

Supplementary Material

Evaluating aerial net gunning and chemical immobilisation for capture of invasive sambar deer (*Rusa unicolor*) and red deer (*Cervus elaphus*) in alpine Australia

Eliane D. McCarthy^{A,*}, *Jordan O. Hampton*^{B,C}, *Rob Hunt*^D, *Stuart Williams*^E, *Grant Eccles*^D, and *Thomas M. Newsome*^A

^ASchool of Biological Sciences, The University of Sydney, Sydney, NSW2000, Australia.

^BFaculty of Veterinary and Agricultural Sciences, University of Melbourne, Parkville, Vic.3052, Australia.

^CTerrestrial Ecosystem Science and Sustainability, Harry Butler Institute, Murdoch University, Perth, WA6150, Australia.

^DNew South Wales National Parks and Wildlife Service, New South Wales National Parks and Wildlife Service, Hurstville, NSW2220, Australia.

^EYass Veterinary Hospital, Yass, NSW, Australia.

*Correspondence to: Eliane D. McCarthy School of Biological Sciences, The University of Sydney, Sydney, NSW 2000, Australia Email: eliane.mccarthy@sydney.edu.au

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Table S1. Capture information, immobilisation and reversal dose information collected for each captured and collared deer: <https://doi.org/10.6084/m9.figshare.21555276>.

S1. Protocol used to estimate the body mass of captured sambar deer (*Rusa unicolor*) from morphometric measurements.

Male and female sambar deer body mass (BM) was estimated using relationships developed from measurements of body length (L; cm) and entire carcass mass (kg) of n = 25 adult male sambar deer and n = 11 adult female sambar deer culled in Victorian state forest in 2012–2013 (Forsyth *et al.* 2014). These relationships were estimated using least squares regression and explained 83.1% and 90.17% of the observed variation for males and females, respectively. The relationship for female sambar deer was:

$$BM = -122.9572 + (1.4919 * L)$$

The relationship for male sambar deer was:

$$BM = -251.818 + (2.327 * L)$$



Fig. S1. Images of male sambar deer (*Rusa unicolor*) taken during aerial net gun capture, and while the animal was recumbent following chemical immobilisation. In the top image, a second net is fired on the sambar deer whilst the animal is restrained by the first net. In the bottom left image, the sambar deer is fitted with a GPS tracking collar (G52D Iridium, Advanced Telemetry Systems, Isanti, MN, USA) and ear tag. The animal wears a blindfold to prevent distress to the animal during immobilisation and antler covers, to prevent harm to personnel working close to the animal during processing. In the bottom right image, a sambar deer is fitted with a blindfold, hobbles, antler covers and an antler protection board.

Image credit: Rob Hunt.

Table S2. Immobilisation quality scoring sheet, used to rate immobilisation quality of aerially net gunned and sedated sambar (*Rusa unicolor*) and red deer (*Cervus elaphus*), adapted from Grint *et al.* (2009).

Immobilisation quality	0	1	2	3	4	Score
Spontaneous posture	Standing	Tired but standing	Lying but can rise	Lying difficulty rising	Unable to rise	
Eye reflex	Normal	Reduced	Slow, full TEL sweep	Slow, partial third eyelid sweep	Absent	
Eye position	Central/alert	Central/relaxed	Forwards/downwards but visible	Forwards/downwards & obscured by TEL	Dilated, nonresponsive	
Jaw tone	Normal	Reduced tone	Much reduced tone	Minimal tone	Absent	
Response to noise	Normal startle	Reduced startle	Relaxed	Minimal startle	Absent reaction	
Resistance in lateral recumbency	Struggling, no lateral recumbency	Some struggle, allows lateral recumbency	Min struggle Permissive	Relaxed	Absent struggle	
General attitude	Excitable	Awake and normal	Tranquil	Drowsy	Comatose	
Mean						

S2. Model output describing post-release mean hourly distances travelled and mean activity of collared sambar (*Rusa unicolor*) and red deer (*Cervus elaphus*) in the 45 days following capture, using generalised additive models fit with thin-plate regression splines.

