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A novel modelling framework to explicitly simulate predator interaction with poison baits

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Appendix S1. Model description

Simulation parameters were drawn from published research on biology and ecology of dingo populations in the WA northern rangelands (see below for details). We assumed that domestic dogs and hybrids could be simulated using the same model parameters as dingoes (Claridge *et al.* 2014).

Dingoes are social animals that live in packs, and we used a maximum pack size of 13 (Thomson, Rose & Kok 1992a). The maximum pack size parameter limited the joining of packs by lone individuals, and forced juveniles to disperse if pack size exceeded 13 after breeding. Each pack establishes a territory, with the maximum allowed territory size being 113 km^2 (Thomson, Rose & Kok 1992a), from which pack members obtain their required resources. Pack territories are not overlapping, while individual's home ranges are (Thomson, Rose & Kok 1992a). Following Heinrichs' (2010) approach, we assumed that the smallest observed pack territory (i.e. 44.5 km^2 or 3.97 hexagons) (Thomson, Rose & Kok 1992a) could occur only in the best quality habitats (score 100), thus we required territories to contain a minimum cumulative resource availability score of 397. Individual *resource targets* (the amount dingoes would consume if resources were unconstrained) was set to 40 for adults and juveniles, and 5 for yearlings. In simply terms, HexSim keeps track of animals' home range distribution and their landscape characteristics (i.e. the resource available). When multiple animals use the same area, these compete for the resource available, with the sum of the resources acquired by all animal available in a particular area being equal to the sum of the resource available. Resource are attributed randomly within individuals of the same social status, although dominant animals (e.g. alpha males) have priority (see below). This indirectly imposed a maximum density of approximately 12 animals per 100 km^2 (Thomson, Rose & Kok 1992a). During the simulations, a resource acquisition category (low, medium, high) was assigned to each individual based on the percentage of the resource target they were able to obtain.

Each pack was assigned an alpha male and an alpha female, and these individuals accounted for the majority of reproduction. In the event that one of these dominant individuals died, alpha status was assigned to another adult member of the pack at random. In roughly 20% of packs, a second female was allowed to successfully reproduce with the alpha-male as well (Thomson, Rose & Kok 1992a). Litter size was drawn from a normal distribution with of mean 5.2 and standard deviation 1.2.

Individuals that could not join or establish a pack were classified as loners (Thomson, Rose & Kok 1992a). Simulated loners were not allowed to reproduce (by definition, a pair that share a territory would constitute a pack). However, loners and packs may compete for the same resources. Data was not available in the literature to estimate the degree of competition between pack members and loners and we set the competition parameter (defined in HexSim as 'pre-emption') to 50%. That is, loners were allowed exclusive access to no more than 50% of the resources available in hexagons they shared with a pack.

Simulated wild dogs were assigned to age classes including juveniles (<12 months), yearlings (13-24 months) and adults (>25 months). Pack size was maintained through density-dependent emigration, triggered when membership exceeded 13 (see above), or when an individual's resources fell below 80% of its target value. Dispersal priority was stratified by age and resources, with non-alpha adults being the first to disperse, followed by yearlings. Pack members' access to the resources available within a territory was stage-stratified, with the alpha male's needs being met first, then the alpha female and juveniles, and finally any non-alpha adults and yearlings. Juveniles were assigned the same resource priority as the alpha female because they derived their resources from the alpha female.

Individuals from a pack dispersed for distances drawn from a lognormal distribution with mean=50.1 km and sd=40.3 km (Thomson, Rose & Kok 1992b). Dispersal distances exceeding 184 km (Thomson, Rose & Kok 1992b) were rejected and replaced with another random draw from the distribution. Loner dispersal distances were drawn from a uniform distribution bound between 11.4 and 42.8 km (Thomson, Rose & Kok 1992b), until they joined or establish a pack. After dispersal, animals explored the landscape in the attempt to establish a home range that met their resource requirements. Maximum allowed home range size was approximately 134 km^2 for adult males, 78 km^2 for other pack members that had dispersed, and 258 km^2 for loners (Thomson 1992).

