

Supplementary Information

Environmental determinants of daily heterothermy in mammals

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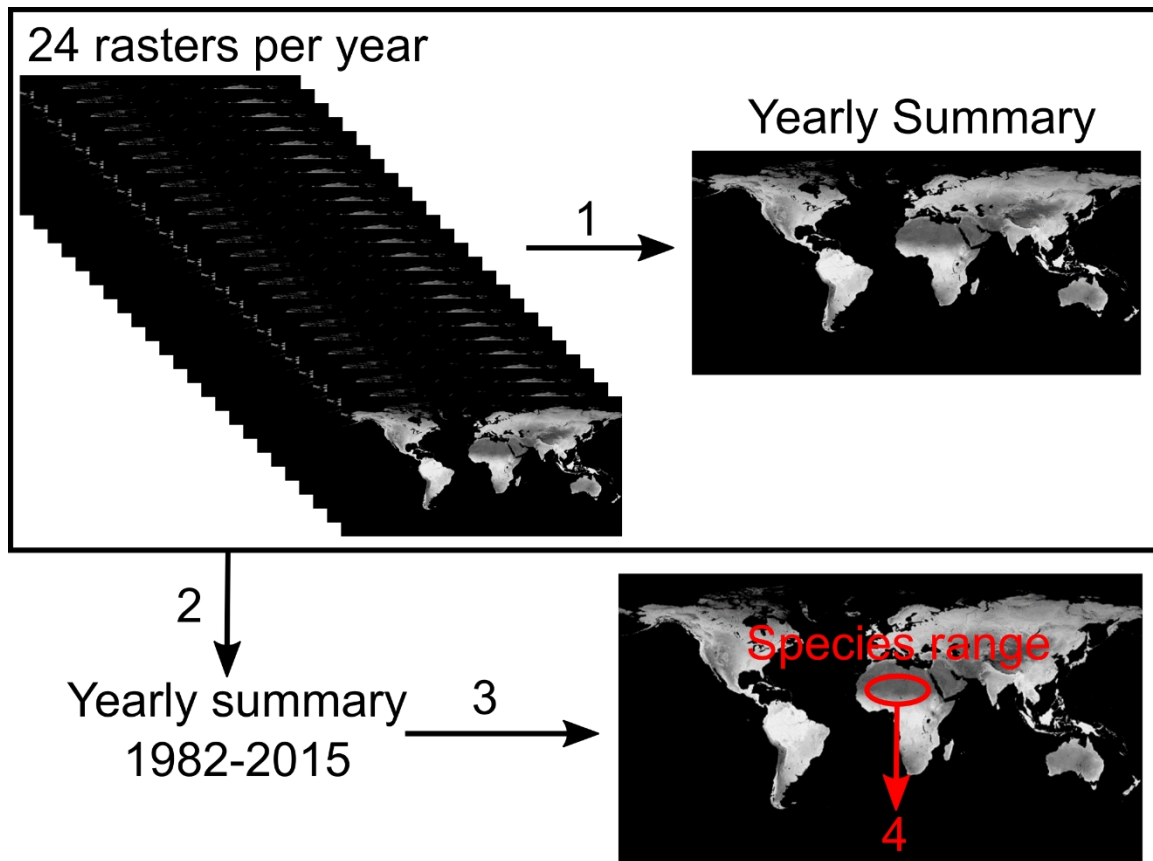


Figure S1. Raster workflow of estimated NDVI statistics. The figure presents steps of how between years variation in productivity was estimated. Step 1: Estimation of per pixel summary statistics (mean or SD) from 24 rasters layers per year (2 per month). Step 2: Estimation of summary statistics as in Step 1 for the years 1982-2015 resulting in 34 raster layers one for each year. Step 3: Estimation of per pixel summary statistics (mean or SD) from the 34 raster layers produced in Step 2, resulting in one raster layer. Step 4. Extracting values from the single raster layer produced in Step 3 that overlap species distributions (shapefile polygons from IUCN terrestrial mammal dataset) to estimate median values within the range of the species. Summary statistics for NDVI estimated at each step for variables used in this study, medians of: averages of yearly means ( $P_M$ : Step 1 mean, Step 3 mean, Step 4 median), averages of yearly SDs ( $P_S$ : Step 1 SD, Step 3 mean, Step 4 median) and average SDs of yearly means ( $P_{SD}$ : Step 1 mean, Step 3 SD, Step 4 median).

Table S1. Correlation matrix of variables for studied 81 mammalian species.  $BT_{min}$  and  $BM$  refer to minimum core body temperature and body mass, respectively. Bioclimatic variables include annual median ( $T_M$ ) and standard deviation ( $T_{SD}$ ) of environmental temperature (BIO1), median diurnal temperature range ( $T_R$ ; BIO2) and temperature seasonality ( $T_S$ ; BIO4). Indexes of yearly level of primary productivity ( $P_M$ ; median of yearly averages), among years variation in productivity ( $P_{SD}$ ; median of standard deviations of yearly averages) and seasonality of productivity ( $P_S$ ; median of within years standard deviations) were calculated from NDVI data and species ranges. \*  $p \leq 0.05$ , \*\*  $p \leq 0.001$ .

