

## Supplementary material

**Full Title:** Strength in Numbers: Group Size Enhances Individual Survival and Colony Longevity in Damaraland Mole-Rats

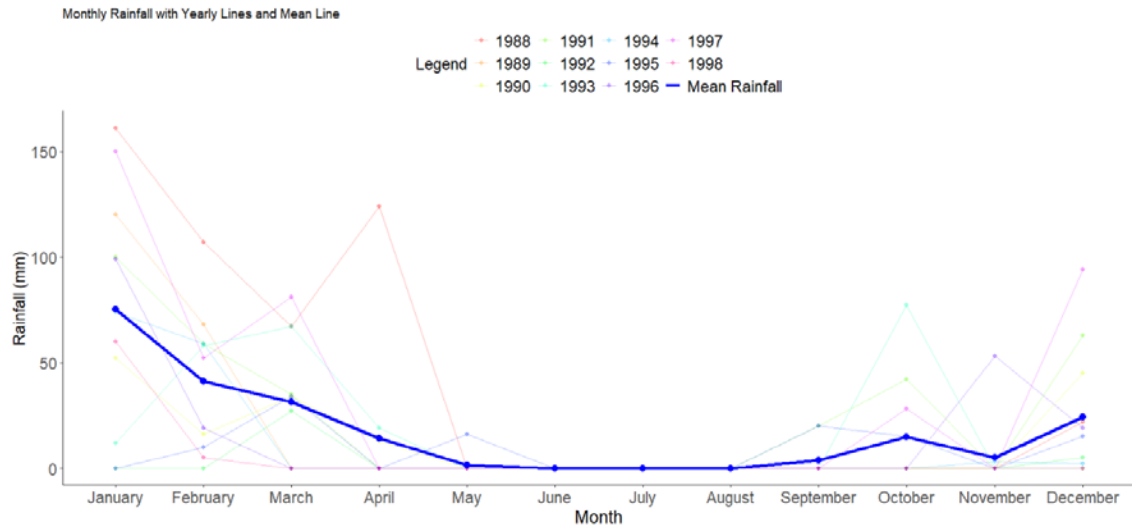


Fig. S1. Monthly rainfall data for rainfall collected at the field site. The blue line represents the mean across the years from 1988 to 1998.

