Supplementary Material

High survivorship and rapid population growth of the greater bilby (*Macrotis lagotis*) reintroduced to a feral predator exclosure

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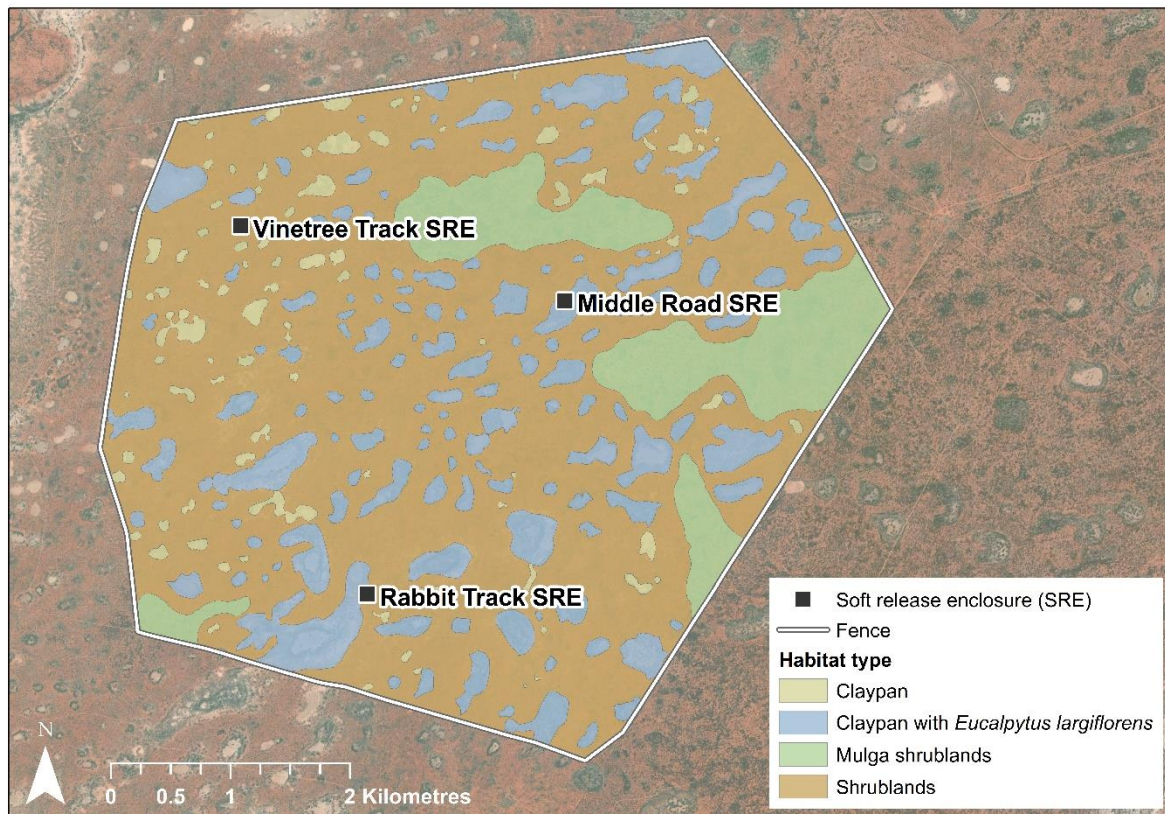
Supplementary material

Fig. S1. Aerial image showing the distribution of habitat types inside the exclosure at Currawinya National Park. The electrified perimeter fence is shown in white. The locations of the three 50 x 50 m soft-release enclosures (SREs) are also shown. (Imagery source: Esri, Maxar, Earthstar Geographics, and the GIS User Community).

Table S1. Autocorrelated kernel density estimation (AKDE) home range area (in hectares) and GPS fixes and fix nights for founder bilbies tracked in 2019, excluding the first month after exiting the soft release enclosure in the exclosure at Currawinya National Park. The approximate age of each bilby is based on records maintained by the captive breeding facility of origin. Bilby weights were measured when the tail-mounted transmitters were attached.

