SUPPORTING INFORMATION

"Breeders are less active foragers than non-breeders in wild Damaraland mole-rats"

Study site supplementary details:

The summers (October – April) in the region are very hot with a mean maximum daily temperature of 34.0°C (range 17.9 – 44.2°C) and a mean minimum of 15.1°C (range -2.1 – 28.9°C) in summer, while in winter (May – September) mean minimum and maximum daily temperature is 3.1°C (range -11.6 – 18.7°C) and 25.0°C (range 8.7 – 39.2°C; averaged over 2009-2016 see Finn et al. 2018), respectively. Throughout the year the soil surface temperature can be more than 10°C above the ambient air temperature and maintain that temperature for over five hours during summer, but at depths inhabited by mole-rats (0.3m – 2m) the temperatures stay between 15 – 35°C with a 12 – 20°C difference between burrow and surface soil temperatures (Bennett et al. 1988).

Reproduction in captivity

At the median litter size of four in our captive population (see Zöttl et al. 2016 for details of the captive set-up), the average total mass of pups at birth was 39.23g (1SD = 4.64), which represented 27.9% (1SD = 0.04) of the female's post-parturition mass (mean = 142.66g, 1SD = 19.41; n = 47 unique litters where the mass of pups was recorded on the date of birth).

Activity in foraging areas is probably a good indicator for cooperative foraging effort

It could be argued that the increased activity detected in foraging areas may be a consequence of dispersal and that individuals spend more time active in peripheral tunnels when they are in the process of dispersing. However, information from our long-term study site, in conjunction with the data collected in this paper, suggests that this is improbable.

We have very little evidence from our field site that dispersal takes place below-ground via burrowing, as would be predicted if dispersal is preceded by periods of digging and manifests in increased activity in peripheral tunnels. Of 44 known dispersal events recorded at our field site as of 2017, the mean dispersal distance was 984m (Finn Msc Thesis, University of Pretoria 2017). If such dispersal events routinely take place below-ground, we would therefore expect much longer tracts of mounds radiating from groups than those which we observe- particularly if one considers the high attrition rate of individuals from groups, which suggests dispersal is frequent (see below). Hazell et al. 2000 made a similar observation of Damaraland mole-rat burrow systems in the Waterburg region in Namibia, and, with additional information from mole-rats that had drowned after falling into an open canal, also concluded that dispersal in Damaraland mole-rats often takes place above-ground. If dispersal is often above-ground, it would appear non-adaptive for animals to expend considerable energy digging immediately prior to dispersal.

In addition, we find that individuals that disappeared in the period between their detection by the reader and their recapture within the group were no more or less active than those who did not disappear in this same time frame. With few predators in their close-off burrow systems, adult survival in mole-rats is thought to be high and disappearance is consequently thought to more often be a consequence of dispersal than it is of in-group mortality. To test whether individuals that disappeared were more active, we recovered all reading sessions where a complete capture of the focal group followed the deployment of the reader array. Of the 39 reading sessions in our data set, 33 fulfilled this criterion, with a mean time between reader deployment and group capture of 125.61 ± 20.68 days (range = 9-452 days); in 5 cases, the group was recaptured but the capture was not complete, so this data was removed. Of the 33 sessions with the requisite information, 244 individuals were recorded by the reader array, and could then subsequently be recaptured in the group (not disappear- 0) or not (disappear- 1). 53 of the 244 individuals (23.7%) disappeared. We then modelled the probability that an individual disappeared in a generalised linear mixed effects model with a binomial error structure, including as fixed effects the mean daily activity in the prior reading session, the time between reader deployment and subsequent live capture, sex, weight and breeding status. As random effects we specified the individual ID and the reading session ID. All continuous covariates were scaled (scaling by sex for the weight term).

From this simple model, mean daily activity did not predict subsequent disappearance after having controlled for the time between reader deployment and live capture (Supplementary Table 1). However, the model did detect a strong breeder effect such that breeders were more likely to be recaptured in a group, as well as a significant effect of weight, with heavier individuals being more likely to disappear. This latter effect is consistent with work in other populations of Damaraland mole-rats indicating that heavier (and presumably older) non-breeding individuals often disperse (Hazell et al. 2000, Torrents-Ticó et al. 2018).

