

Appendix S1

Release protocols

Twenty eastern quolls (10 females and 10 males) were released at Silver Plains at dusk on 09/11/2020.

Pre-release health checks

On the morning of release, all quolls underwent health checks at Trowunna Wildlife Sanctuary by attending veterinarian, Dr Felicity Kerr. Quolls were lightly sedated using 1mg/kg diazepam (Valium) administered via intramuscular injection in the thigh. Procedures undertaken during these checks included:

- Physical examination
 - Weight
 - General body condition check
 - External parasite check
 - Respiratory function check
 - Heart rate measurement
 - Size measurements (head width, tail width)
 - Teeth check
- Blood smear
 - Visual assessment to check for abnormally high/low white blood cell counts
- Ear biopsy (genetic sample)
- VHF transmitter attachment

VHF transmitter attachment

VHF transmitters (A2480, Advanced Telemetry Systems Australia) were attached to the tail using elastic adhesive bandage (Fixomull sports bandage), using a method which has been successfully used in bandicoots (Coetsee et al. 2016; Robinson et al. 2018) and has been trialled on captive

eastern quolls (R Brewer and N Robinson, pers comm). Transmitters weighed approximately 4.1g, equivalent to between 0.25 and 0.61% of the release weight of the animals used in this study. This was therefore much less than the 5% of body mass limit recommended by the NSW DPI Radio tracking in wildlife research guidelines (ARRP 2015).

To attach the transmitters, approximately 4cm of the tape was shaved around the circumference, starting ~3cm from the tail base. A single length of Fixomull tape approximately 20cm length was wrapped once around the shaved tail (firmly, but not so tight as to restrict circulation). The VHF transmitter was placed on top of the tape with the antenna running down the length of the tail towards the tip, then the tape wrapped around the tail a further 2-3 times (Image 3).

In previous trials, transmitters were usually shed within 3-4 weeks as the tape loses adhesion and hair regrows, however we found that transmitters were shed within 2 – 15 days of attachment. In subsequent re-attachments in the field we therefore amended these methods to ensure that the transmitters stayed on the quolls for longer. To do this, we attached the transmitters using two lengths of tape, the first wrapped as above and the second wrapped in the opposite direction over the top. We then cut a shorter length of tape in half lengthways, and wrapped each half either above or below the transmitter to provide a firmer attachment. Note that the tape was never pulled tight around the tail, and the additional lengths were added to prevent quolls chewing through the tape to remove the transmitter and to prevent the inner layers of tape losing adhesion due to moisture. These second deployments lasted on average 20 ± 2 days, noting that 6 of 12 deployments were manually removed and could have lasted longer.

