

Ecography

ECOG-04027

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2019. Addressing common pitfalls does not provide
more support to geographical and ecological abundant-
centre hypotheses. – *Ecography* doi: 10.1111/
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Supplementary material

Appendix 1

Fig. A1. Biplot of the principal component analyses on the explanatory variables. BorFor = Boreal Forest; Crop = Crop; Des = Desert; Grass = Grassland; Past = Pasture; PolDes = Polar Desert; Sav = Savannah; Shrub = Shrubland; TempFor = Temperate Forest; TropFor = Tropical Forest; NDVI_m = mean NDVI; NDVI_sd = NDVI seasonality; bio1 = Annual Mean Temperature; bio2 = Mean Diurnal Range; bio3 = Isothermality; bio4 = Temperature Seasonality; bio5 = Max Temperature of Warmest Month; bio6 = Min Temperature of Coldest Month; bio7 = Temperature Annual Range; bio8 = Mean Temperature of Wettest Quarter; bio9 = Mean Temperature of Driest Quarter; bio10 = Mean Temperature of Warmest Quarter; bio11 = Mean Temperature of Coldest Quarter; bio12 = Annual Precipitation; bio13 = Precipitation of Wettest Month; bio14 = Precipitation of Driest Month; bio15 = Precipitation Seasonality (Coefficient of Variation); bio16 = Precipitation of Wettest Quarter; bio17 = Precipitation of Driest Quarter; bio18 = Precipitation of Warmest Quarter; bio19 = Precipitation of Coldest Quarter.