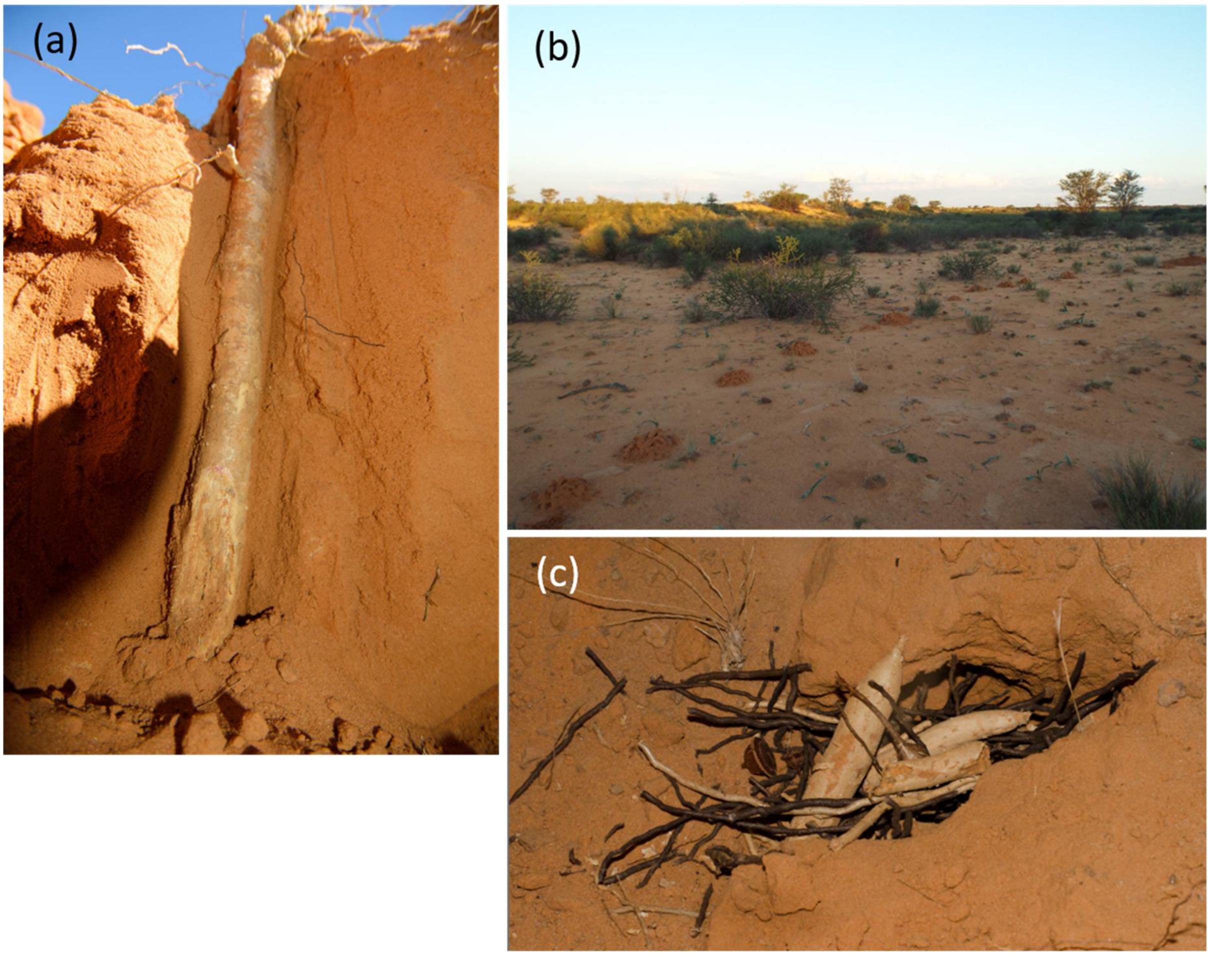
Supplementary Table 1. The probability of disappearance between reader deployment and group recapture. Estimates, standard errors and P-values taken from a generalized linear mixed model assuming a binomial error structure. Estimates provided on the log scale (logit link).