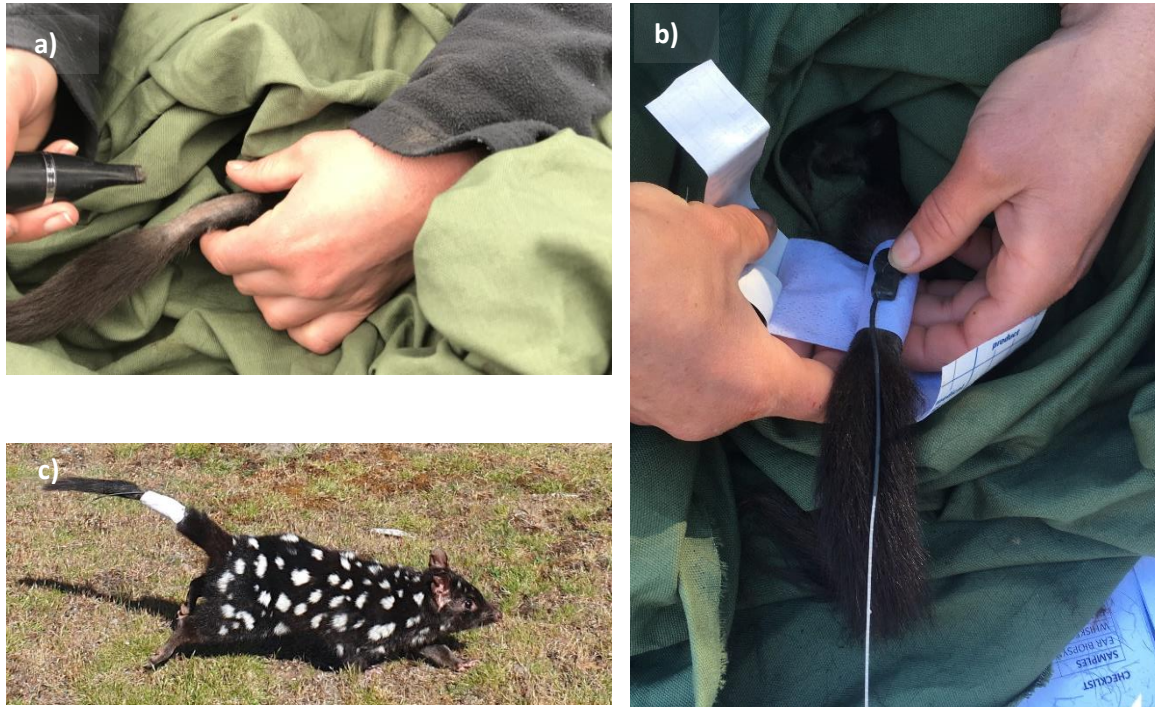


Image 1. Attaching a VHF transmitter in the field: a) approximately 4cm of tail is shaved to allow the tape to adhere; b) the VHF transmitter is placed on top of a single layer of Fixomull™ sports tape, then secured with additional layers; and c) a quoll with transmitter attached.

Transport and release

Quolls were transferred to wooden transport cases or pet carriers (**Image 2**) with straw from their home enclosures for the trip to the release site (approx. 2h transit time). Final checks of the transmitter attachment were undertaken at site immediately prior to release.

Quolls were released at dusk at three release sites approximately 500m apart (**Error! Reference source not found.**). Carriers were placed on the ground within 5m of cover (dense, shrubby vegetation) and 10m of a supplementary feeding station (see below), and the carrier door closest to the vegetation opened. Animals were monitored until all quolls had departed the carriers.

Three stations were initially setup at the release sites. Two additional stations were added/moved based on the quoll movements, to ensure that food was targeted to the quolls as much as possible (**Error! Reference source not found.**).

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62 **Image 2.** Quolls in transport boxes prior to release

63 *Supplementary feeding stations*

64 Approximately 4kg quoll mix (2kg kangaroo mince, 1kg each of carrot and apple) was added to each
65 feeding station approximately 2h post release on 09/11/2020. Food was not added until after the
66 quolls had been released to avoid attracting other carnivores (particularly devils) to the area. The
67 food was consumed within approximately 4 days, with the camera data indicating that the released
68 eastern quolls were the primary consumers.

69 Feeding stations were not refilled during the following ten days, as trapping was being undertaken in
70 the immediate vicinity and quolls were unlikely to enter traps if food was freely available. Stations
71 were subsequently stocked weekly (with meat only, as the vegetables were observed to be picked
72 out in the initial round) until the second trapping trip which commenced on 11/12/2020. Following
73 completion of trapping, stations were restocked with decreasing frequency (from every 10 days to
74 once per month) until approximately 6 months post-release.

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Model comparison tables

Survival models

Bayesian Cox proportional-hazards models were fitted using the ‘inla’ and ‘inla.surv’ functions with default settings (normal priors with mean zero and variance 1,000) within the INLA package (Lindgren and Rue 2015). Best-fitting models were selected using the widely applicable information criteria (WAIC, Vehtari et al. 2017). Note that although the release + sex model and release only models are equivalent (within 2 WAIC points), parsimony dictates that the model with fewest terms (the release-only model) should be selected as the top model. Inspection of the Release + Sex model fixed-effects coefficients confirm that there is no significant effect of sex (95% confidence intervals overlap zero).

Table S 1. Model selection table for survival models.

Model	WAIC	DIC	LogLik	dWAIC
Release + Sex	325.03	324.76	-165.41	0.00
Release	325.84	325.67	-162.36	0.81
Release * Sex	328.84	328.38	-171.93	3.81
Sex	331.17	331.09	-162.33	6.14
Null	331.38	331.34	-158.98	6.35

Table S 2. Fixed effects for release-only survival model, back-transformed to obtain relative hazard estimates. Note that coefficient estimates for the BNP2019 and SIPL2020 releases are expressed relative to the BNP2018 release. Back-transformed model effects are regarded as statistically significant if 95% credible intervals do not overlap 1.

	Mean	SD	0.025 quantile	0.5 quantile	0.975 quantile	sig
(Intercept)	0.018	1.334	0.010	0.018	0.030	*
Release:BNP2019	0.979	1.452	0.479	0.974	2.066	
Release:SIPL2020	0.172	2.143	0.033	0.182	0.649	*

Table S 3. Model selection table for dispersal analyses. Note that all models, including the null model, also included tracking duration as a predictor variable (omitted here for reasons of space). All models were fitted using a gamma distribution.