Survival rates were stratified by both age and resource class, and were modified further to simulate environmental stochasticity. Age-class specific survival rates from Thomson et al (1992a) were assigned to individuals falling in the medium resource category. To include environmental stochasticity in the model, as opposed to the original model where a collection of five values defined as the upper and lower 95% confidence interval (CIs) from Thomson et al (1992a), the mean, and the two mid points between the mean and the CIs were provided and randomly selected (with replacement) each simulated year, we now use the new HexSim v4 feature 'Global Variable' in such a way that at each time step, survival rates were drawn from a normal distribution with mean and standard deviation from the baseline scenario from Pacioni, et al. (2018) parameter values (mean=0.9, SD=0.096 for yearling and adults; mean=0.622, SD=0.082 for juveniles).

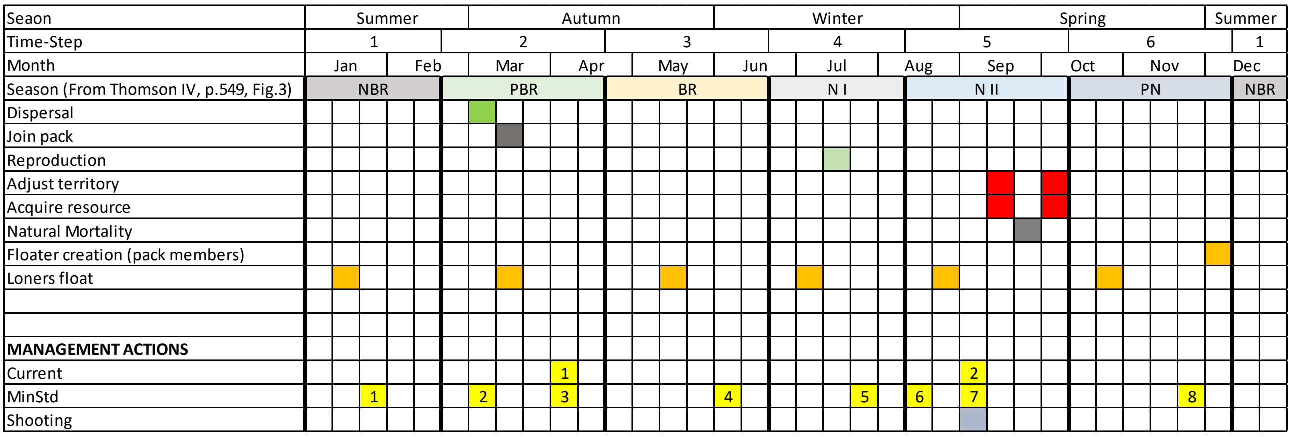

Figure S1. Schematic representation of Thomson's (1992) dogs' seasons, aligned with calendar seasons, model time steps (second line), calendar months (third line) and the life history events in the model within each season.

Table S1. Mean wild dog density (SD) at year 5 and 30 for different scenarios.

		Incomplete		Complete		Small cell	
	λ_0	5 years	30 years	5 years	30 years	5 years	30 years
No Control	n.a.	13.81 (1.68)	13.17 (1.57)	13.97 (1.57)	13.19 (1.570	13.47 (1.77)	13.19 (1.57)
Current Control	0.4	11.8 (1.4)	9.79 (1.59)	11.33 (1.55)	9.27 (1.52)	10.95 (1.76)	9.85 (1.61)
Current Control	1.3	7.53 (1.09)	2.7 (0.62)	7.42 (1.23)	2.34 (0.54)	6.49 (1.33)	1.68 (0.83)
Minimum Standard	0.4	7.93 (1.38)	8.55 (1.36)	7.82 (1.25)	8.3 (1.59)	6.76 (1.41)	8.56 (1.7)
Minimum Standard	1.3	3.19 (0.57)	2.11 (0.5)	2.92 (0.5)	1.87 (0.37)	1.34 (0.55)	0.41 (0.4)
Post-eradication							
No Control	n.a.	0.74 (0.17)	6.91 (1.98)	0.17 (0.05)	4.78 (2.01)	n.a.	n.a.
Current Control	0.4	0.5 (0.13)	1.64 (0.57)	0.11 (0.04)	0.55 (0.36)	n.a.	n.a.
Current Control	1.3	0.36 (0.09)	0.63 (0.24)	0.06 (0.03)	0.18 (0.12)	n.a.	n.a.