Fixed Effect Estimates	**Estimate**	**Std. Error**	**P value**	
(Intercept)	-19.82	5.61	< 0.001	***
Mean activity	0.50	1.01	0.620	
Time between reading and group capture	4.93	2.73	0.072	.
Weight	6.67	2.61	0.011	*
Breeding status - breeder	-21.40	10.43	0.040	**
Sex - male	4.27	4.44	0.335	

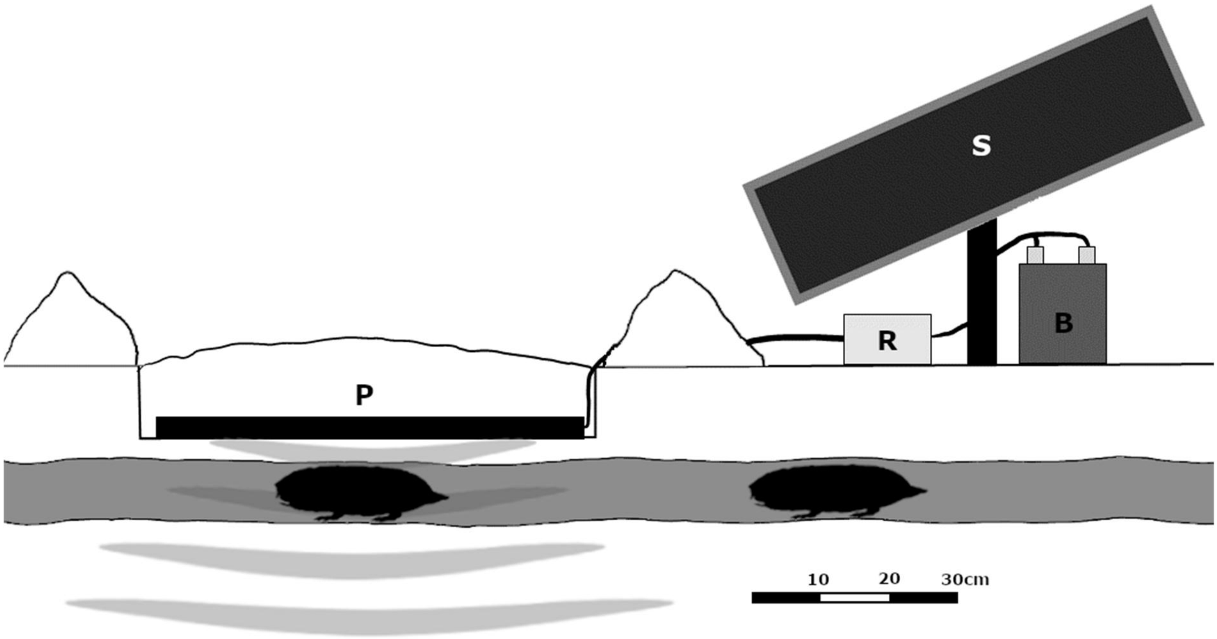
Supplementary Table 2. Daily activity of Damaraland mole-rats, minimal model output. Estimates, standard errors and P-values taken from a generalized linear mixed model assuming a poisson error structure. Estimates provided on the log scale (logit link). Marginal R^2 is 0.04 and conditional R^2 squared is 0.58.

Fixed Effect Estimates	Estimate	Std. Error	P value	
(Intercept)	1.02132	0.11269	< 0.001	***
Sex - male	0.1688	0.09663	0.08066	.
Breeding status - breeder	-0.38134	0.12516	0.00231	**
Group size	-0.03137	0.09325	0.73652	