Sex	ID	Origin/Captive breeding facility	Approximate age at commencement of tracking	Weight (kg) at commencement of tracking	Number of GPS fixes (number of tracking nights)	Home range area 95% AKDE (ha)
Female	Balarra	Taronga Western Plains Zoo, NSW	2 years	1.20	204 (23)	95.40
(*n* = 7)	Eyre	Currumbin Wildlife Sanctuary, Qld	2 years	1.19	222 (31)	94.99
	Jane	Ipswich Nature Centre, Qld	2.5 years	1.60	208 (29)	22.26
	Lola	Billabong Sanctuary, Qld	1.5 years	0.94	194 (22)	48.03
	Lulu	Monarto Zoo, SA	2.5 years	1.30	159 (23)	31.80
	Marli	Kanyana Wildlife Rehabilitation Centre, WA	3 years	1.58	315 (43)	49.16
	Opal	Charleville Bilby Experience, Qld	1 year	1.06	182 (25)	16.95
Mean home range size (± s.e.)						**51.23 (± 12.22)**
Male	Barnsy	Halls Gap, Vic	3 years	1.75	205 (24)	582.85
(*n* = 5)	Dusty	Alice Springs Desert Park, NT	2.5 years	2.13	227 (30)	347.43
	Macro [A]	Dreamworld, Qld	3 years	2.81	163 (26)	52.56
	Nung	Charleville Bilby Experience, Qld	1.5 years	2.28	191 (24)	109.27
	Onyx	Dreamworld, Qld	2 years	2.16	154 (30)	150.18
Mean home range size (± s.e.)						**248.46 (± 97.22)**
Mean home range size excluding male (Macro) returned to captivity (± s.e.)						**297.43 (± 108.42)**

[A] Returned to captivity approximately 6–7 months post-release due to ongoing loss of condition.

Table S2. Autocorrelated kernel density estimation (AKDE) home range area (in hectares) and GPS fixes and fix nights for wild-born bilbies tracked in 2021 in the exclosure at Currawinya National Park. All wild-born bilbies were born inside the exclosure at Currawinya National Park, and all were estimated to be between 0.5–2 years of age. Bilby weights were measured when the tail-mounted transmitters were attached.

Sex	ID	Approximate age or age class at commencement of tracking	Weight (kg) at commencement of tracking	Number of GPS fixes (number of tracking nights)	Home range area 95% AKDE (ha)
Female	Balonne	Adult	1.08	232 (25)	14.38
(*n* = 5)	Diamantina	Adult	1.13	236 (25)	18.32
	Georgina	Adult	0.93	174 (22)	29.89
	Mary	Adult	0.97	190 (20)	25.36
	Shell	Adult	1.04	200 (25)	16.04
Mean home range size (± s.e.)					**20.80 (± 2.94)**
Male	Cooper	Adult	1.95	228 (24)	246.77
(*n* = 6)	Gordon	Adult	2.37	204 (25)	224.21
	Mitchell	Adult	1.20	223 (25)	194.39
	Moc	Adult, 2 years [A]	2.28	226 (25)	438.38
	Paroo	Sub-adult, ~0.5 years	0.89	183 (20)	29.53
	Yarra	Adult	1.84	235 (23)	167.15
Mean home range size (± s.e.)					**216.74 (± 54.19)**

[A] This bilby was a first-generation, wild-born bilby of 'Marli' in Table S1. An accurate date of birth was calculate based on multiple recaptures of 'Marli' during different pouch young developmental stages of this bilby.