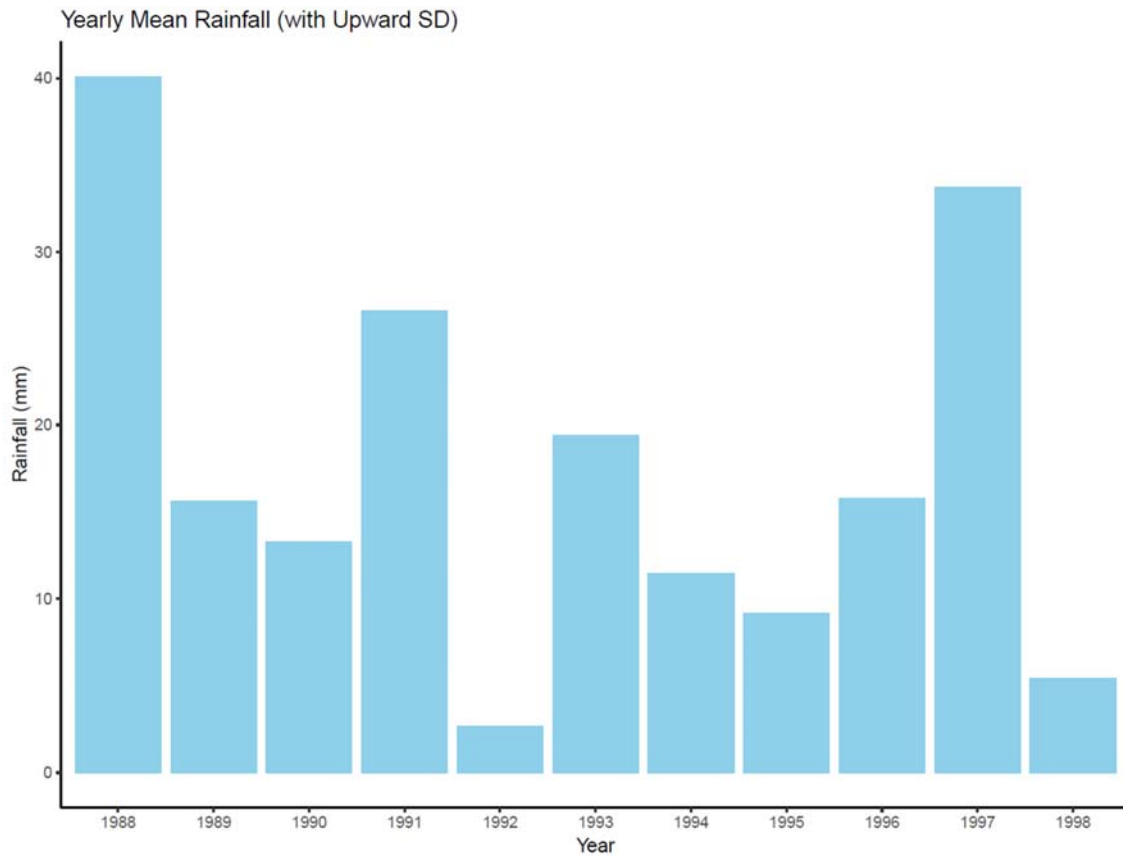


Fig. S2. Yearly mean rainfall data for rainfall collected at the field site.

As per Fig. S1 and Fig. S2, rainfall was unpredictable and varied depending on the month and year throughout the study period. It was personally observed that periods of low rainfall caused delayed dispersal, which supports the current literature (Faulkes *et al.* 1997; Molteno & Bennett 2002; Young *et al.* 2010; Faulkes & Bennett 2013). Dispersal following rain supports the idea that the soil being easier to excavate (Lovegrove 1989), facilitating easier dispersal (but see Zelová *et al.* (2010)).