Supplementary Figures

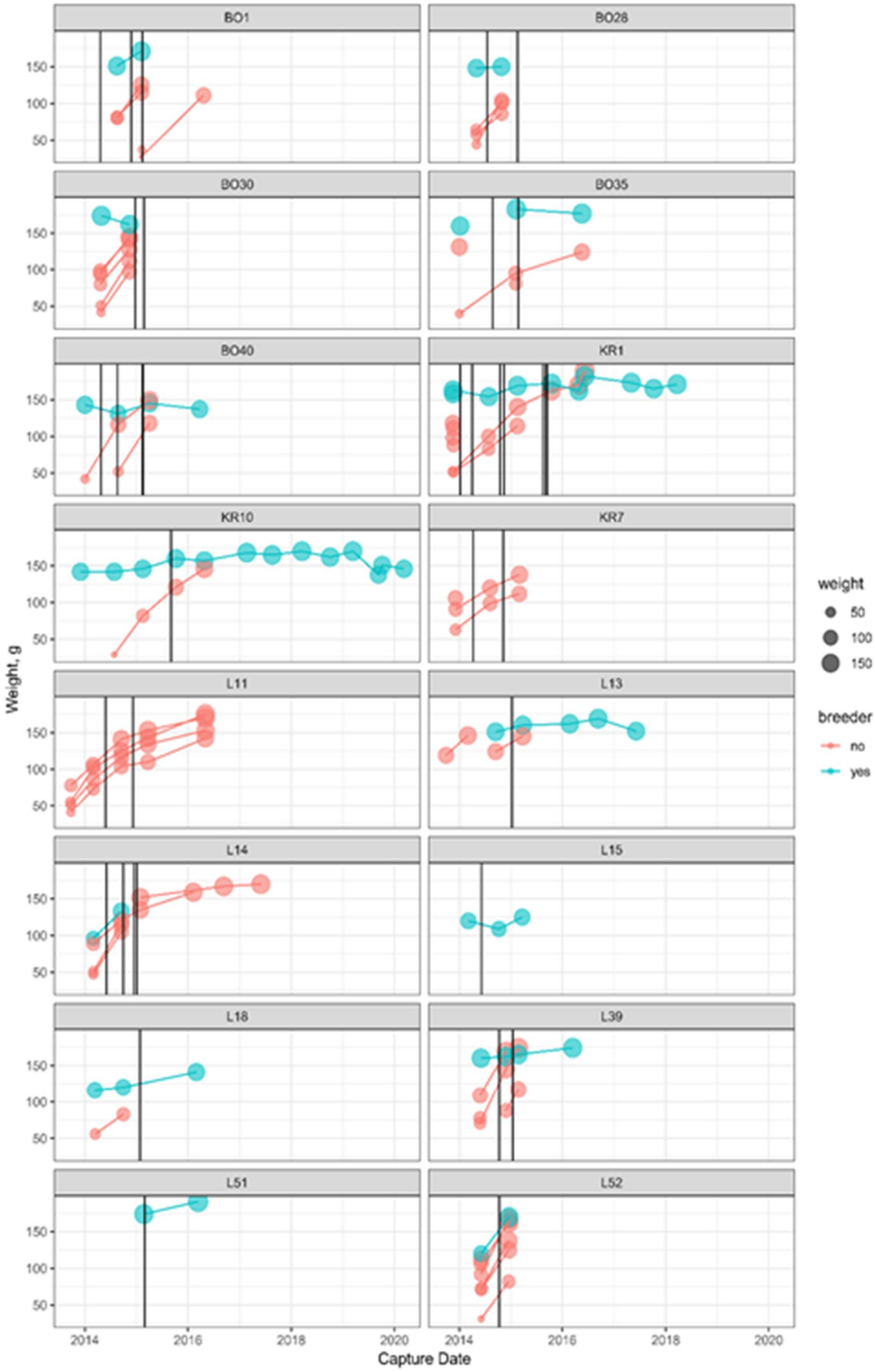


Supplementary Figure 1: a) The below-ground root stock of a Gemsbok cucumber, the principal food resource of the Damaraland mole-rat in the Kalahari Desert. The roots of cucumbers are usually 50cm in length, and often extend to 1m. b) Fresh mounds on the surface, as indicative of recent and ongoing tunnel expansion. c) A communal food store containing pieces of gemsbok cucumber and other roots. These storage areas in the tunnels are typical for all *Bathyergidae* mole-rats and in social species contain food. Pictures copyright Kyle Finn (a,c) & Jack Thorley (b).



Supplementary Figure 2: Illustration of the placement of the reader array in the field. A shallow hole is carefully dug between two mole-rat mounds and the antenna (P) is placed inside. The panel has a range of ca. 30cm in a widening cone and any transponder tag passing within range is stored in the recorder (R). The recorder is powered by a car battery (B) attached to a solar panel (S).

Supplementary Figure 3: RFID reader array with a custom made decoder LID650/608 (DorsetID, Aalten, Netherlands) attached to the panel antenna ANT612. The black panel scans for passive integrated transponder tags at regular intervals which are stored on a USB drive attached to the white recording box. Red and black cables are attached to a power source.