Table S3. Second order (home range compared to exclosure) and third order (GPS fixes compared to home range) pairwise comparisons from multivariate analysis of variance (MANOVA) of habitat selection for the founders and wild-born bilby groups at Currawinya National Park. Positive (+) and negative (-) signs indicate whether habitats in rows were selected more or less than habitats in columns. Triple signs indicate significant deviation from random selection ($P < 0.05$). Overall habitat ranking is determined by the number of positive selection values in each row (+), with the highest value representing the most selected habitat.

	Claypan	Claypan with *E. largiflorens*	Mulga	Shrublands	Overall ranking
Second order					
Founder bilbies (2019)					
Claypan	0	- - -	+	- - -	1
Claypan with *E. largiflorens*	+++	0	+++	+	3
Mulga	-	- - -	0	- - -	0
Shrublands	+++	-	+++	0	2
Wild-born bilbies (2021)					
Claypan	0	- - -	+	- - -	1
Claypan with *E. largiflorens*	+++	0	+++	-	2
Mulga	-	- - -	0	- - -	0
Shrublands	+++	+	+++	0	3
Third order					
Founder bilbies (2019)					
Claypan	0	-	- - -	- - -	0
Claypan with *E. largiflorens*	+	0	-	-	1
Mulga	+++	+	0	+	3
Shrublands	+++	+	-	0	2
Wild-born bilbies (2021)					
Claypan	0	+	-	-	1
Claypan with *E. largiflorens*	-	0	0	- - -	0
Mulga	+	+	0	+	3
Shrublands	+	+++	-	0	2

Table S4. Second and third order habitat selection and use for the founder bilbies (2019) released to the exclosure, and wild-born bilbies (2021). Triple signs

(>>>) indicate where comparative use of habitats was significantly different ($P < 0.05$).

