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Wildlife Research

Supplementary Material

Cost-effectiveness of volunteer and contract ground-based shooting of sambar deer in Australia

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Table S1. Key costs (2021 AUD) of ground-based shooting of sambar deer in Alpine National Park, Victoria, Australia, 2015–2020. h, hours; vol., volunteer; cont., contractor.

Cost category	Description	Unit cost (AUD)	<i>n</i>	Total (AUD)
<i>Organisational</i>				
Planning	60 h per year per block	57 ^A	480	27 360
Communication	80 h per year per block	57	640	36 480
Procurement for contract shooters	76 h per year per block	57	608	34 656
Reporting	16 h per year per block	57	128	7 296
<i>Operational</i>				
Pre-operation	8 h per operation (cont.)	57	152	8 664
	12 h per vol. operation (vol.)	57	312	17 784
During operation	4 h per prof. operation (cont.)	57	76	4 332
	35 h per operation (BHP year 1 vol.)	57	315	17 955
	8 h per operation (BHP years 2–4 vol.)	57	88	5 016
	35 h per vol. operation (HWP vol.)	57	210	11 970
Data management	16 h per operation	57	720	41 040
Contractor fees	Per operation	25 000	19	475 000
Accommodation	Volunteer-nights (BHP)	35	330	11 550
<i>Equipment</i>				
Thermal monocular	Unit	5 000	2	10 000
Thermal scope	Unit	7 000	2	14 000
Handheld GPS	Unit	1 000	6	6 000
SMR trunked radios	Unit	1 500	6	9 000
Parks Victoria vehicle	Unit	15 000	1	15 000

^A Average hourly rate (Parks Victoria Enterprise Agreement 2016,

<https://www.fwc.gov.au/documents/documents/agreements/fwa/ae423611.pdf>)

Table S2. Posterior distribution of all model parameters for the effectiveness of different ground-based shooting methods for volunteer shooters in Alpine National Park, Victoria, Australia, May 2015–May 2016. LCL, lower 95% credible interval; UCL, upper 95% credible interval; ess, effective sample size; \hat{R} , Gelman-Rubin diagnostic.

Model parameters	Mean	LCL	UCL	ess	\hat{R}
Dispersion parameter (r)	30.328	1.056	167.171	129700	1.000
<i>Linear effects</i>					
Vehicle spotlight (intercept)	-2.927	-6.374	-0.097	33504	1.000
Day stalking	-11.057	-24.134	-3.777	370021	1.000
Day stalking with gundogs	-1.462	-3.346	0.303	100615	1.000
Night stalking spotlight	-8.001	-22.476	0.396	394401	1.000
Night stalking thermal	-0.009	-1.462	1.479	72155	1.000
Shift duration (hours)	0.447	0.072	0.906	62296	1.000
Team size	-0.290	-1.239	0.684	41087	1.000
<i>Random effect of operation</i>					
Operation 1	0.176	-0.656	1.374	152410	1.000
Operation 2	-0.228	-1.963	0.766	145216	1.000
Operation 3	-0.151	-1.778	0.947	162287	1.000
Operation 4	0.022	-1.103	1.204	244450	1.000
Operation 5	-0.098	-1.199	0.870	146813	1.000
Operation 6	-0.002	-1.092	1.192	122198	1.000
Operation 7	0.284	-0.408	1.466	85061	1.000
Operation 8	-0.026	-1.003	0.962	201083	1.000

Table S3. Posterior distribution of all model parameters for the effectiveness of ground-based shooting using volunteer and contract shooters in Alpine National Park, Victoria, Australia, 2016–2020. LCL, lower 95% credible interval; UCL, upper 95% credible interval; ess, effective sample size; \hat{R} , Gelman-Rubin diagnostic.

