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1 **Observations on the behaviour of the northern hairy-nosed wombat (*Lasiorhinus***
2 ***krefftii*) in a translocated population**

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11

12 **Abstract**

13 The natural distribution of the critically endangered northern hairy-nosed wombat
14 (*Lasiorhinus krefftii*), is confined to Epping Forest National Park, Queensland; however, a
15 small number of animals have been translocated to establish an insurance population at
16 Richard Underwood Nature Refuge (RUNR), Queensland. Northern hairy-nosed wombat
17 behaviour is poorly understood, mostly due to its cryptic behaviour. Thirty-two wildlife
18 cameras set up at burrow mouths at RUNR were used to capture social and solitary
19 behaviour. Over a six month period between December 2016 and May 2017, 0.31% (21
20 videos of 6607) of recordings captured social behaviour, suggesting that the northern
21 hairy-nosed wombat is actively avoiding social interactions at the burrow mouth.

22 Vocalisation was only observed during social interaction. The results were similar to data
23 from Epping Forest National Park and studies on other wombat species. In this respect the
24 translocated population appeared to behave in a manner typical of the wild population.

25

26 **Key words:** *Mammal; Marsupial; Semi-arid; Burrowing Behaviour*

27 **Introduction**

28 Understanding the behaviour of endangered species can assist their conservation. The
29 critically endangered northern hairy-nosed wombat (*Lasiorhinus krefftii*) is a large,

30 herbivorous marsupial that displays nocturnal behaviour and a semi-fossorial nature
31 (Shimmin and White, 2002; Horsup, 2004; Hogan *et al.*, 2009). The species' only natural
32 population is confined to Epping Forest National Park, Queensland (146°42 E, 22°21 S)
33 (Johnson, 1991b); however, a small translocated population has been established within
34 the species' former range, at St. George, Queensland (Johnson, 1991b; Dinwoodie, 2012)
35 within the Richard Underwood Nature Refuge (27°40'3.62S, 148°42'14.27). Between July
36 2009 and September 2010 five male and ten female wombats have been brought to the site
37 with births and mortalities the population during this study was 10 animals.

38 The behaviour of the northern hairy-nosed wombat has been little studied due to the
39 species' nocturnal activity patterns and semi-fossorial behaviour (Johnson and Crossman,
40 1990; Hogan *et al.*, 2009). It is generally agreed, however, that the northern hairy-nosed
41 wombat displays solitary behaviour (Johnson, 1991a). Stenke (2000) directly observed
42 social interactions between individuals at Epping Forest National Park; however, from
43 1300 observation hours, only 12 social interaction observations (wombat/wombat) were
44 made.

45

46 The objectives of this study were to: (a) describe elements of solitary and social
47 behavioural patterns of wild northern hairy-nosed wombats in the vicinity of burrow
48 entrances; and (b) determine the effectiveness of using remote camera traps for
49 behavioural studies of wombats.

50

51 **Methods**

52 *Field site*

53 The Richard Underwood Nature Refuge (RUNR) is a 130 ha property surrounded by
54 agricultural land, near St. George, Queensland, and is managed by the Queensland
55 Department of Environment and Science (DES). The major vegetation communities found
56 are tussock grassland mainly dominated by the introduced buffel grass (*Cenchrus ciliaris*),
57 open woodland with species including poplar box (*Eucalyptus populnea*), and dense
58 woodland especially dominated by cypress pine (*Callitris preissii*). There are 61 burrows
59 within the RUNR site (Figure 1), occupied by 10 translocated northern hairy-nosed

60 wombats, with 20 burrows recognised as ‘primary’ burrows (DES) –currently known to be
61 occupied by wombats frequently.

62 *Remote camera monitoring*

63 Eighteen burrows are equipped with one or more cameras in an ongoing monitoring
64 program using 32 camera traps (Trophy Cam HD 119466/119467 and Trail Aggressor
65 Cam HD 119776C) Cameras were only set at burrows known to be active (determined by
66 presence of fresh tracks and scats) and were situated at the end of the burrow ‘runway’, at
67 a distance of three to five meters, to minimise disturbance.

68 Camera SD cards were retrieved every two days. All cameras were set for 30 second
69 videos when triggered, with 10 second delay between triggers, and were mounted on solar
70 panel tripods (SLIK F153) to maintain battery charge. As the cameras had been deployed
71 for approximately five years, wombats are assumed to be habituated to the cameras, and
72 not to display any altered behaviour on recordings. Data were collected for a six month
73 period (December 2016–May 2017).

74 *Wombat behaviour*

75 Following Stenke (2000), solitary behaviour was defined as any activity by a single
76 wombat recorded in the field of view of a camera placed at the mouth of the burrow.
77 Social behaviour was defined as any activity by two or more wombats recorded in the
78 same field of view. However, these definitions are only based on the focal area of the
79 behavioural observations, at the burrow mouth. Behavioural interactions outside and away
80 from the burrow mouth were not investigated in this study. All video captures which
81 included more than one wombat were identified within the dataset and were extracted for
82 analysis. Due to the highly unbalanced nature of the observations (0.3% social, 99.7%
83 solitary) a randomised subset of solitary observations was selected to create numerical
84 balance using a random number generator; this sample was stratified by date to ensure
85 seasonal effects were captured in analysis.

86 Videos were treated as focal animal samples (Altman 1974) and scored using an ethogram
87 developed specifically for this study with more detailed levels of behavioural definition
88 [Fine] nested within broader behavioural categories [Coarse] to enable post-hoc clustering
89 of behaviours if required for analysis (Table 1). Behavioural descriptions are modified

90 from those defined in previous wombat studies, and other fauna studies (Stenke, 2000;
91 Hogan, 2004; Hogan *et al.*, 2009; Nevin and Gilbert, 2005).