	$BT_{min}$	$BM$	$T_M$	$T_{SD}$	$T_R$	$T_S$	$P_M$	$P_S$	$P_{SD}$
$BM$	<b>0.22*</b>								
$T_M$	0.14	-0.16							
$T_{SD}$	0.01	-0.15	<b>-0.37**</b>						
$T_R$	<b>-0.23*</b>	0.02	-0.05	-0.20					
$T_S$	<b>-0.36**</b>	0.02	<b>-0.64**</b>	0.06	<b>0.59**</b>				
$P_M$	<b>0.38**</b>	0.01	0.19	0.18	<b>-0.76**</b>	<b>-0.64**</b>			
$P_S$	<b>0.37**</b>	0.13	<b>-0.27*</b>	<b>0.28**</b>	<b>-0.36**</b>	-0.14	<b>0.68**</b>		
$P_{SD}$	<b>0.23*</b>	0.09	0.11	-0.09	-0.04	0.04	<b>0.36**</b>	<b>0.57**</b>	

Table S2. Differences in studied variables between arid (factor level = 1) and non-arid species (level = 0). Results for ordinary (OLS) and phylogenetic (PGLR) generalized least squares.

variable	Humid species ( $AI \geq 0.5$ )			Arid species ( $AI < 0.5$ )			OLS			PGLS			
	mean (s.d.)	min-max	med	mean (s.d.)	min-max	med	$\beta$ (s.e.)	t	p	$\beta_{PGLS}$ (s.e.)	t	p	$\lambda$
Minimum body temperature (°C)	19.4 (5.1)	10.4-28.6	18.6	18.2 (5.9)	7.7-31	17.1	-0.25 (0.22)	-1.14	0.26	-0.08 (0.23)	-0.33	0.74	0.853
Body mass (g)	160.9 (506.0)	2-2880	28.0	468.3 (1847.2)	4-9000	468.3	0.07 (0.23)	0.29	0.77	-0.02 (0.16)	-0.13	0.89	1.000
Yearly temperature (°C)	19.9 (6.7)	4.5-26.8	22.7	18.4 (5.2)	5.6-26.2	18.4	-0.12 (0.25)	-0.55	0.59	0.18 (0.22)	0.80	0.42	0.723
Among years t. variation (°C)	3.5 (2.1)	0.4-11.0	2.8	2.6 (1.4)	0.3-6.8	2.2	<b>-0.49 (0.22)</b>	<b>-2.26</b>	<b>0.027</b>	-0.38 (0.22)	-1.73	0.088	0.408
Diurnal temperature range (°C)	11.2 (1.6)	8.4-13.9	11.2	14.4 (1.3)	11.2-16.5	14.6	<b>1.48 (0.15)</b>	<b>9.74</b>	<b>&lt;.0001</b>	<b>1.27 (0.15)</b>	<b>8.41</b>	<b>&lt;.0001</b>	0.850
Temperature seasonality (°C)	3.1 (2.9)	0.5-9.7	2.4	5.3 (2.0)	1.0-10.7	5.1	<b>1.05 (0.19)</b>	<b>5.46</b>	<b>&lt;.0001</b>	<b>0.35 (0.15)</b>	<b>2.36</b>	<b>0.021</b>	0.967
Yearly productivity	0.63 (0.13)	0.39-0.84	0.63	0.30 (0.11)	0.14-0.50	0.28	<b>-1.59 (0.14)</b>	<b>-11.50</b>	<b>&lt;.0001</b>	<b>-1.59 (0.14)</b>	<b>-11.50</b>	<b>&lt;.0001</b>	<.0001
Productivity seasonality	0.09 (0.03)	0.05-0.18	0.08	0.06 (0.03)	0.01-0.13	0.06	<b>-0.93 (0.20)</b>	<b>-4.64</b>	<b>&lt;.0001</b>	<b>-0.89 (0.20)</b>	<b>-4.41</b>	<b>&lt;.0001</b>	0.159
Among years p. variation	0.02 (0.003)	0.02-0.03	0.02	0.02 (0.006)	0.01-0.04	0.02	-0.10 (0.22)	-0.46	0.65	-0.10 (0.22)	-0.46	0.65	<.0001

Table S3. Results from rotated principal component analysis of environmental predictors calculated from species ranges of 81 mammals. Given are percentages of explained variation in environmental variables by the rotated principal components (RCs) and standardized loadings of environmental variables to the given components. In bold are indicated main environmental predictors loadings to the components.