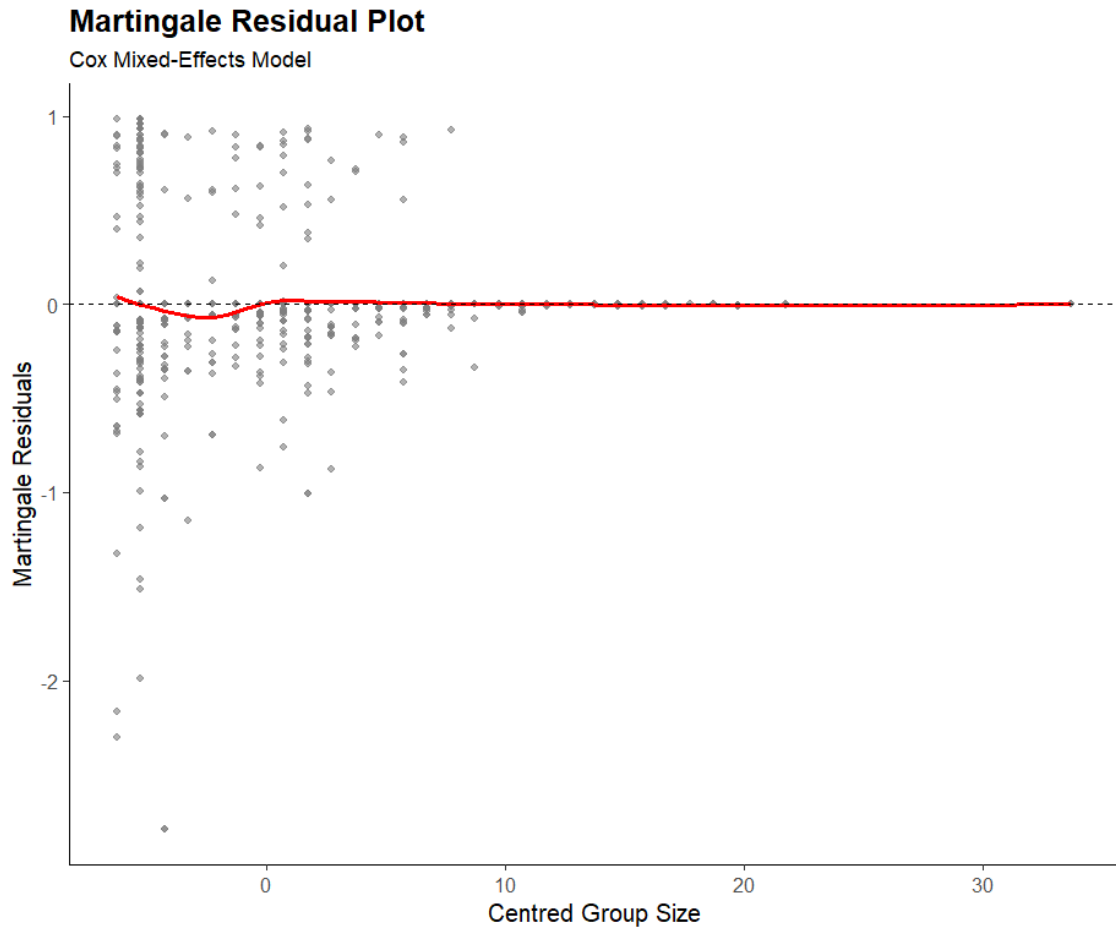


Fig. S3. Martingale residuals from the Cox proportional hazard model for group size. Grey points show individual martingale residuals plotted against centred group size (GroupSize\_c). The red line represents a LOWESS smooth through the residuals, illustrating the linearity of the effect. The approximately horizontal trend of the red line indicates that a linear term for group size is appropriate.

