and 56.25°) and three speeds (6, 8 and 12 km/hr) were used. All flights were in clear and sunny conditions around midday to avoid shadows. All diggings within the flight path were recorded by ground-truthing (Fig 5). The number of observed diggings were scored from video footage by 13 observers under simulated live video feed conditions. Observer was used as a random, blocking factor in the ANOVA.

Fig 4. Multi-rotor RPA being used to survey bilby habitat.

Results

There were no significant effects of interactions (Table 1). There were significant differences of the main effects of altitude and speed (Table 1). Significantly more diggings were detected at the flight altitude of 12 m than 25 m (Fig 7). Significantly more diggings were detected at 6 km/h than at 10 km/h (Fig 7; LSD: $P = 0.004$). There was no significant effect of camera angle (Table 1).

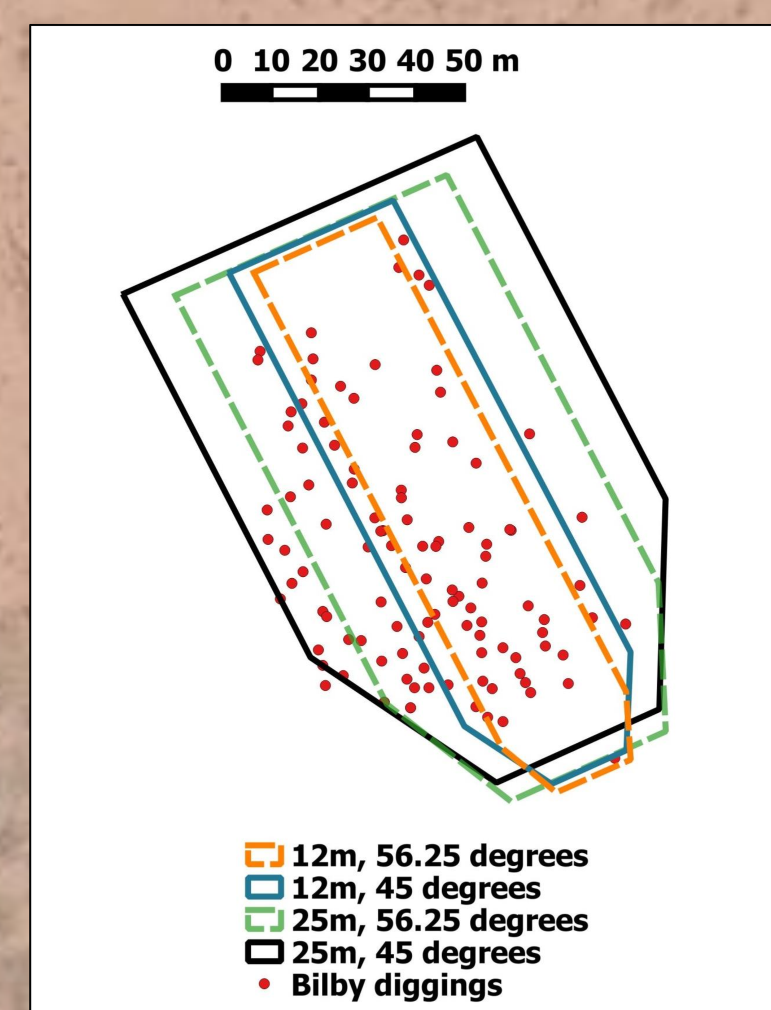

Fig 5. Flight path FOV (camera FOV × flight path length) of each altitude and camera angle treatment and bilby diggings recorded from ground-truthing.

Discussion and Management Implications

We identified that lower altitude and slower speed result in increased detectability of bilby sign. Lower altitude resulted in a threefold increase in the proportion of diggings detected. As altitude increases and the field of view (FOV) increases, more diggings are present in the FOV (Fig 5), however the decrease in detectability results in a lower proportion of diggings detected.

A decrease in speed resulted in an increase in detectability, but not to the same magnitude as altitude. Flying lower and slower resulted in higher detectability; however there is a trade-off between speed and the total distance a RPA can fly due to limited battery power if viewing live footage in the field. Therefore increasing the speed to 8 km/h with a slight cost in detectability will allow the RPA to cover 30 % more ground over a 20 min flight time.