| Analysis type	Habitat rankings and comparative use	
	Founder bilbies (2019)	**Wild-born bilbies (2021)**
Second order	Claypan with *E. largiflorens* > Shrubland >>> Claypan > Mulga shrublands	Shrublands > Claypan with *E. largiflorens* >>> Claypans > Mulga shrublands
Third order	Mulga shrublands > Shrublands > Claypan with *E. largiflorens* > Claypan	Mulga shrublands > Shrublands > Claypan > Claypan with *E. largiflorens*
	and	**and**
	Mulga shrublands and Shrublands >>> Claypan	Shrublands >>> Claypan with *E. largiflorens*
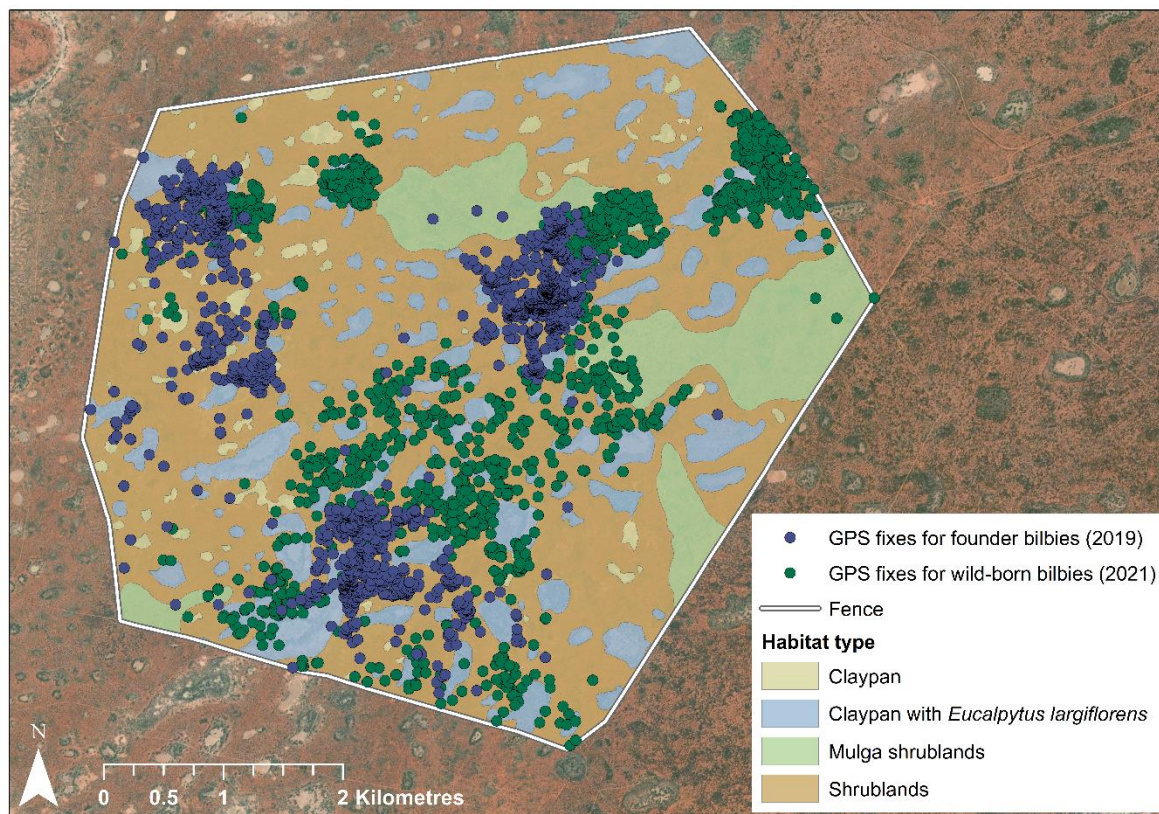
Fig. S2. Habitat types in the exclosure at Currawinya National Park and pooled GPS fixes for founder bilbies tracked in 2019 and the wild-born bilbies tracked in 2021. (Imagery source: Esri, Maxar, Earthstar Geographics, and the GIS User Community).
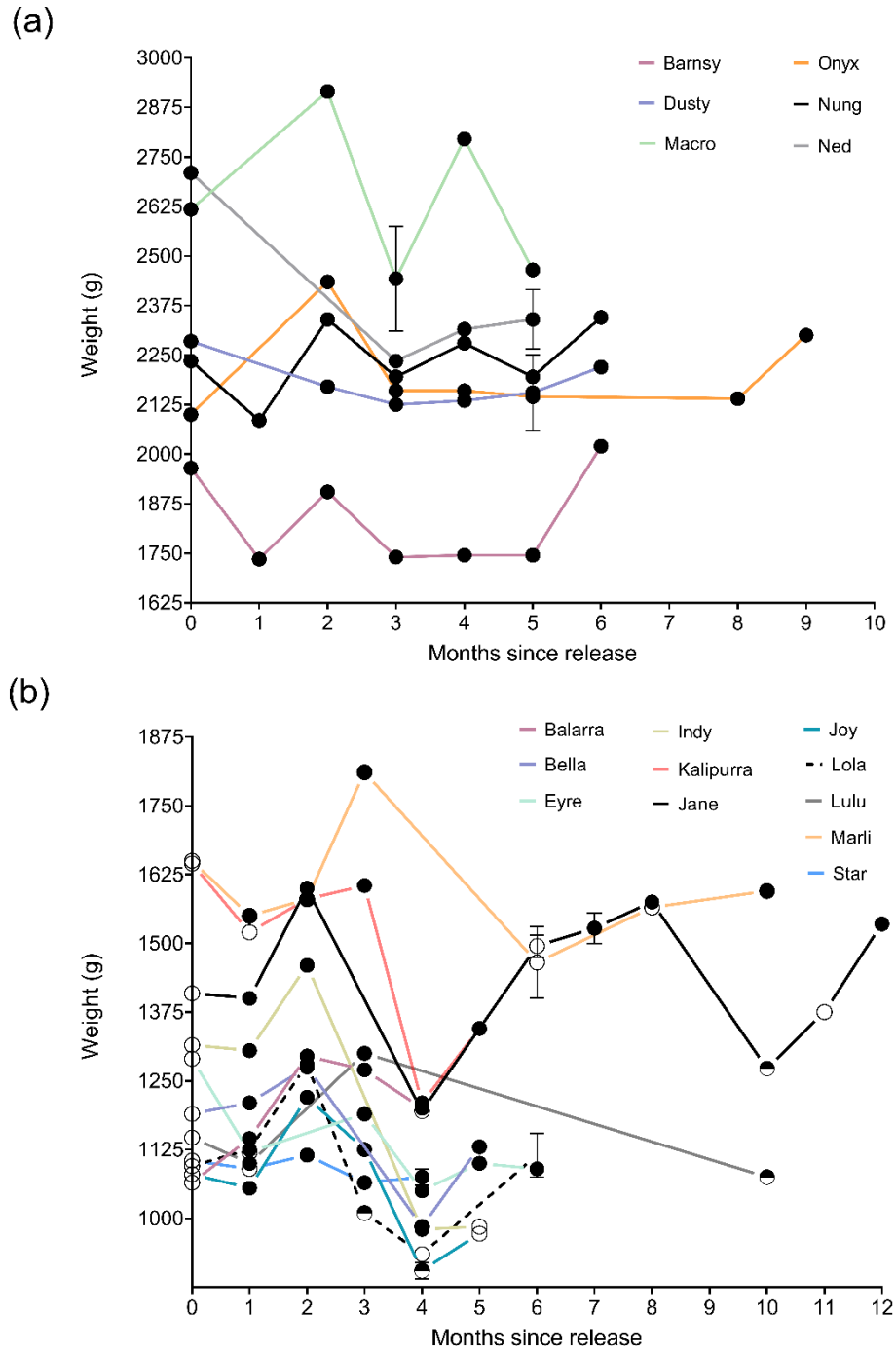
(a)