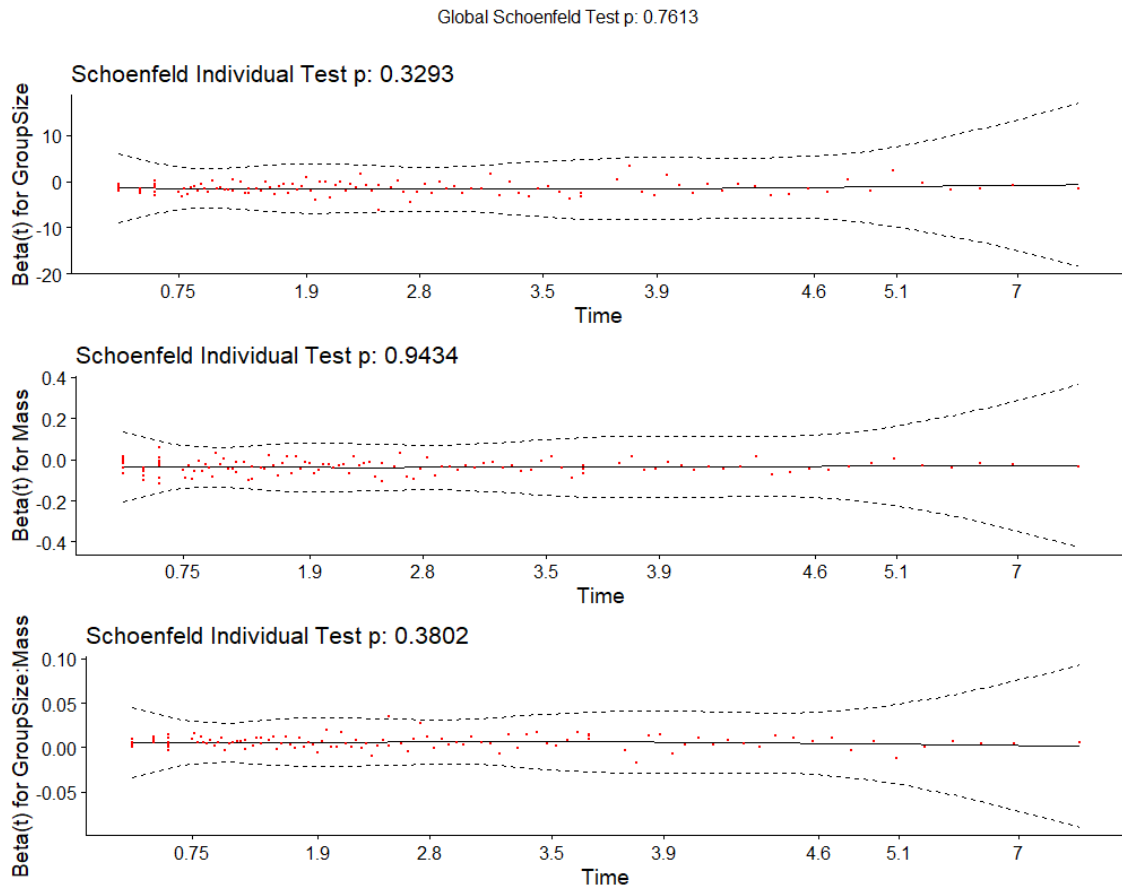


Fig. S4. The Schoenfeld for the individual states data to test whether scaled group size, mass and group size and mass interaction is consistent over time.