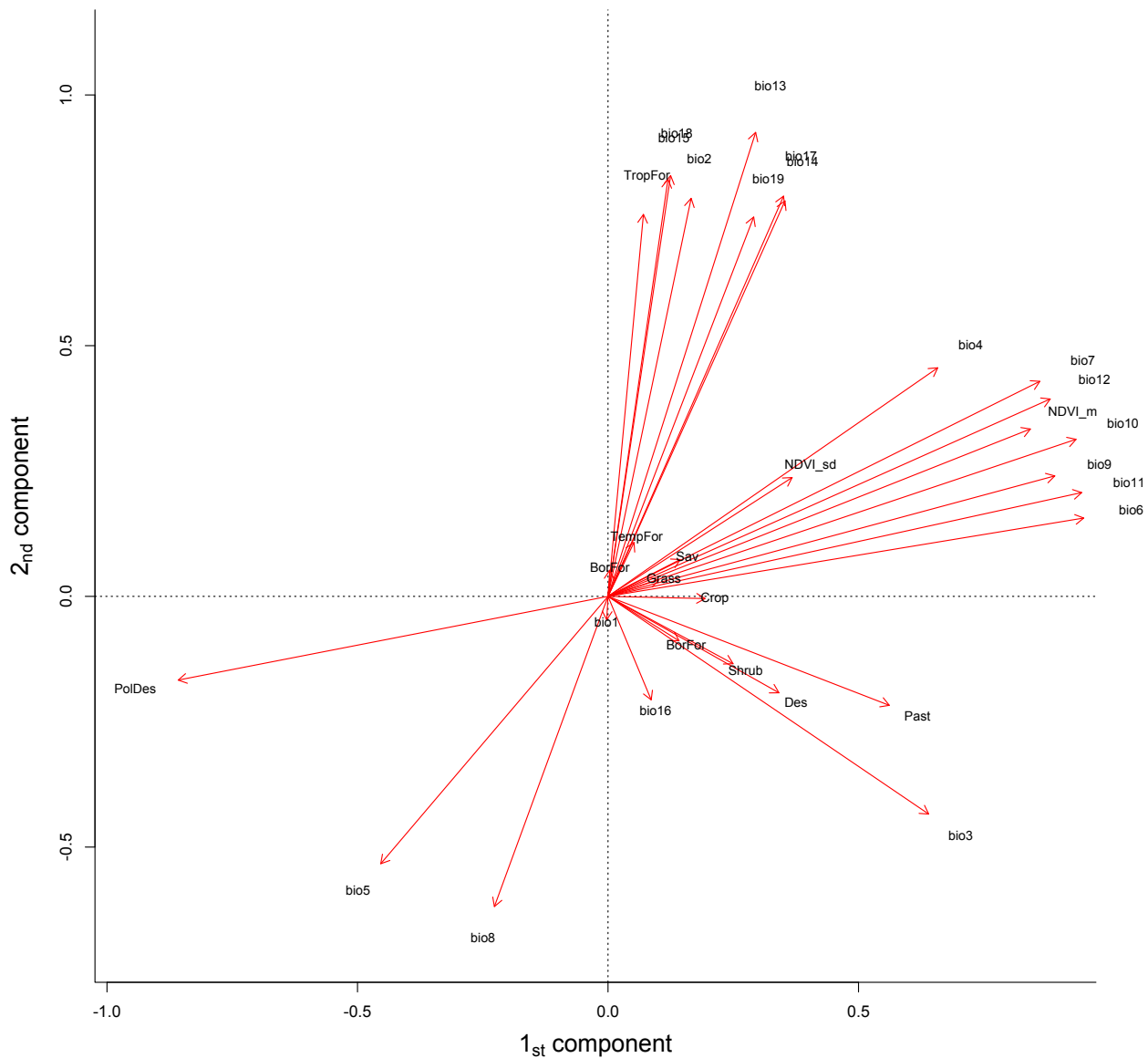


Fig. A2. Correlation between the 9 centrality/marginality measures. The upper triangular of the matrix represent the Spearman's correlation coefficients, the lower present a graphical visualization of the tightness of the correlations. CD = Centroid distance; ED = Edge Distance, SUIT = Suitability; MAR = Marginality; MAH = Mahalanobis distance; envCD = distance from the centroid of the environmental space; envED = distance from the edge of the environmental space.

