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Wildlife Research

Supplementary Material

The application of catch–effort models to estimate the efficacy of aerial shooting operations on sambar deer (*Cervus unicolor*)

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Table S1. Parameter estimates from the fitted model (Equation 1 & 2). SD – standard error; LCL – lower 90% credible limit; UCL – upper 90% credible limit; \hat{R} – Brooks-Gelman-Rubin convergence diagnostic, based on 30,000 MCMC iterations.

Parameter	Estimate	SD	LCL	UCL	\hat{R}
$\beta[1]$	0.4	0.12	0.21	0.6	1
$\beta[2]$	0.36	0.14	0.12	0.59	1
$\beta[3]$	-0.76	0.19	-1.1	-0.46	1
$\beta[4]$	-2.7	0.53	-3.7	-1.9	1
$\beta[5]$	-0.9	0.2	-1.2	-0.57	1
$\beta[6]$	-0.62	0.21	-0.97	-0.3	1
$\beta[7]$	0.34	0.099	0.17	0.5	1
$\beta[8]$	-0.51	0.27	-0.98	-0.092	1
$\beta[9]$	1	0.063	0.92	1.1	1
$\beta[10]$	0.19	0.14	-0.048	0.41	1
α	-2.2	0.069	-2.4	-2.1	1
$\kappa[1]$	0.32	0.068	0.21	0.43	1
$\kappa[2]$	-0.69	0.13	-0.92	-0.47	1
$\kappa[3]$	-0.0055	0.17	-0.28	0.27	1
$\kappa[4]$	-0.43	0.62	-1.5	0.5	1
$\kappa[5]$	-0.16	0.15	-0.41	0.089	1
$\kappa[6]$	-1.2	0.34	-1.8	-0.67	1
$\kappa[7]$	0.19	0.077	0.068	0.32	1
$\kappa[8]$	-0.19	0.35	-0.77	0.37	1
$\kappa[9]$	0.13	0.035	0.071	0.18	1
$\kappa[10]$	-0.16	0.094	-0.31	-0.0026	1
μ_k	-0.21	0.21	-0.56	0.11	1
σ_k	0.58	0.2	0.33	0.95	1
$\eta[1]$ (intercept)	0.15	0.045	0.073	0.22	1
$\eta[2]$ (elevation)	-0.2	0.041	-0.27	-0.13	1
$\eta[3]$ (season)	0.21	0.061	0.11	0.31	1
$\eta[4]$ (elevation \times season)	0.33	0.071	0.21	0.45	1

Table S2. Average proportional overlap (OL) of the operational area (Area) at each site achieved each primary period by the helicopter while searching. Min, Max – minimum and maximum proportional overlap, respectively.

Site	Area (km²)	OL	min	max
Alpine NP - Bogong High Plains	717	0.51	0.33	0.61
Alpine NP - Eastern Alps	393	0.34	0.16	0.85
Burrowa-Pine Mountain NP	205	0.69	0.43	0.89
Coopracambra NP	200	0.41	0.24	0.58
Croajingolong NP	574	0.43	0.14	0.56
Errinundra NP	386	0.41	0.26	0.60
Mt Buffalo NP	266	0.67	0.58	0.77
Mt Mitta Mitta RP	39	0.95	0.93	0.98
Snowy River NP	1077	0.60	0.44	0.71
Wabba WP	214	0.63	0.18	0.98

Table S3. Summary of estimates of the initial (*N*) and residual (*R*) densities of sambar deer (deer/km²) at the start and end of each period, respectively, within the operational area at 10 sites in Eastern Victoria. Values in brackets are the 90% credible intervals for the estimates. The operational area (km²) represents the effective search area traversed by the helicopter during searches.