	RC1 (25%)	RC2 (23%)	RC3 (16%)	RC4 (15%)	RC5 (18%)
Yearly temperature	-0.01	<b>0.94</b>	0.14	-0.20	-0.19
Among years temperature variation	-0.10	-0.16	-0.06	<b>0.97</b>	0.12
Diurnal temperature range	<b>0.98</b>	-0.09	0.01	-0.10	-0.13
Temperature seasonality	<b>0.51</b>	<b>-0.78</b>	0.18	0.03	-0.24
Yearly productivity	<b>-0.69</b>	0.29	0.21	0.10	<b>0.56</b>
Productivity seasonality	-0.25	-0.15	0.37	0.16	<b>0.85</b>
Among years productivity variation	-0.02	0.04	<b>0.95</b>	-0.07	0.27

Table S4. Models selection procedure applied in the study. Full model included factor aridity, body mass, five principal components and two-way interactions the predictors. "reduced predictor" refers to a predictor included in above model (see: "statistics of reduced predictor") but excluded in given analysis.

reduced predictor	model statistics		statistics of reduced predictor		
	AIC	$\Delta$ AIC	$\beta$ PGLS (s.e.)	t	p
full model	220.52				
Body mass*RC4	218.52	2.00	0.01 (0.12)	0.03	0.97
Body mass*RC2	216.58	1.94	-0.03 (0.12)	-0.21	0.84
Arid*RC5	214.67	1.91	-0.14 (0.54)	-0.27	0.79
Arid*RC2	213.02	1.65	0.12 (0.22)	0.54	0.59
Body mass*RC5	211.50	1.52	0.07 (0.11)	0.64	0.53
Body mass*RC1	210.63	0.87	0.14 (0.14)	0.97	0.33
Body mass*Arid	209.15	1.48	-0.12 (0.18)	-0.67	0.41
Arid*RC1	208.02	1.13	0.23 (0.27)	0.87	0.39
Body mass*RC3	207.60	0.42	0.16 (0.14)	1.18	0.24
Arid*RC3	207.20	0.40	0.29 (0.26)	1.12	0.26

Table S5. Results from two rotated principal component analysis of environmental predictors calculated from species ranges of 46 arid and 35 not arid mammals. Given are percentages of explained variation in environmental variables by the rotated principal components (RCs) and standardized loading of environmental variable to the given components.

arid	RC1 (35%)	RC2 (16%)	RC3 (15%)	RC4 (15%)	RC5 (15%)
Yearly temperature	-0.03	0.89	0.12	-0.20	-0.36
Among years temperature variation	0.05	-0.15	0.00	<b>0.99</b>	0.04
Diurnal temperature range	-0.20	0.09	0.96	0.00	0.15
Temperature seasonality	-0.12	-0.28	0.18	0.03	0.93
Yearly productivity	0.89	-0.03	-0.25	0.11	-0.21
Productivity seasonality	0.91	-0.33	-0.11	0.10	-0.09
Among years productivity variation	0.88	0.38	-0.03	-0.14	0.10

humid	RC1 (31%)	RC2 (18%)	RC3 (16%)	RC4 (16%)	RC5 (16%)
Yearly temperature	-0.91	0.05	-0.02	-0.22	-0.26
Among years temperature variation	0.24	-0.03	-0.04	<b>0.96</b>	0.10
Diurnal temperature range	0.10	0.95	0.13	-0.05	0.23
Temperature seasonality	0.86	0.25	0.30	0.14	0.17
Yearly productivity	-0.60	-0.41	-0.24	-0.31	-0.46
Productivity seasonality	0.35	0.28	0.13	0.11	0.87
Among years productivity variation	0.18	0.13	0.97	-0.04	0.12

Table S6. Parameter estimates for two phylogenetically generalized least squares (PGLS) analysis of environmental variables predicting minimum body temperature in arid ( $R_{Is}^2 = 0.50$ ,  $R_{ce}^2 = 0.47$ ,  $R_{Ir}^2 = 0.41$ ) and not arid mammals ( $R_{Is}^2 = 0.44$ ,  $R_{ce}^2 = 0.44$ ,  $R_{Ir}^2 = 0.31$ ).

arid	$\beta_{PGLS}$ (s.e.)	$t$	$p$
Intercept	-0.15 (0.47)	-0.31	0.76
IBM	0.33 (0.15)	2.19	0.034
RC1	0.37 (0.12)	3.01	0.005
RC2	0.21 (0.15)	1.38	0.18
RC3	-0.10 (0.14)	-0.76	0.45
RC4	0.13 (0.13)	1.05	0.30
RC5	-0.09 (0.13)	-0.64	0.52
$\lambda = 0.614$ , AIC = 123.6, N = 46			
humid	$\beta_{PGLS}$ (s.e.)	$t$	$p$
Intercept	-0.14 (0.69)	-0.20	0.84
IBM	0.27 (0.20)	1.35	0.19
RC1	-0.21 (0.20)	-1.06	0.30
RC2	-0.13 (0.16)	-0.84	0.41
RC3	-0.12 (0.15)	-0.80	0.43
RC4	<b>-0.42 (0.15)</b>	<b>-2.83</b>	<b>0.009</b>
RC5	0.09 (0.16)	0.59	0.56
$\lambda = 0.846$ , AIC = 103.4, N = 35			