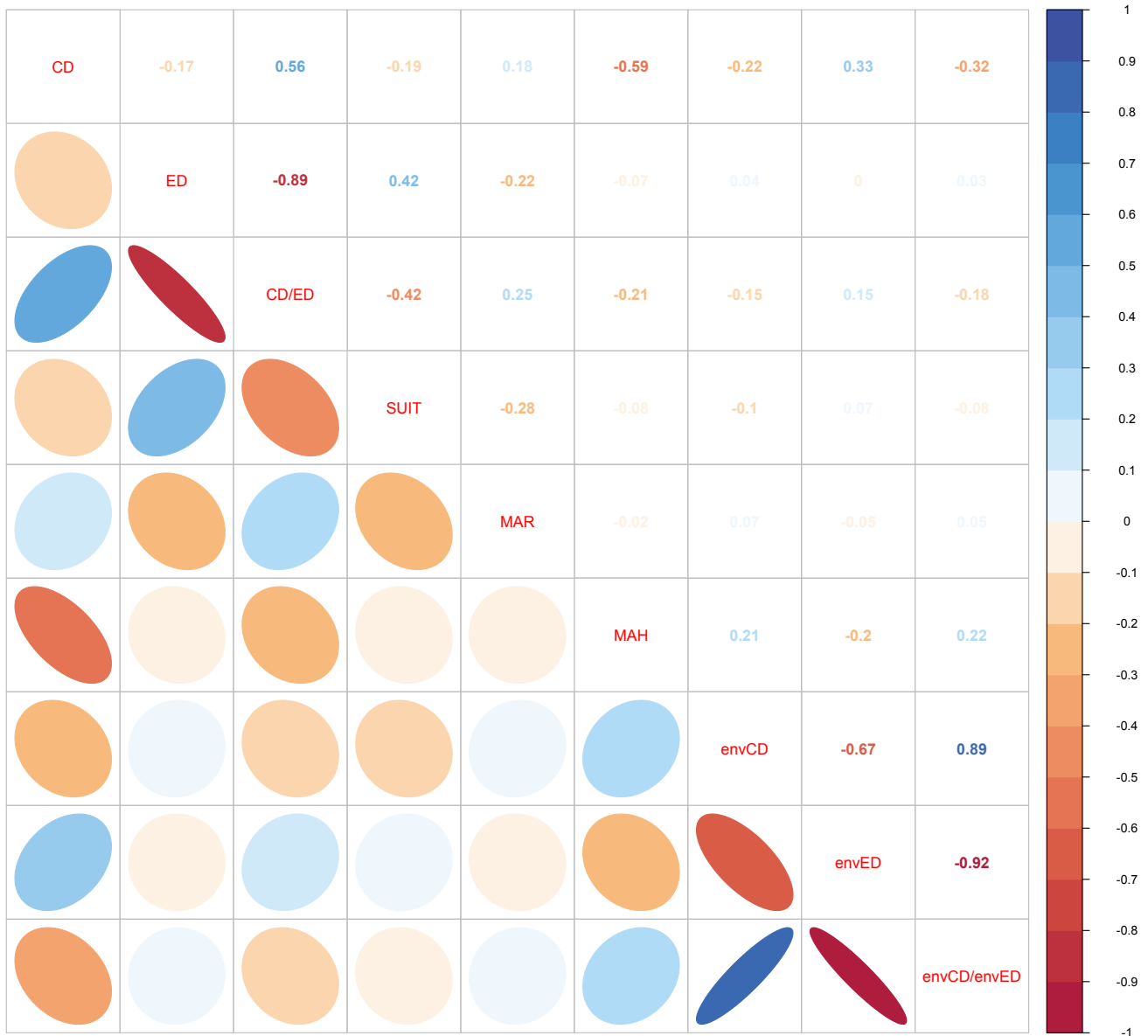


Fig. A3. Distribution of the Spearman's correlation coefficients between species population density and the 9 centrality/marginality measures on the restricted dataset. Blue bars represent the significant coefficients. The sign in parentheses indicates the expected sign of the coefficient under the Abundance-centre hypothesis. CD = Centroid distance; ED = Edge Distance, SUI = Suitability; MAR = Marginality; MAH = Mahalanobis distance; envCD = distance from the centroid of the environmental space; envED = distance from the edge of the environmental space.