92

93 *Statistics*

94 A contingency table analysis was used to test the difference between time in coarse
95 behavioural categories for solitary and social wombats. A time budget was developed across
96 the six month observation period for both solitary wombats and social interactions, outlining the
97 basic behaviour of vocalization, compared to the corresponding solitary behaviour. Behaviour
98 was classified in three ways; (1) coarse behaviour, (2) fine behaviour, and (3) 'social'
99 behaviour.

100

101 **Results**

102 A total of 6607 video captures was collected between December 2016 and May 2017. Of
103 these, just 21 (0.3%) represent social events, with two wombats present; the remainder
104 were solitary individuals. There were no video captures with more than two wombats
105 present. No wombats could be individually identified. Social events are therefore
106 described between individuals as a broad description independent of sex or age.

107

108 In cases where two animals appeared together, interaction occurred. This included chasing
109 (in aggressive instances), vocalizing, and alertness. In the few instances where two animals
110 were captured on camera vocalizing, it appeared to be the approaching animal which
111 started calling. Behaviours observed during social events included running, alertness,
112 sitting and standing (Figure 2). It was found that the coarse behaviour locomotion
113 decreased during social interactions by approximately 50%.

114 The main behaviours of solitary animals were locomotion (walking and lying down),
115 grooming (scratching) and scent marking (defecating) (Figure 2). Additional behaviours
116 observed in solitary events included lying down, sitting, and grooming.

117 There was a significant difference ($X^2=12.59$, $df=6$, $p=<0.01$) in the frequencies of coarse
118 behavioural categories between solitary and social individuals.

119

120 **Discussion**

121 This is the first study to examine the behaviour of a translocated population of the northern
122 hairy-nosed wombat, and only the second behavioural study with this species overall. Out
123 of the 6607 videos recorded, only 0.3% were of social interaction. Similar results were
124 found by Stenke (2000), where out of 1300 observation hours, only 12 incidents of social
125 behaviour were recorded. This suggests that the northern hairy-nosed wombat may avoid
126 social interaction, presumably to facilitate maintenance of low metabolic activity, and
127 digestion of relative low quality food with no excess energy expenditure (Woolnough,
128 1998). However social interactions were occasionally recorded at the burrow entrances,
129 and usually with apparent agonistic behaviour displays including alertness, vocalization,
130 and avoidance or chasing.

131 The use of digital video recording systems for monitoring the behaviour of the northern
132 hairy-nosed wombat was shown to be successful but was limited to the immediate vicinity
133 of the burrow entrances primarily lives as a solitary individual. Johnson and Crossman
134 (1991) found similar results, where both solitary and communal behaviour were recorded
135 in the species. Communal behaviour was referred to as an overlap of burrow use. In this
136 study the frequency of solitary behaviour and social behavioural events were significantly
137 different.

138 Vocalisations were only recorded at burrow entrance when two wombats were present. A
139 significant increase in energy intensive behaviours, including walking and running, during
140 social interactions was also seen. It may be that this increased energy cost is potentially
141 driving the low occurrence of social interaction at burrow entrances. If this high frequency
142 of solitary behaviour is a consequence of active avoidance, the mechanism for such
143 avoidance remains unclear.

144

145 This study has demonstrated that cameras are a suitable method for monitoring and
146 assessing the behaviour of northern hairy-nosed wombats at occupied burrows. Further
147 investigation of behaviour can be accomplished by GPS-collaring, to explore ranging
148 behaviour and more detailed burrow sharing in the northern hairy-nosed wombat. Social
149 behaviour can furthermore be explored by adding proximity loggers to collars. This has

150 been used in cattle (Patison *et al.*, 2010) and koalas (Ellis *et al.*, 2015), to determine
151 interaction between individuals, and would potentially give an additional perspective in
152 social behaviour of the northern hairy-nosed wombat.

153

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159

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201

202

203 The Authors declare no conflict of interest.

204

205 **Table 1. Ethogram coding of behavioural categories and their definitions used during**
 206 **monitoring of the northern hairy-nosed wombat (Nevin and Gilbert 2005; Hogan *et***
 207 ***al.*, 2009).**

208

Coarse	Fine	Description
00 Unobservable		Not visible on camera but wombat vocalizations audible on video recording
10 Locomotion	11 Walking	Slow ambulation
	12 Running	Rapid ambulation
	13 Stopping	Cessation of movement
	14 Lying Down	Lying flat on stomach or flank
	15 Sitting	Sitting position with hind legs tucked under the body. Front legs still stretched.
	16 Digging	Digging around, or at, the burrow entrance
	17 Standing	Weight on all four feet, stationary
20 Grooming	21 Scratching	Using any leg to scratch, usually from a sitting position
	22 Dusting	Lying on flank, flicking dirt with front leg on abdominal region
30 Alertness	31 Looking	Passively looking around, no tension observed
	32 Listening/ staring	Ears forward or towards side, tension in body composure
40 Foraging	41 Foraging	Eating surrounding vegetation
50 Social behaviour	51 Passive	Lying, sitting or standing participants without vocalization or movement
	52 Active	One or both participants walking or running past each other, vocalization can be present
	53 Aggressive	Chasing of participants accompanied by strong vocalization
60 Scent communication	61 Urinating	
	62 Defecating	
	63 Sniffing	Nose towards ground, either slow movement or cessation of movement
70 Other		

209