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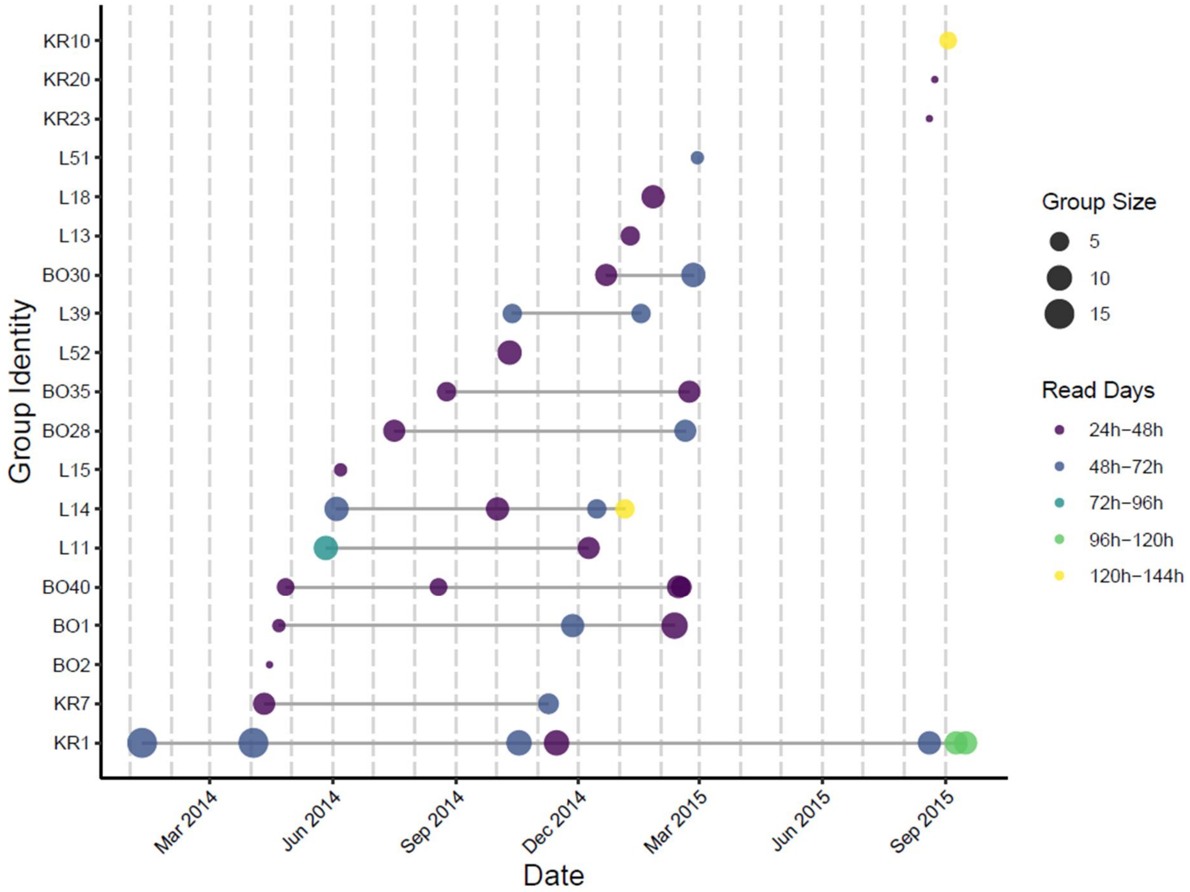
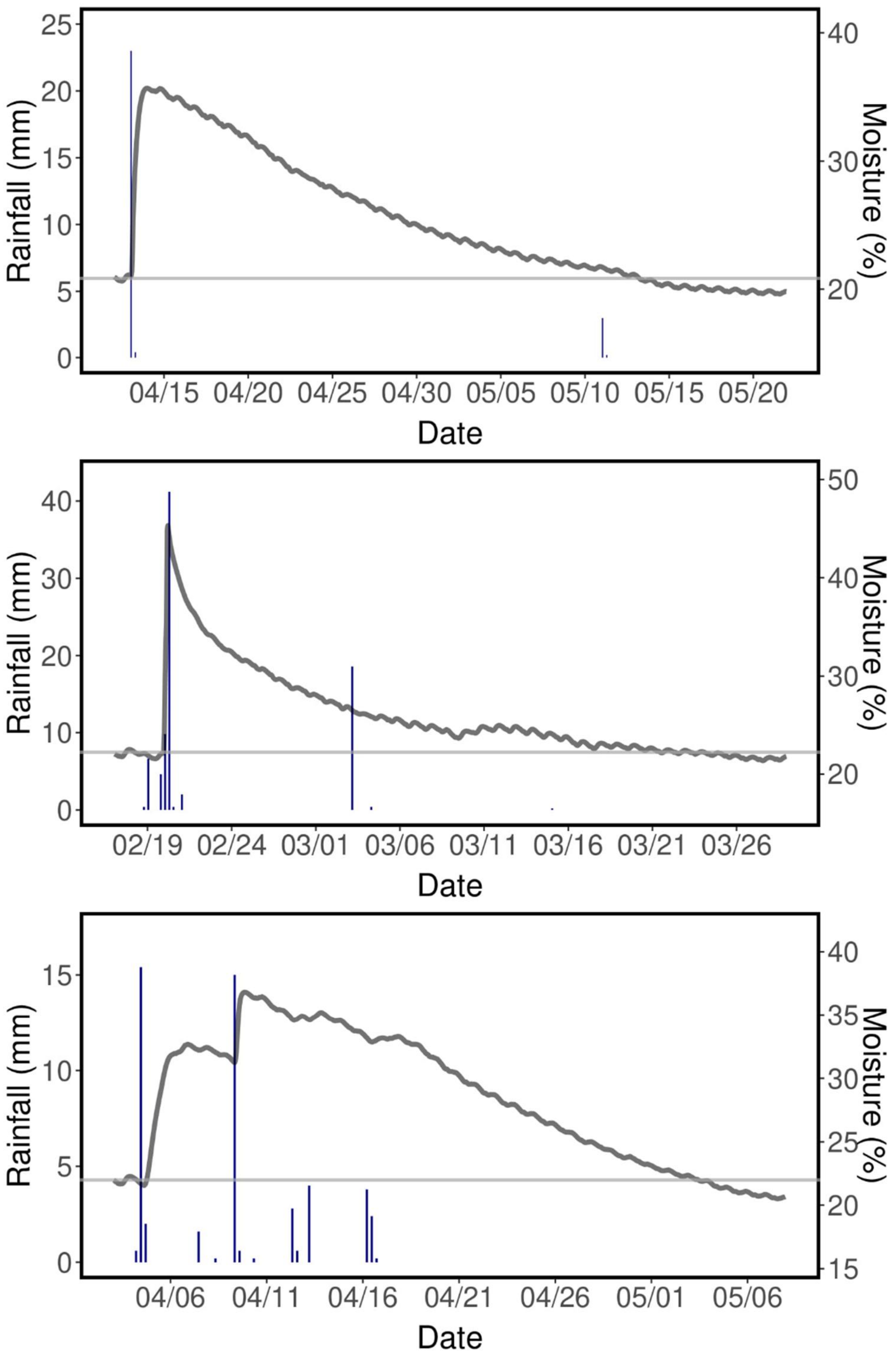
KR7
L11
L13
L14
L15
L18
L39
L51
L52
50
100
150
2014
2016
2018
2020
Weight, g
Capture Date
weight
50
100
150
breeder
no
yes