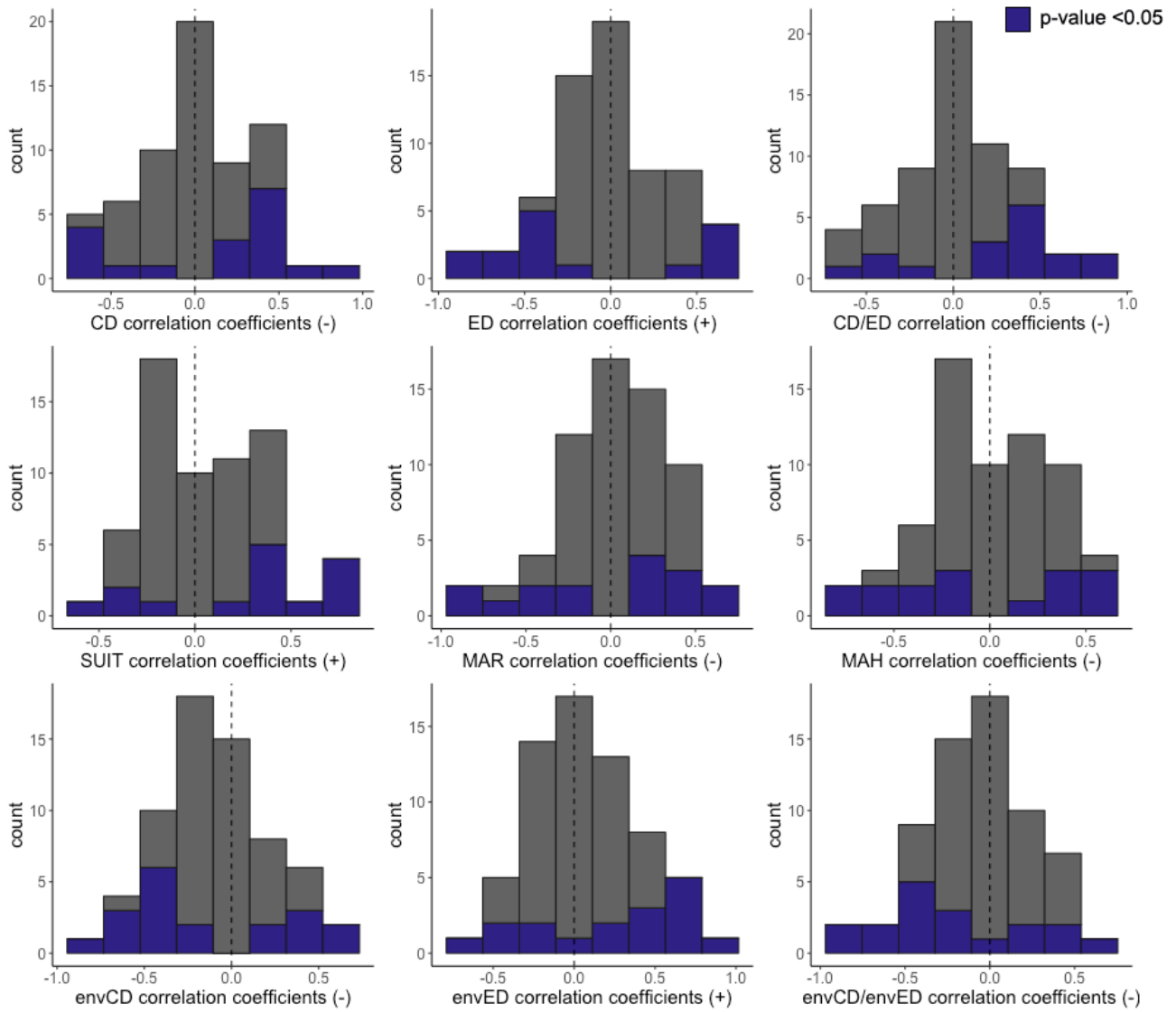


Fig. A4. Partial effects of environmental niche tolerance on the effect sizes of the centrality and marginality measures based on the restricted dataset. Size of data points is proportional to the sample size. CD = Centroid distance; ED = Edge Distance, SUIT = Suitability; envCD = distance from the centroid of the environmental space; envED = distance from the edge of the environmental space.