Models	K	AICc	Δ AICc	ModelLik	AICcWt	LL	Cum.Wt
Release	5	983.17	0.00	1.00	0.36	-486.02	0.36
Release + weight_adj	6	984.13	0.96	0.62	0.22	-485.26	0.58
Release + Sex * weight_adj	8	984.56	1.39	0.50	0.18	-482.84	0.75
Release + Sex	6	985.28	2.11	0.35	0.12	-485.83	0.88
Release + Sex + weight_adj	7	986.52	3.36	0.19	0.07	-485.16	0.94
Release * weight_adj	8	988.66	5.50	0.06	0.02	-484.89	0.97
Release * Sex	8	989.74	6.58	0.04	0.01	-485.43	0.98
Release * Sex + weight_adj	9	990.51	7.34	0.03	0.01	-484.42	0.99
Release * weight_adj + Sex	9	990.87	7.71	0.02	0.01	-484.60	1.00
Sex * weight_adj	6	994.06	10.89	0.00	0.00	-490.22	1.00
Null	3	995.89	12.72	0.00	0.00	-494.73	1.00
weight_adj	4	997.63	14.47	0.00	0.00	-494.45	1.00
Sex	4	997.98	14.82	0.00	0.00	-494.62	1.00
Sex + weight_adj	5	999.85	16.69	0.00	0.00	-494.36	1.00
Release * Sex * weight_adj	14	1000.69	17.53	0.00	0.00	-481.57	1.00

98 **Table S 4.** Model selection table for body condition analyses. Note that 't' refers to days since
 99 release, 'Rel' to release (Booderee NP 2018, Booderee NP 2019 and Silver Plains 2020), and 'wgt_adj'
 100 refers to the sex-adjusted release weight.

Models	K	AICc	Δ AICc	Modellik	AICcWt	LL	Cum.Wt
(t + t ²) * (Sex + Rel)	14	-472.14	0.00	1.00	0.97	251.26	0.97
(t + t ²) * Sex * Rel	20	-464.82	7.32	0.03	0.02	254.87	1.00
(t + t ²) * Sex + Rel	10	-460.09	12.05	0.00	0.00	240.65	1.00
(t + t ²) * Sex	8	-460.03	12.11	0.00	0.00	238.41	1.00
(t + t ²) * Rel + Sex	12	-449.57	22.57	0.00	0.00	237.66	1.00
(t + t ²) * (Rel + wgt)	14	-447.60	24.54	0.00	0.00	238.99	1.00
(t + t ²) * Rel * wgt	20	-442.97	29.17	0.00	0.00	243.94	1.00
(t + t ²) * Rel	11	-441.36	30.78	0.00	0.00	232.41	1.00
(t + t ²) * Rel + wgt	12	-441.29	30.86	0.00	0.00	233.51	1.00
t * Sex	6	-440.87	31.27	0.00	0.00	226.66	1.00
t * Sex + Rel	8	-438.49	33.65	0.00	0.00	227.64	1.00
(t + t ²) + Sex	6	-438.33	33.82	0.00	0.00	225.39	1.00
(t + t ²) + Sex + Rel	8	-437.82	34.32	0.00	0.00	227.31	1.00
t * (Sex + Rel)	10	-436.22	35.92	0.00	0.00	228.72	1.00
(t + t ²) * wgt	8	-432.78	39.37	0.00	0.00	224.78	1.00
t + t ²	5	-429.77	42.37	0.00	0.00	220.05	1.00
(t + t ²) + wgt	6	-429.08	43.06	0.00	0.00	220.77	1.00
(t + t ²) + Rel	7	-428.19	43.95	0.00	0.00	221.40	1.00
(t + t ²) + Release + wgt	8	-427.80	44.35	0.00	0.00	222.29	1.00
t + Sex	5	-419.02	53.12	0.00	0.00	214.67	1.00
t + Sex + Rel	7	-416.52	55.63	0.00	0.00	215.56	1.00
t * Rel + Sex	9	-416.32	55.82	0.00	0.00	217.65	1.00

Models	K	AICc	Δ AICc	Modellik	AICcWt	LL	Cum.Wt
t * wgt	6	-410.03	62.11	0.00	0.00	211.24	1.00
t	4	-409.15	62.99	0.00	0.00	208.68	1.00
t * (Rel + wgt)	10	-408.84	63.30	0.00	0.00	215.03	1.00
t + wgt	5	-408.26	63.89	0.00	0.00	209.29	1.00
t * Rel	8	-406.68	65.46	0.00	0.00	211.73	1.00
t * Rel + wgt	9	-406.15	66.00	0.00	0.00	212.57	1.00
t + Rel	6	-406.01	66.14	0.00	0.00	209.23	1.00
t + Release + wgt	7	-405.23	66.91	0.00	0.00	209.92	1.00
Null	3	-387.42	84.72	0.00	0.00	196.77	1.00