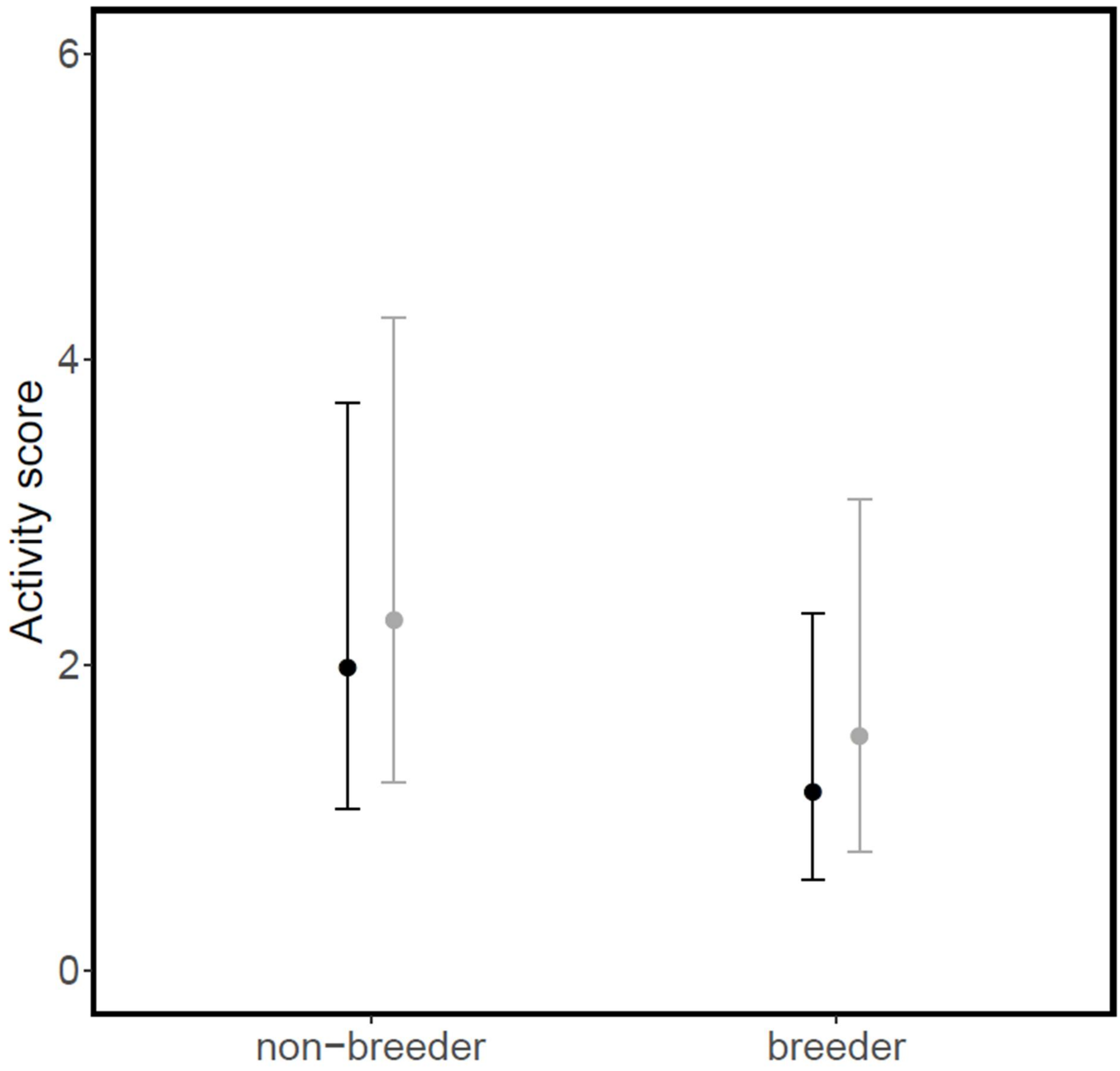
Supplementary Figure 4: The identification of breeding males using capture history and weights information. Each panel indicates the capture history of males present in a group that were detected by the reader array (reader deployments shown by black vertical lines). Note that any males recruited into the group after the last reader deployment are not shown, as we wish to emphasize the contrasts between breeding and non-breeding males in relation to the placement of the reader. From this plot, we show that breeding males (blue) are often heavier than non-breeders and persist in groups for longer.



