

Supporting Online Material

1. Material and Methods

We used the average home range data of 279 mammal species as published in Kelt and Van Vuren (*S1*). These are almost exclusively based on minimum convex polygon estimates from radio telemetry studies. For all except five species (*Xerus erythropus*, *Sciurus lis*, *Petrogale assimilis*, *Eremitalpa granti*, *Thylogale stigmatica*) we were able to extract species typical social unit sizes (single, pair, group)(*S2*). We note that group sizes may vary within species (e.g. *S3*), but only in rare cases are home range or density estimates in the literature accompanied by information on local group size, hampering a more refined analysis at this point.

We find that larger species tend to live in larger social units (Poisson Regression: Group size = $0.87 + 0.26 \log(M)$, $t = 8.92$, $p < 0.001$, sample size = 274). To account for the effect of grouping in the context of our model, we perform our analyses with home range size per individual, $H = (\text{observed home range} / \text{social unit size})$ as response. Mean population density estimates for 563 mammal species were obtained from Damuth (*S4*) and are available from the author of this study upon request (damuth@lifesci.ucsb.edu). We classified the diet groups, herbivores (including granivores), omnivores and carnivores (including insectivores), resulting in 272 and 541 diet-classified species for home range and density data, respectively. We repeated our analyses using a subset of the data with only species common to both data-sets. The herbivore data were obtained from the same sources as above, for carnivores 416 density and 272 home range size estimates

for 35 species of the order Carnivora were obtained from literature. The results for this subset are not qualitatively different from full dataset and are presented in SI Table 1.

For mammals the error rate in body size is substantially lower than that of estimated space use and following McArdle (*S5*) we analyzed observed scaling relationships using ordinary least squares regression, (see *S6* for the additional use of reduced major axis and ordinary least squares bisector regression applied to the scaling of abundances in stream communities; see *S7* and *S8* for limitations of these techniques in allometry).

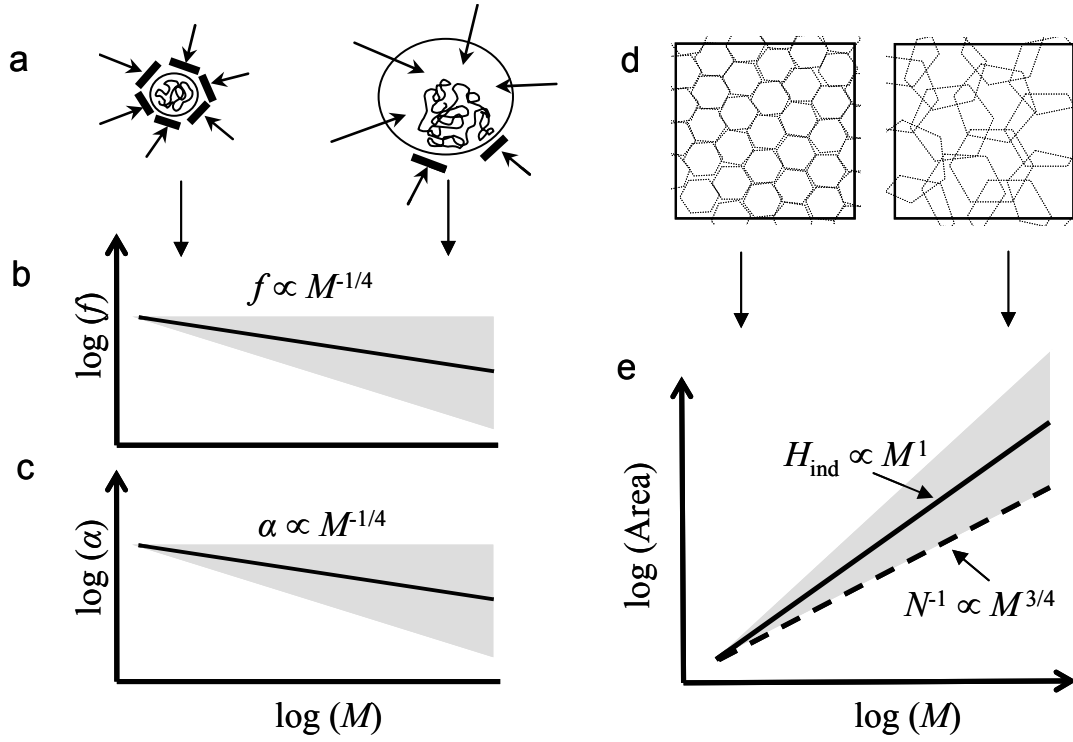
The scaling coefficient of mammalian field energy expenditure has been approximated by Nagy (*S9*), based on doubly-labelled water analyses from 79 species: $b_0 = 8.88 \text{ Wkg}^{-1}$.