The effect of time of day, lighting conditions and different vegetation types still require testing. We recommend ground-truthing to determine false positive and negative error. With the rapid development of RPA and battery technology, combined with an understanding of the detectability of sign, RPA have the potential to become a useful tool in detecting the presence of species, particularly mammals that leave digging sign, in remote locations or across large areas.

Fig 6. Images of the FOV from each altitude and camera angle treatment: A. 12 m and 45°; B. 25 m and 45°; C. 12 m and 56.25°; D. 25 m and 56.25°.

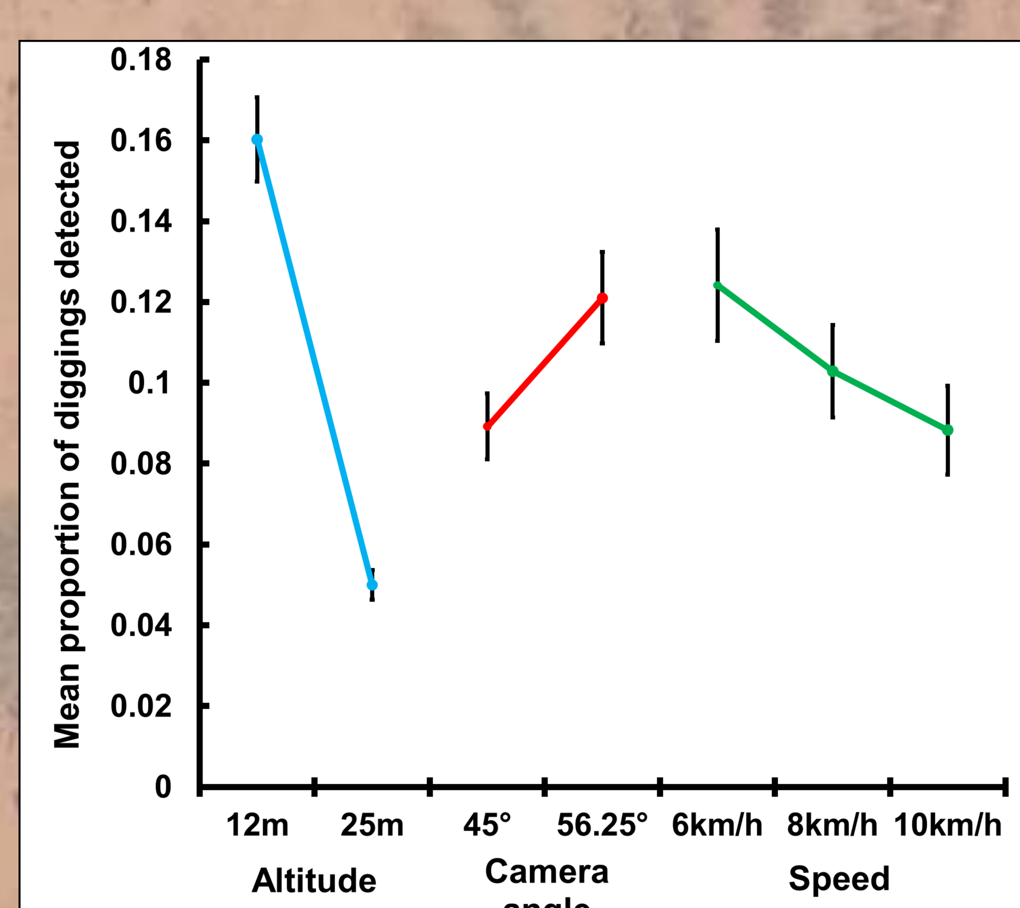

Fig 7. Mean proportions (±1 SE) of diggings detected for each main effect.

Table 1. ANOVA of the number of detections of bilby diggings.

Source	d.f.	MS	*F*	*P*	Effect size (η_p^2)
Altitude (A)	1	762.981	51.113	<0.001	0.279
Camera angle (C)	1	1.083	0.073	0.788	0.001
Speed (S)	2	63.404	4.247	0.016	0.060
A x C	1	1.853	0.124	0.725	0.001
A x S	2	24.981	1.673	0.192	0.025
C x S	2	5.583	0.374	0.689	0.006
A x C x S	2	7.160	0.480	0.620	0.007
Observer	12	55.120	3.693	<0.001	0.251
Error	132	14.927			

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