Supplementary Figure 5: Time course of Damaraland mole-rat activity recording via an RFID reader array. The array was set up at 19 groups between January 2014 and October 2015 for 1-5 days (duration of sampling indicated by the colour of the point). Some groups were sampled repeatedly (horizontal lines), generating a total of 38 unique sampling periods. The size of the points reflects the group size just prior to the deployment of the array.



Supplementary Figure 6: Effect of rainfall on the soil moisture in 40 cm depth. Soil moisture is represented by the dark grey line, and rainfall by the blue bars (each bar represents the quantity of rain over 6 hours). The light grey line shows the mean moisture over the 24 hours preceding the first rainfall.



Supplementary Figure 7: Model estimates for foraging activity of breeders and non-breeders in Damaraland mole-rats for the model presented in Table 1. Black dots represent females. Grey dots represent males. Predictions were estimated from the GLMM for a mean group size, with error bars indicating the 95% confidence intervals conditional on the fixed effects (see Table 1).

Supplementary References

Hazell, R.W.A., Bennett, N.C., Jarvis, J.U.M., & Griffin, M. 2000 Adult dispersal in the co-operatively breeding Damaraland mole-rats (*Cryptomys damarensis*): a case study from the Waterberg region of Namibia. *J. Zool. Lond.* **252**, 19-25.

Torrents-Ticó, M., Bennett, N.C., Jarvis, J.U. & Zöttl, M. 2018 Sex differences in timing and context of dispersal in Damaraland mole-rats (*Fukomys damarensis*). *Journal of Zoology* **306**, 252-257.

Zöttl, M., Vullioud, P., Mendonça, E., Torrents-Ticó, M., Gaynor, D., Mitchell, A., & Clutton-Brock, T. 2016. *PNAS* **113**, 10382- 10387.