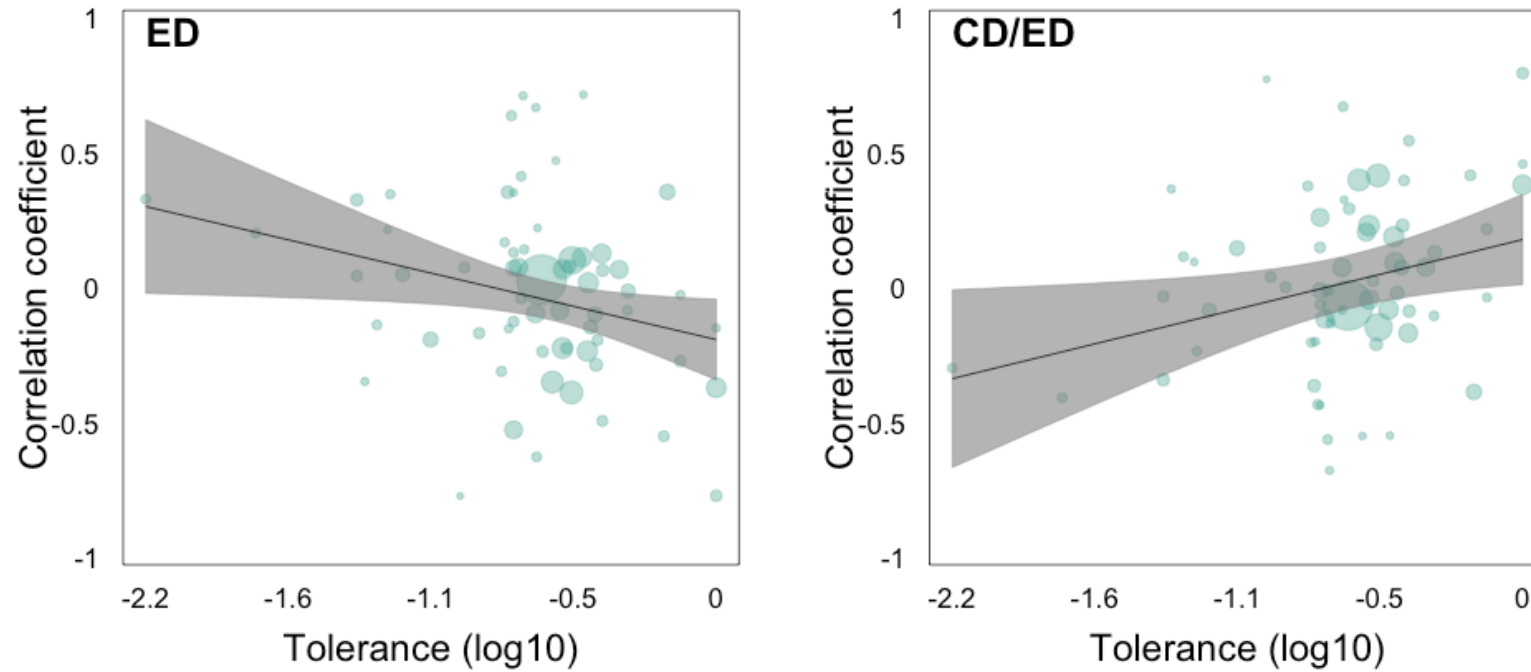


Table A1. Weighted Spearman's correlation coefficients between population density estimates and the 9 centrality/marginality measures. CD = Centroid distance; ED = Edge Distance, SUIT = Suitability; MAR = Marginality; envCD = distance from the centroid of the environmental space; envED = distance from the edge of the environmental space; n = sample size; n_1deg = number of independent 1 degree cells in which the point fall. * = p-value<0.05; ** = p-value<0.01; *** = p-value<0.001.

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg
Aves	Galliformes	Cracidae	<i>Mitu tuberosum</i>	-0.474	-0.084	-0.104	0.677 **	0.302	-0.667 **	-0.304	0.435	-0.16	13	6
Aves	Galliformes	Cracidae	<i>Penelope jacquacu</i>	0.48 **	-0.263	0.48 ***	-0.355	0.4 **	-0.084	0.06	0.134	-0.15	14	6
Aves	Passeriformes	Certhiidae	<i>Certhia brachydactyla</i>	0.082	-0.074	0.287	0.003	-0.547 *	0.032	-0.136	0.315	-0.344	46	6
Aves	Passeriformes	Certhiidae	<i>Certhia familiaris</i>	-0.365 ***	0.098	-0.141	0.355 **	0.282	-0.296	-0.445	0.405	-0.445	41	6
Aves	Passeriformes	Corvidae	<i>Pica pica</i>	-0.26	-0.103	0.166	-0.109	-0.419	0.135	-0.12	-0.2	0.134	15	6
Aves	Passeriformes	Paridae	<i>Parus major</i>	-0.153	-0.055	0.004	0.053	-0.225 *	0.01	-0.076	-0.287 *	0.002	112	18
Aves	Piciformes	Picidae	<i>Dendrocopos major</i>	-0.026	-0.414	0.417	-0.027	0.133	-0.228	-0.061	0.086	-0.045	52	12
Aves	Piciformes	Picidae	<i>Dendrocopos minor</i>	-0.276	-0.002	0.032	-0.416	0.057	0.846 **	0.714 **	-0.577	0.785 ***	29	6
Aves	Piciformes	Picidae	<i>Picus viridis</i>	-0.169	-0.553	0.514	0.569	0.676	0.63	0.597	-0.601	0.597	7	5
Mammalia	Carnivora	Canidae	<i>Canis aureus</i>	-0.277 **	0.375 ***	-0.479 ***	-0.623 ***	-0.138	0.729 ***	0.519 ***	-0.503 ***	0.419 ***	27	6
Mammalia	Carnivora	Canidae	<i>Canis lupus</i>	0.719 ***	0.3 *	-0.244	0.141	0.538 ***	0.032	-0.266 *	-0.488 ***	0.035	50	34
Mammalia	Carnivora	Canidae	<i>Cuon alpinus</i>	-0.012	-0.064	-0.057	0.209 *	0.251	0.191	-0.136	0.064	0.102	36	10
Mammalia	Carnivora	Canidae	<i>Lycaon pictus</i>	0.315	0.474	-0.099	-0.181	-0.092	-0.497 *	0.046	0.013	0.076	12	8
Mammalia	Carnivora	Felidae	<i>Acinonyx jubatus</i>	0.159	0	-0.071	-0.509 **	-0.145	0.108	-0.13	-0.086	-0.058	23	13
Mammalia	Carnivora	Felidae	<i>Leopardus pardalis</i>	-0.556 **	0.412 *	-0.44 *	0.478 *	-0.798 ***	0.187	0.124	-0.083	0.124	35	8
Mammalia	Carnivora	Felidae	<i>Panthera leo</i>	-0.353 ***	0.039	-0.316 **	0.223 **	0.265 **	-0.006	0.129	0.038	0.056	38	18
Mammalia	Carnivora	Felidae	<i>Panthera onca</i>	-0.178	0.71 **	-0.677 **	-0.31	0.08	0.599 *	0.621 **	-0.269	0.654 **	9	7
Mammalia	Carnivora	Felidae	<i>Panthera pardus</i>	0.371 ***	-0.109	0.109	-0.296 **	0.277 ***	-0.089	-0.109	0.054	-0.072	112	32