(b)

Fig. S3. Weights of founder bilbies released to the exclosure at Currawinya National Park in 2019. Weights of (a) six male founders and (b) 11 female founders. Pre-release weights are indicated at '0 months since release'. Standard error bars are shown where multiple weights were taken in a single month. For (b) females, hollow circles indicate an inactive pouch; filled circles indicate an active pouch with pouch young present; half-filled circles indicate an active pouch without pouch young (i.e. lactating teats).
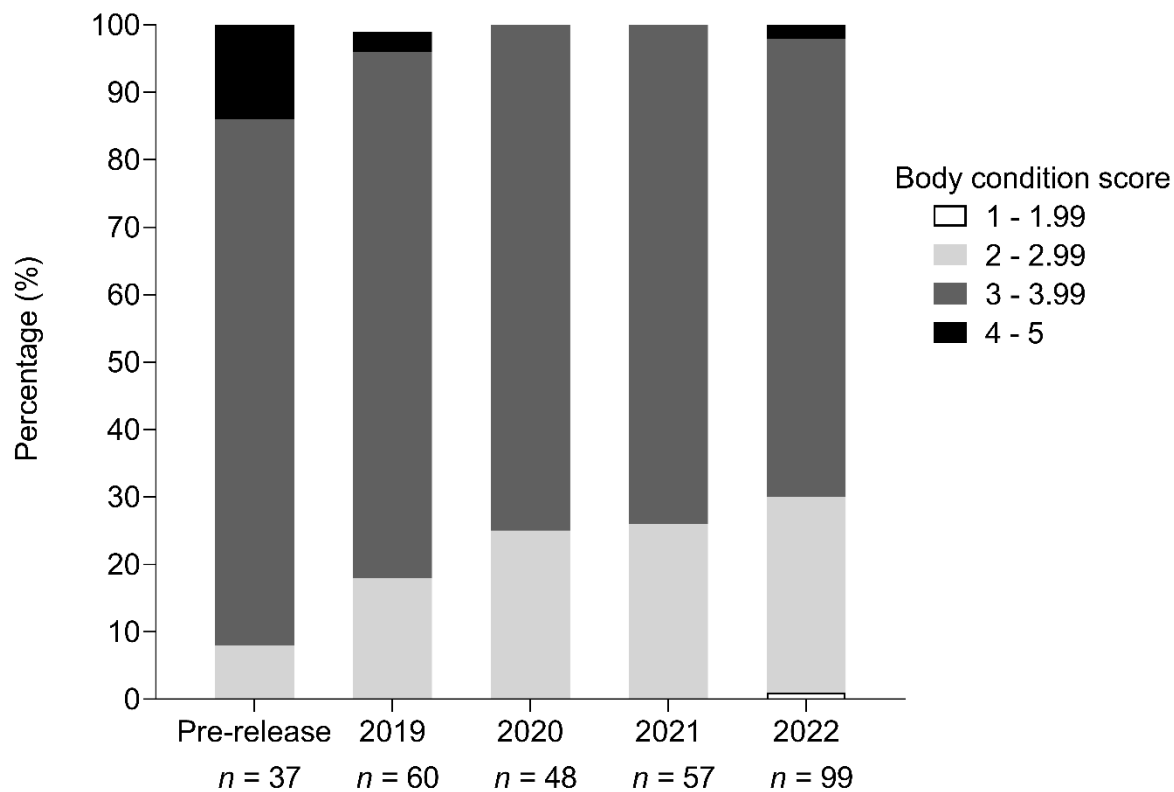
Fig. S4. Percentage of body condition scores for bilbies from pre-release health checks (founders) and for bilbies captured between 2019 and 2022 (founder and wild-born bilbies)