As estimate of the assimilation efficiency for a typical diet we use 0.40 for herbivores, 0.60 for omnivores and 0.80 for carnivores. We log-transformed body size, M , home range size, H , and density, N , data for analysis, and employed least squares regression to examine scaling exponents and model fits. We calculated α by using the model fits for N^{-1} and H derived from the empirical data.

2. Supporting Figures

Figure S1. Schematic outline of the proposed mechanism leading to the observed scaling of home range size and population density. **a** Species with larger body sizes, M , and thus larger area needs (N^{-1} , solid circle) have proportionally smaller day ranges (D , here represented as potential daily movement paths, line): $N^{-1} \propto M^{3/4}$, while $D \propto M^{1/4}$. As a consequence larger species interact with their neighbors (arrows) less frequently, and neighbor intrusions (unblocked arrows) are more probable. **b** Given random walk the gas equation predicts neighbor interaction frequency $f \propto N D d$, where d is interaction distance and tends to scale between M^0 and $M^{1/2}$ (grey area). Taking the midpoint of d results in $f \propto M^{-3/4} M^{1/4} M^{1/4} = M^{-1/4}$. Here we test for $f \propto M^{-1/4}$ (line). **c** Home range exclusivity, α , is presumed to be proportional to f and should then scale as $\alpha \propto M^{-1/4}$. **d** Due to increased neighbor intrusions, home ranges (hexagons) of large bodied species overlap. Home range size overestimates the actual area per individual, N^{-1} . **e** Metabolic needs which scale as $M^{3/4}$ determine the scaling of N^{-1} . Decreased energy supply rate due to neighbor effects result in a home range exclusivity scaling of $M^{-1/4}$ and an approximate scaling of home range size of $H \propto M^1$ (the grey area indicates the potential range due to variation in d , interaction distance).

Figure S1



3. Supporting Tables

Table S1. Observed scaling relationships of per individual area use in mammals for restricted data – only species included with data for both N^{-1} and H . Data are obtained from two measures, the inverse of population density (N^{-1}) and individual home range size (H , corrected for group size). These data are also analyzed by trophic level, herbivores (Herb) and carnivores (Carn). The slope analysis gives the individual scaling exponents, m , and the scaling exponents for α , proportional home range exclusivity, which are given as $\alpha = m(N^{-1}) - m(H)$, where m refers to the calculated scaling exponents. Numbers in brackets are the 95% confidence intervals. The r^2 values are based on log-transformed data.

* Sample size (number of species).

| | | n^* | Cross-over | Intercept | Slope | | Model | |
|-------------|----------------------------|-------|---------------------------------------|--|--------------------|----------------------|--------------|-------|
| | | | $M(\text{kg}) \text{ at } N^{-1} = H$ | $\text{Area}(\text{ha}) \text{ at } M = 1$ | m | $\alpha \propto M^x$ | F | r^2 |
| All | H | 104 | 0.001 (0.013) | 8.35 (3.34) | 1.04 (0.14) | -0.18 (0.19) | 200.0 | 0.66 |
| | N^{-1} | 104 | | | | | | |
| Herb | H | 58 | 0.018 (0.107) | 2.02 (0.81) | 1.03 (0.13) | -0.24 (0.16) | 244.4 | 0.81 |
| | N^{-1} | 58 | | | | | | |
| Carn | H | 35 | 0.459 (0.666) | 66.87 (34.01) | 1.06 (0.24) | -0.22 (0.36) | 76.65 | 0.69 |
| | N^{-1} | 35 | | | | | | |

4. Supporting References

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