Sambar males (n = 9)

Mean hourly distance travelled

Param. Terms	Est.	Std. error	t	P
Intercept	3.29	0.05	60.48	<0.001
<i>Month</i>	0.65	0.69	9.39	<0.001
Smooth Terms	edf	Ref. df	F	P
<i>s(t_{overall})</i>	3.26	4.04	1.45	0.2400
<i>s(t_{month}):April</i>	5.02	6.16	2.83	0.0144
<i>s(t_{month}):November</i>	1.00	1.00	1.45	0.2286
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.29	30.6	360	

Mean activity

Param. Terms	Est.	Std. error	t	P
Intercept	-1.04	0.03	-33.85	<0.001
<i>Month</i>	0.71	0.37	18.98	<0.001
Smooth Terms	edf	Ref. df	F	P
<i>s(t_{overall})</i>	3.39	4.20	15.90	<0.001
<i>s(t_{month}):April</i>	4.22	5.20	1.51	0.187
<i>s(t_{month}):November</i>	0.002	0.002	0.002	0.998
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.59	58.3	360	

Sambar females (n = 5)

Mean hourly distance travelled

Param. Terms	Est.	Std. error	t	p
Intercept	3.55	0.05	69.34	<0.001
<i>Month</i>	0.14	0.09	1.59	0.113
Smooth Terms	edf	Ref. df	F	p
<i>s(t_{overall})</i>	5.52	6.66	3.90	<0.001
<i>s(t_{month}):April</i>	1.00	1.00	2.10	0.1488
<i>s(t_{month}):November</i>	0.001	0.002	0.04	0.9929
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.10	12.5	270	

Mean activity

Param. Terms	Est.	Std. error	t	p
Intercept	-0.73	0.03	-26.31	<0.001
<i>Month</i>	0.25	0.05	5.29	<0.001
Smooth Terms	edf	Ref. df	F	P
<i>s(t_{overall})</i>	3.34	4.15	7.84	<0.001
<i>s(t_{month}):April</i>	1.00	1.00	0.18	0.6720
<i>s(t_{month}):November</i>	<0.001	<0.001	0.003	0.9990
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.24	25.9	270	

Red males ($n = 2$)**Mean hourly distance travelled**

Param. Terms	Est.	Std. error	t	P
Intercept	4.36	0.07	59.13	<0.001
<i>Month</i>	-0.37	0.10	-3.56	<0.001
Smooth Terms	edf	Ref. df	F	P
$s(t_{overall})$	6.74	7.63	1.40	0.140
$s(t_{month}):April$	3.68	4.38	1.21	0.411
$s(t_{month}):November$	1.77	2.25	0.24	0.845
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.65	70.3	90	

Mean activity

Param. Terms	Est.	Std. error	t	p
Intercept	-0.37	0.04	-8.85	<0.001
<i>Month</i>	-0.03	0.06	-0.44	0.662
Smooth Terms	edf	Ref. df	F	p
$s(t_{overall})$	7.45	8.13	20.55	<0.001
$s(t_{month}):April$	1.00	1.00	12.47	<0.001
$s(t_{month}):November$	<0.001	<0.001	0.07	0.997
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.69	72.1	90	

Red females ($n = 3$)**Mean hourly distance travelled**

Param. Terms	Est.	Std. error	t	p
Intercept	3.55	0.08	42.09	<0.001
<i>Month</i>	0.65	0.14	4.42	<0.001
Smooth Terms	edf	Ref. df	F	p
$s(t_{overall})$	2.57	3.20	1.94	0.109
$s(t_{month}):April$	1.00	1.00	0.74	0.392
$s(t_{month}):November$	<0.001	<0.001	0.011	0.999
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.15	17.8	135	

Mean activity

Param. Terms	Est.	Std. error	t	p
Intercept	-0.90	0.03	-31.80	<0.001
<i>Month</i>	0.69	0.05	15.06	<0.001
Smooth Terms	edf	Ref. df	F	p
$s(t_{overall})$	1.00	1.00	14.00	<0.001
$s(t_{month}):April$	4.51	5.54	2.43	0.027*
$s(t_{month}):November$	<0.001	<0.001	0.001	0.999
Model fit	R-sq (adj.)	Dev. (%)	No. obs.	
	0.68	68.4	135	