Model parameters	Mean	LCL	UCL	ess	\hat{R}
Dispersion parameter (r)	12.455	3.760	51.720	32535	1.000
<i>Linear effects</i>					
Contract shooters (intercept)	-0.264	-1.584	0.885	3396	1.055
Volunteer shooters	-1.521	-2.049	-1.007	26142	1.000
Contractors BHP	0.000	-0.001	0.000	47991	1.000
Contractors HWP	0.000	-0.001	0.001	24416	1.000
Volunteers BHP	0.000	-0.001	0.001	80855	1.000
Volunteers HWP	0.002	0.000	0.003	38264	1.000
Cumulative seasonal kill	0.000	-0.005	0.005	130984	1.000
Number of deer seen	0.186	0.148	0.231	200242	1.000
<i>Random effect of operation within management unit</i>					
Unit BHP-B	0.217	-0.213	0.914	2484	1.071
Unit BHP-D	0.032	-0.431	0.683	2364	1.076
Unit HWP-B	-0.088	-0.689	0.432	3482	1.060
Unit HWP-D	-0.094	-0.698	0.420	3385	1.059
Operation 1	-0.036	-0.570	0.623	2843	1.062
Operation 2	0.239	-0.301	0.986	3141	1.053
Operation 3	0.216	-0.359	0.979	3313	1.050
Operation 4	-0.082	-0.653	0.598	3107	1.057
Operation 5	0.246	-0.281	0.986	3099	1.054
Operation 6	0.107	-0.402	0.785	2879	1.062
Operation 7	0.196	-0.366	0.934	3249	1.053
Operation 8	0.190	-0.333	0.899	2870	1.059
Operation 9	0.181	-0.358	0.900	3079	1.057
Operation 10	0.073	-0.467	0.799	3085	1.055
Operation 11	0.046	-0.476	0.740	2938	1.061
Operation 12	0.301	-0.218	1.082	3255	1.050
Operation 13	0.303	-0.209	1.072	3306	1.052

Operation 14	0.040	-0.512	0.752	3157	1.056
Operation 15	0.261	-0.236	0.994	2977	1.059
Operation 16	0.223	-0.326	0.973	3194	1.053
Operation 17	0.067	-0.449	0.780	2998	1.060
Operation 18	0.180	-0.416	0.928	3423	1.051
Operation 19	-0.034	-0.618	0.663	3202	1.055
Operation 20	0.187	-0.372	0.927	3209	1.054
Operation 21	0.155	-0.448	0.898	3364	1.050
Operation 22	0.046	-0.512	0.770	3216	1.055
Operation 23	0.207	-0.347	0.961	3248	1.053
Operation 24	0.130	-0.532	0.893	3748	1.045
Operation 25	0.017	-0.557	0.742	3246	1.054
Operation 26	0.181	-0.402	0.933	3334	1.051
Operation 27	0.205	-0.343	0.983	3096	1.054
Operation 28	0.083	-0.443	0.859	3178	1.055
Operation 29	0.268	-0.258	1.037	3207	1.052
Operation 30	0.270	-0.256	1.026	3274	1.053
Operation 31	0.091	-0.426	0.796	2977	1.059
Operation 32	0.282	-0.214	1.013	3016	1.057
Operation 33	-0.145	-0.842	0.451	4848	1.040
Operation 34	-0.144	-0.812	0.438	4639	1.044
Operation 35	-0.096	-0.748	0.500	4541	1.046

Table S4. Posterior distribution of all parameters from the Resource Utilisation Function (RUF) based on the utilisation distribution (UD) of volunteer and contract shooters in Alpine National Park, Victoria, Australia, 2016–2020. LCL, lower 95% credible interval; UCL, upper 95% credible interval; ess, effective sample size; \hat{R} , Gelman-Rubin diagnostic.

Model parameters	Volunteer shooters					Contract shooters				
	Mean	LCL	UCL	ess	\hat{R}	Mean	LCL	UCL	ess	\hat{R}
<i>Zero inflation</i>										
Intercept	-12.6643	-20.3174	-6.2013	7476	1.001	-11.6388	-18.4417	-6.1911	7476	1.001
Distance to roads	0.0079	0.0038	0.0127	7350	1.001	0.0084	0.0039	0.0139	7350	1.001
Distance to watercourses	0.0016	-0.0028	0.0060	7073	1.000	0.0059	0.0009	0.0119	7073	1.000
Distance to peatlands	0.0059	0.0024	0.0104	7377	1.001	0.0021	0.0008	0.0040	7377	1.001
Probability of wooden vegetation cover	0.0185	-0.0614	0.0984	6997	1.000	0.0516	-0.0150	0.1262	6997	1.000
Slope	0.3983	0.0854	0.7626	7091	1.000	0.1982	-0.0773	0.5012	7091	1.000
Sambar deer activity	0.6266	-0.1098	1.5012	7006	1.000	0.1995	-0.4353	0.8378	7006	1.000
<i>Beta distribution</i>										
Intercept	-5.9596	-7.1943	-4.7532	7530	1.000	-5.8736	-6.7428	-5.0415	7530	1.000
Distance to roads	-0.0015	-0.0027	-0.0004	6990	1.000	-0.0003	-0.0014	0.0006	6990	1.000
Distance to watercourses	-0.0015	-0.0025	-0.0007	6428	1.000	-0.0007	-0.0019	0.0004	6428	1.000