Site	Period	<i>N</i> (90% CI)	<i>R</i> (90% CI)
Alpine NP–Bogong High Plains (717 km ²)	1	1.5 (1.24–1.81)	1.41 (1.15–1.71)
	2	1.17 (1–1.36)	0.73 (0.57–0.93)
	3	1.24 (1.04–1.46)	0.98 (0.78–1.2)
	4	0.79 (0.65–0.94)	0.62 (0.48–0.77)
	5	1.16 (1–1.35)	0.7 (0.54–0.89)
Alpine NP–Eastern Alps (393 km ²)	1	1.44 (1.14–1.79)	1.2 (0.9–1.55)
	2	1 (0.75–1.28)	1 (0.75–1.28)
	3	1.62 (1.27–2)	1.58 (1.24–1.96)
	4	1.35 (1.07–1.67)	1.24 (0.96–1.56)
	5	2.06 (1.62–2.55)	1.97 (1.53–2.45)
Burrowa–Pine Mountain NP (207 km ²)	1	0.48 (0.37–0.61)	0.42 (0.31–0.55)
	2	0.56 (0.44–0.68)	0.35 (0.24–0.48)
	3	0.49 (0.35–0.64)	0.47 (0.34–0.63)
	4	0.57 (0.43–0.73)	0.34 (0.2–0.5)
	5	0.45 (0.27–0.67)	0.44 (0.26–0.66)
Coopracambra NP (200 km ²)	1	0.08 (0.03–0.13)	0.07 (0.02–0.13)
	2	0.09 (0.04–0.16)	0.09 (0.03–0.15)
	3	0.11 (0.05–0.19)	0.11 (0.05–0.19)
	4	0.15 (0.07–0.26)	0.13 (0.05–0.23)
	5	0.16 (0.05–0.3)	0.16 (0.05–0.3)
Croajingolong NP (575 km ²)	1	0.42 (0.3–0.56)	0.35 (0.24–0.49)
	2	0.56 (0.41–0.75)	0.52 (0.36–0.7)
	3	0.57 (0.43–0.74)	0.51 (0.36–0.68)
	4	0.82 (0.61–1.07)	0.82 (0.6–1.06)
	5	0.92 (0.69–1.19)	0.85 (0.62–1.11)
Errinundra NP (386 km ²)	1	0.55 (0.39–0.73)	0.54 (0.38–0.72)
	2	0.65 (0.48–0.83)	0.6 (0.43–0.78)
	3	0.84 (0.63–1.08)	0.79 (0.58–1.04)
	4	0.94 (0.7–1.2)	0.88 (0.65–1.15)
	5	1.24 (0.91–1.62)	1.21 (0.88–1.58)

Mt Buffalo NP (267 km ²)	1	1.41 (1.23–1.62)	1.17 (0.99–1.38)
	2	1.26 (1.12–1.41)	0.82 (0.68–0.97)
	3	1.08 (0.96–1.22)	0.66 (0.54–0.79)
	4	0.96 (0.84–1.09)	0.72 (0.6–0.85)
	5	1.37 (1.23–1.53)	0.54 (0.39–0.7)
Mount Mitta Mitta RP (39 km ²)	1	0.62 (0.45–0.8)	0.44 (0.28–0.63)
	2	0.65 (0.5–0.8)	0.32 (0.18–0.48)
	3	0.42 (0.28–0.6)	0.32 (0.18–0.5)
	4	0.37 (0.23–0.55)	0.19 (0.05–0.38)
	5	0.21 (0.03–0.45)	0.21 (0.03–0.45)
Snowy River NP (1077 km ²)	1	2.79 (2.53–3.09)	1.76 (1.5–2.06)
	2	2.14 (1.97–2.35)	0.99 (0.81–1.19)
	3	1.28 (1.12–1.47)	0.93 (0.76–1.12)
	4	1.16 (1.02–1.31)	0.79 (0.66–0.95)
	5	1.08 (0.93–1.25)	0.91 (0.76–1.08)
Wabba WP (214 km ²)	1	1.22 (0.98–1.48)	1.07 (0.83–1.33)
	2	1.24 (1.03–1.49)	1.07 (0.86–1.31)
	3	1.71 (1.42–2.03)	1.71 (1.42–2.03)
	4	1.91 (1.65–2.2)	1.1 (0.84–1.39)
	5	1.67 (1.3–2.08)	1.53 (1.16–1.94)