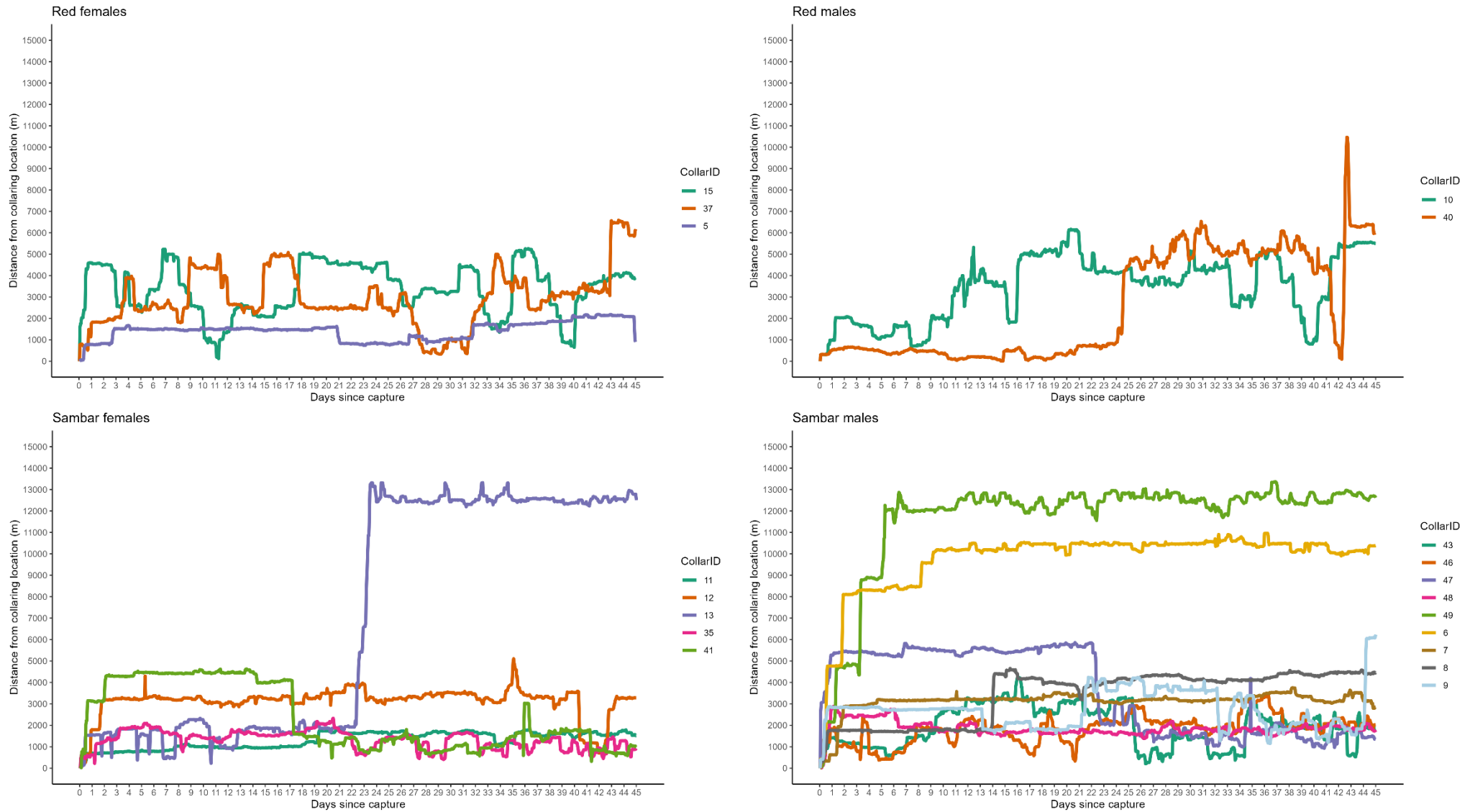


Fig. S2. Distances travelled from capture location for five aerially captured and collared 14 sambar deer (*Rusa unicolor*) and five red deer (*Cervus elaphus*), during a 45-day monitoring period following aerial net gunning, immobilisation, and collaring. Red and sambar deer were captured in Kosciuszko National Park, Australia in over two operation periods, in April and November 2021.

References:

Forsyth, DM, Woodford, L, Moloney, PD, Hampton, JO, Woolnough, AP, and Tucker, M (2014). How Does a Carnivore Guild Utilise a Substantial but Unpredictable Anthropogenic Food Source? Scavenging on Hunter-Shot Ungulate Carcasses by Wild Dogs/Dingoes, Red Foxes and Feral Cats in South-Eastern Australia Revealed by Camera Traps. *PLoS ONE* **9**(6), e97937. doi: 10.1371/journal.pone.0097937.

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