SECR Analyses

The results of the AIC analyses of the SECR models indicated three models for 2021 data and two models for 2022 data, with Δ AIC$_C$ $\leq$ 2.0 (Table S6). For 2021, the most parsimonious model held all parameters as constant, while the two remaining models (with Δ AIC$_C$ $\leq$ 2.0) included sex as a covariate in the detection sub-model. For 2022, both models with Δ AIC$_C$ $\leq$ 2.0 included sex and a site-specific learned response to the trap locations as covariates on the detection parameters. Model averaging (within year) was used to obtain density and population estimates.

Table S5. The five best performing spatially explicit capture-recapture models for bilby density estimates in 2021 and 2022. Where 'D' represents density; 'lambda0', 'sigma' and 'g0' are detection parameters; 'h2' is a covariate for sex; '~1' is where the parameter is held constant (i.e. not influenced by covariates); 'b' is a permanent global learned response; and 'bk' is a permanent detector-specific learned response. Models in bold were used to calculate the population density (i.e. where Δ AIC$_C$ $\leq$ 2). All 2021 models used the 'hazard half-normal' detection functions, and 2022 models used the 'exponential' detection function.

Year	Model	Number of parameters	AIC$_C$	Δ AIC$_C$
2021	**D~1, lambda0~1, sigma~1**	4	**226.67**	**0.00**
	D~1, lambda0~1, sigma~h2	5	**226.84**	**0.17**
	D~1, lambda0~h2, sigma~1	5	**228.58**	**1.91**
	D~1, lambda0~1, sigma~h2 + bk	6	229.11	2.44
	D~1, lambda0~bk, sigma~h2	6	229.61	2.95
2022	**D~1, g0~bk + h2, sigma~h2**	**7**	**1,012.73**	**0.00**
	D~1, g0~bk, sigma~h2	**6**	**1,013.36**	**0.64**
	D~1, g0~1, sigma~h2 + bk	6	1,021.14	8.42

Year	Model	Number of parameters	AIC$_C$	Δ AIC$_C$
	D~1, g0~h2, sigma~h2 + bk	7	1,023.42	10.70
	D~1, g0~1, sigma~h2 * bk	7	1,023.43	10.71

Year	Model		AIC$_C$	Δ AIC$_C$