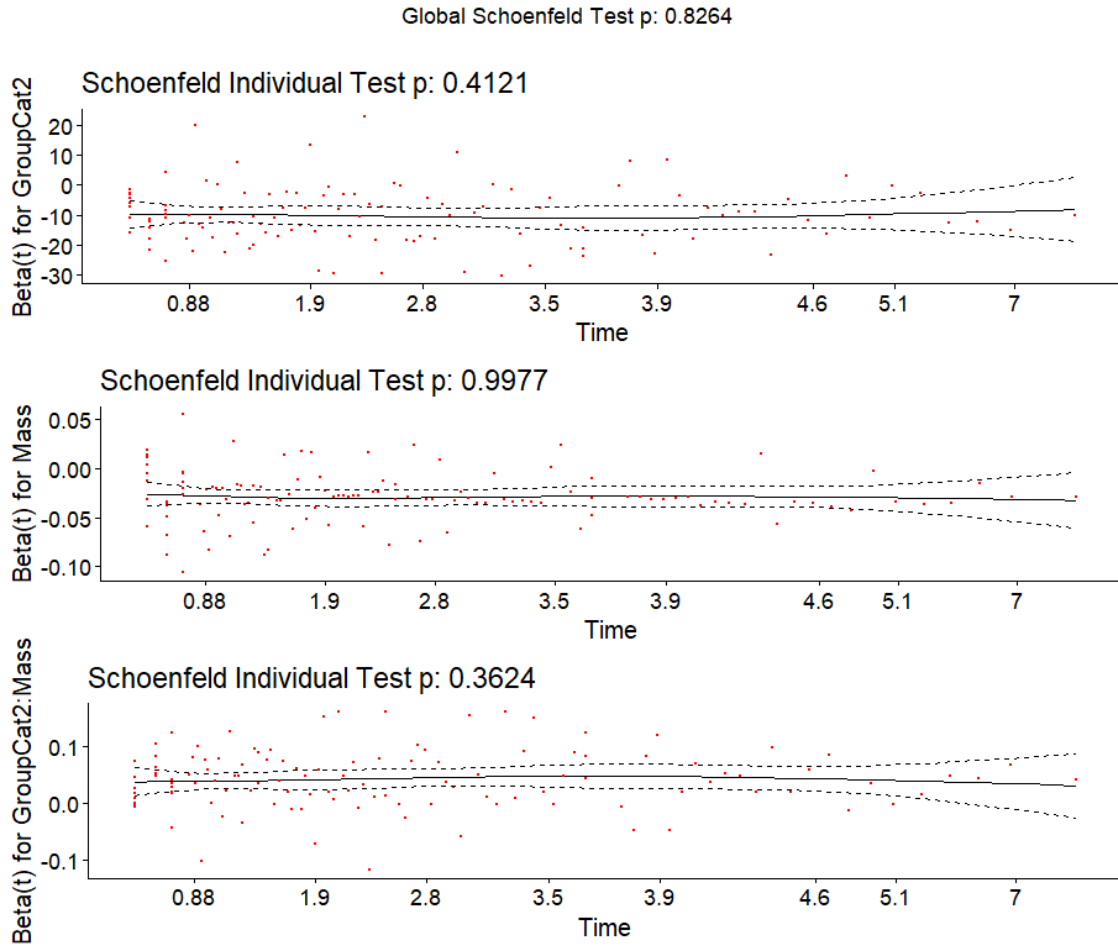


Fig. S5. The Schoenfeld for the individual states data to test whether group size categories of solitary or paired versus grouped, mass and group size category and mass interaction is consistent over time.