Distance to peatlands	-0.0003	-0.0017	0.0010	1860	1.007	-0.0003	-0.0014	0.0006	1860	1.007
Probability of wooden vegetation cover	0.0013	-0.0189	0.0215	6471	1.000	-0.0071	-0.0233	0.0094	6471	1.000
Slope	-0.0917	-0.1827	-0.0048	6619	1.000	-0.0613	-0.1402	0.0196	6619	1.000
Sambar deer activity	-0.0414	-0.2315	0.1478	6967	1.000	-0.0348	-0.1859	0.1006	6967	1.000

Fig. S1a: Space-use of volunteer and contract deer shooters in the management block BHP in Alpine National Park, Victoria, Australia, 2016–2019. Shooters' utilisation distributions (UD) were calculated using the biased random bridge method (BRB) with GPS locations collected every five minutes.

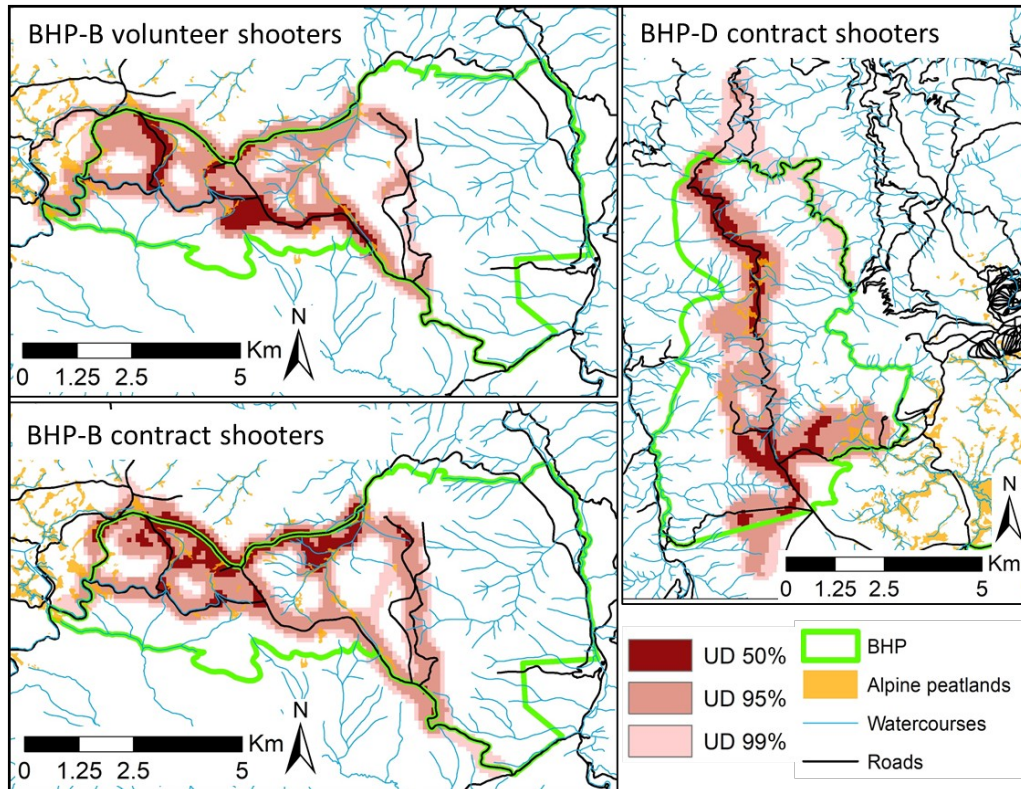


Fig. S1b: Space-use of volunteer and contract deer shooters in the management block HWP in Alpine National Park, Victoria, Australia, 2016–2020. Shooters' utilisation distributions (UD) were calculated using the biased random bridge method (BRB) with GPS locations collected every five minutes.