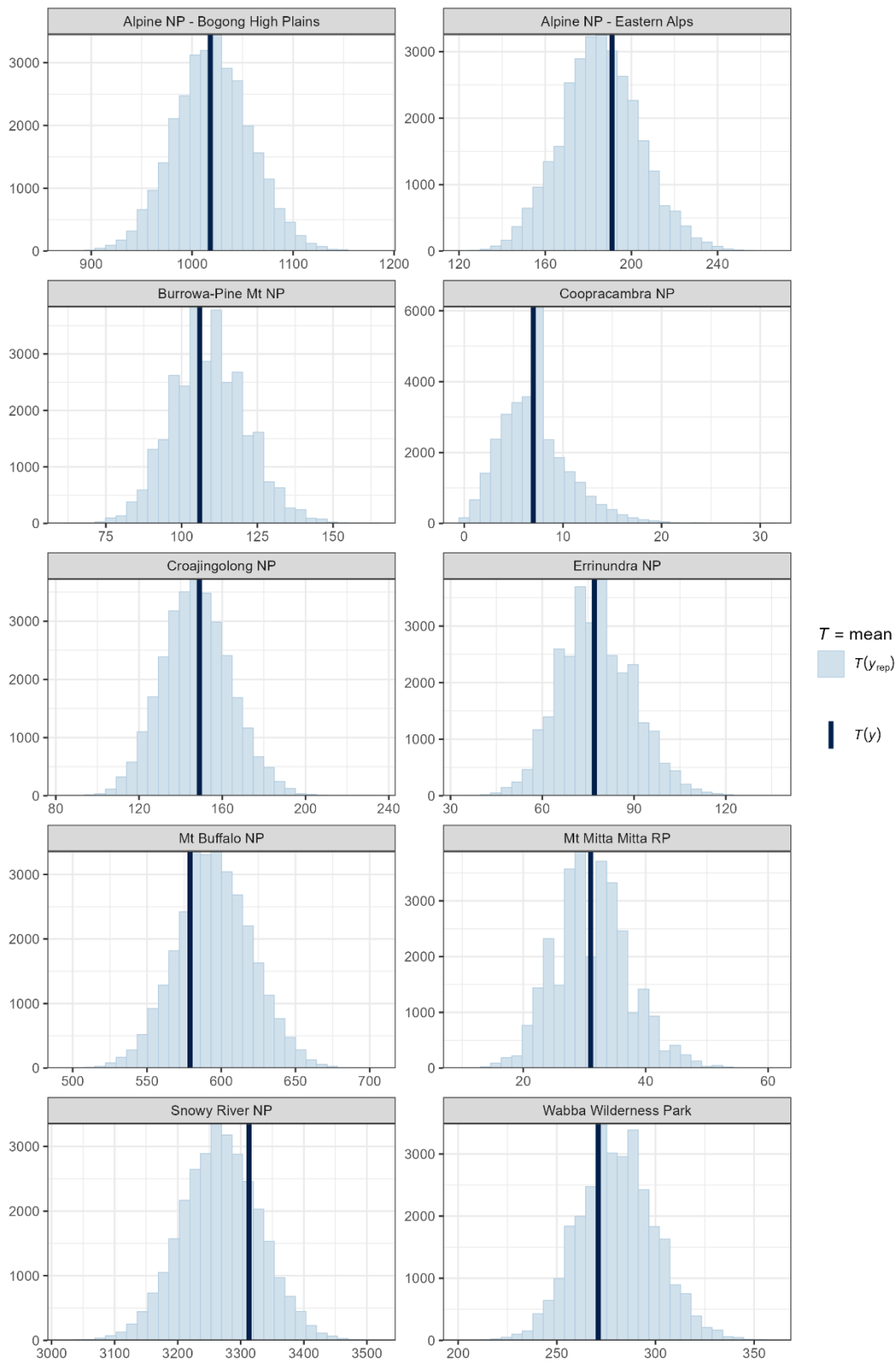


Figure S1. Posterior predictive checks of the number of sambar deer removed from the operational area at each site ($T(y)$ – solid vertical line) versus the distribution of the number of deer removed predicted by the model ($T(y_{rep})$ – light blue bars).

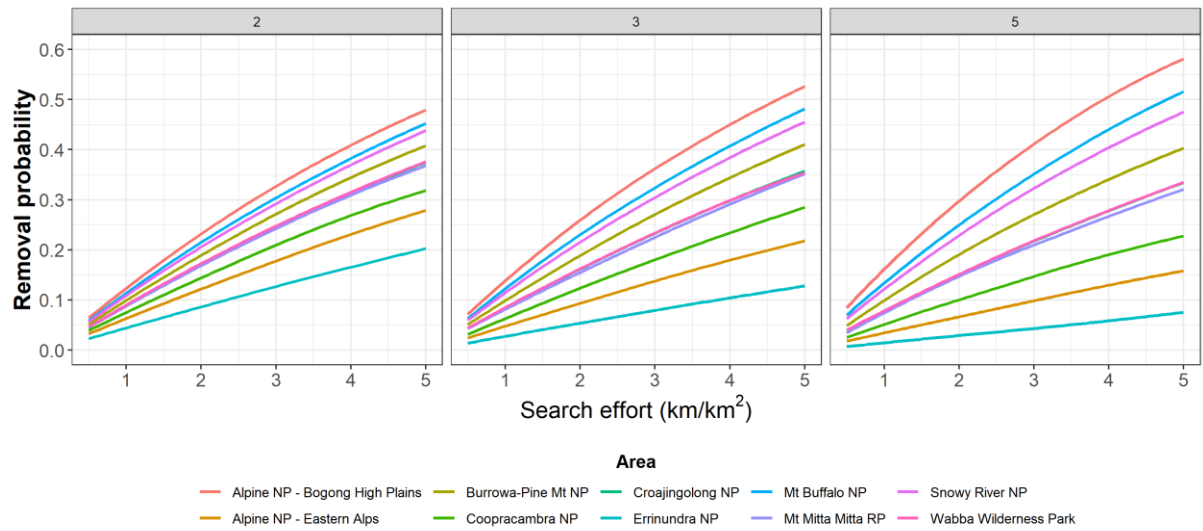


Figure S2. Probability of removal with helicopter search effort (km/km²), for varying number of removal occasions (left to right panels) estimated for 10 sites in eastern Victoria.