Global Schoenfeld Test p: 0.3417

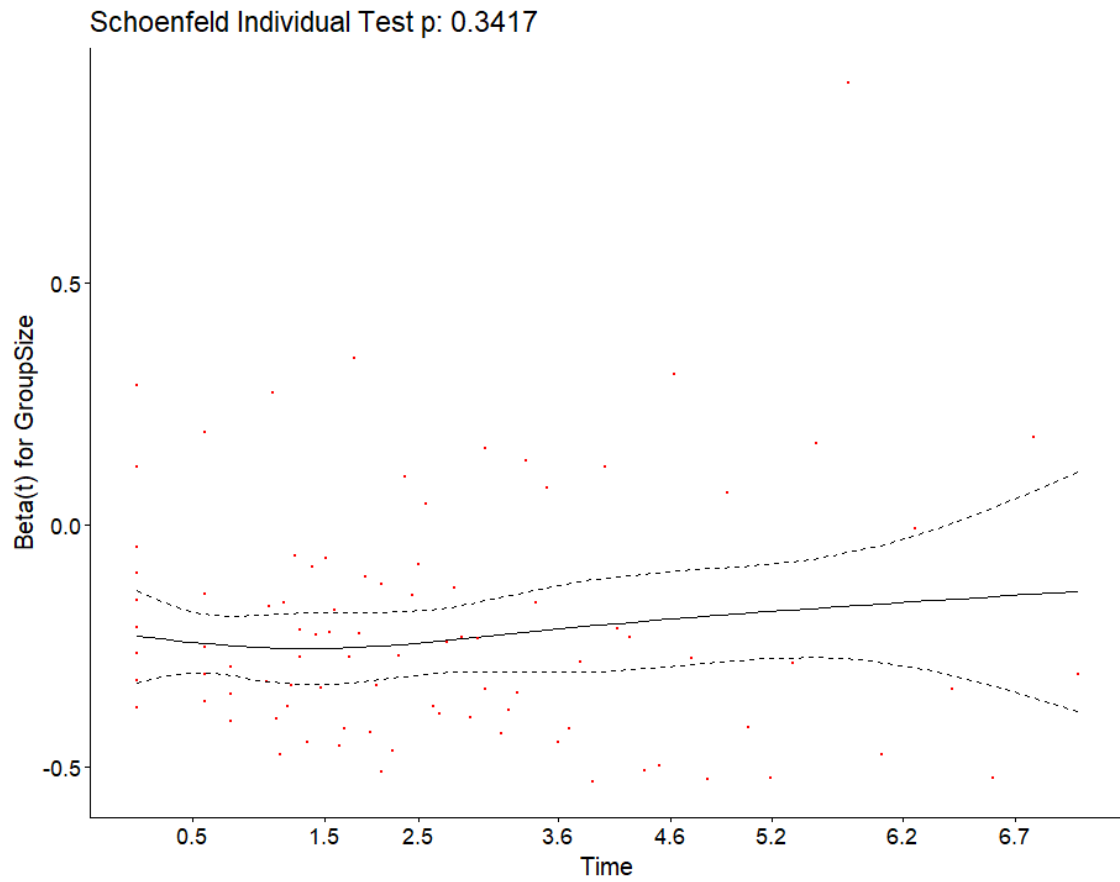


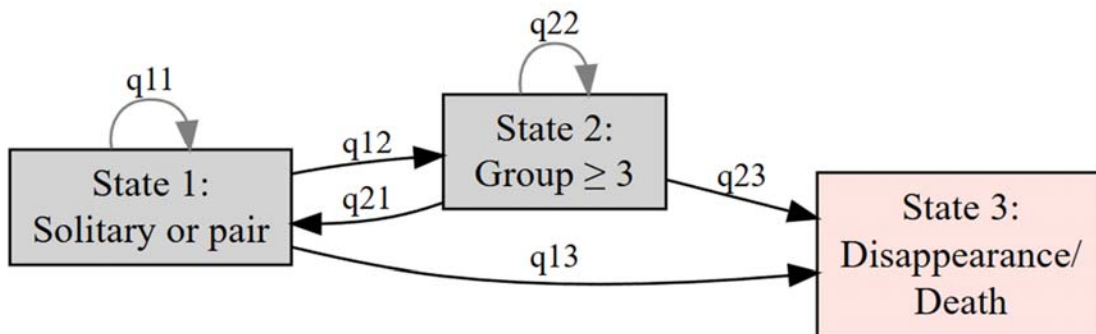
Fig. S6. The Schoenfeld test to determine whether scaled group size effect is consistent over time.

## Markov multi-state modelling of group size survival trajectories

The group size survival trajectories of individuals that were solitary, or in a pair, or in a group of three or more as a life history state estimated using multi-state Markov models (MSM). In this framework, each individual occupies one of a finite number of states at any instant, and transitions between states occur according to a set of instantaneous transition intensities ('q-values'). These intensities represent the expected instantaneous rate of moving from one state to another, assuming the Markov property—that future state occupancy depends only on the current state and not on the preceding history.

The model included two transient states (State 1: solitary/pair, State 2:  $\geq 3$  individuals) and one absorbing state (State 3: disappearance/death), with the latter representing permanent loss to follow-up. All allowable transitions were specified a priori based on biological expectations (i.e. can state 1 remain state 1:  $q_{11}$ ). The fitted model estimates the transition intensity matrix  $Q$ , where each off-diagonal element  $q_{ij}$  represent the instantaneous rate of moving from state  $i$  to state  $j$ . Diagonal elements tell us the total rate at which animals exit a state. They are just the negative of all the outgoing transition rates. Transition probability matrices were then derived from  $Q$  to describe expected state occupancy over time.

The multi-state model can be shown diagrammatically as:



The  $q$  matrix using the above probabilities.

$$Q = \begin{pmatrix} q_{11} & q_{12} & q_{13} \\ q_{21} & q_{22} & q_{23} \\ 0 & 0 & 0 \end{pmatrix}$$

**Table S1. State-related survivorship of individuals in solitary or pair state and those in a group of three or more.** Probability of transitioning (going from one state to another) between states over a one-year period for individuals that have ever been in a solitary or pair state at some time/period of their life history (n=123). Confidence intervals are estimated using the delta method.

<b>Group Size Transition States</b>	<b>1-Year Probability (95% CI)</b>
Single or Pair → Single or Pair	<b>0.1476</b> (0.1123, 0.1896)
Single or Pair → Grouped (3+)	<b>0.3101</b> (0.2415, 0.3670)
Single or Pair → Disappearance	<b>0.5422</b> (0.4695, 0.6290)
Grouped (3+) → Single or Pair	<b>0.1984</b> (0.1599, 0.2327)
Grouped (3+) → Grouped (3+)	<b>0.5025</b> (0.4206, 0.5615)
Grouped (3+) → Disappearance	<b>0.2992</b> (0.2560, 0.3925)

## References

1.  
Faulkes, C., Bennett, N., Bruford, M.W., O'brien, H., Aguilar, G. & Jarvis, J. (1997). Ecological constraints drive social evolution in the African mole-rats. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, 264, 1619-1627.
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Zelová, J., Šumbera, R., Okrouhlík, J. & Burda, H. (2010). Cost of digging is determined by intrinsic factors rather than by substrate quality in two subterranean rodent species. *Physiology & behavior*, 99, 54-58.