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg
Mammalia	Carnivora	Felidae	<i>Panthera tigris</i>	0.121 *	-0.227 ***	0.226 ***	-0.232 **	0.559 ***	0.122	0.071	-0.1	0.088	99	24
Mammalia	Carnivora	Hyaenidae	<i>Crocuta crocuta</i>	-0.128	0.232 **	-0.196	0.078	-0.006	0.177	-0.319 *	0.078	-0.306 *	34	20
Mammalia	Carnivora	Mustelidae	<i>Martes martes</i>	-0.265	0.327	-0.298	-0.335	0.346	0.376	-0.15	-0.228	0.03	13	7
Mammalia	Carnivora	Ursidae	<i>Melursus ursinus</i>	-0.073	0.175	-0.166	0.185 **	0.072	-0.252 ***	0.116	-0.449 ***	0.349 ***	48	11
Mammalia	Carnivora	Ursidae	<i>Ursus arctos</i>	-0.019	-0.55 ***	0.416 **	-0.247	0.352	0.464 *	0.397 ***	-0.102	0.211	16	13
Mammalia	Cetartiodactyla	Bovidae	<i>Aepyceros melampus</i>	0.125	-0.206 **	0.196 **	-0.024	-0.023	-0.16	-0.23 **	0.249 **	-0.24 ***	88	54
Mammalia	Cetartiodactyla	Bovidae	<i>Alcelaphus buselaphus</i>	-0.133	-0.199	0.18	-0.271	0.242	-0.312	-0.029	-0.037	-0.006	45	28
Mammalia	Cetartiodactyla	Bovidae	<i>Antidorcas marsupialis</i>	0.139	-0.014	-0.065	0.323 *	-0.415 *	-0.641 ***	0.013	-0.246	0.253	19	19
Mammalia	Cetartiodactyla	Bovidae	<i>Bos gaurus</i>	0.014	-0.183 **	0.227 **	0.261 *	-0.071	0.172 *	-0.234	0.221	-0.216	72	15
Mammalia	Cetartiodactyla	Bovidae	<i>Boselaphus tragocamelus</i>	0.061 *	0.255 ***	-0.022	0.312 ***	-0.281 ***	-0.504 ***	0.004	-0.121 **	0.041	69	12
Mammalia	Cetartiodactyla	Bovidae	<i>Cephalophus rufilatus</i>	0.45	0.667 ***	-0.083	0.317	0.033	-0.133	-0.4	0.5	-0.417	9	9
Mammalia	Cetartiodactyla	Bovidae	<i>Connochaetes gnou</i>	0.143	0.345	-0.235	0.195	0.142	0.219	-0.471 *	0.198	-0.273	12	10
Mammalia	Cetartiodactyla	Bovidae	<i>Connochaetes taurinus</i>	0.524 ***	-0.421 ***	0.479 ***	-0.353 ***	0.297 ***	-0.289 ***	-0.425 ***	0.364 ***	-0.426 ***	90	38
Mammalia	Cetartiodactyla	Bovidae	<i>Damaliscus lunatus</i>	-0.04	0.058	-0.031	-0.272 *	0.457 ***	-0.012	-0.03	0.062	-0.03	64	29
Mammalia	Cetartiodactyla	Bovidae	<i>Damaliscus pygargus</i>	-0.491	-0.152	-0.2	0.815 ***	0.401	-0.049	-0.219	-0.019	0.085	10	10
Mammalia	Cetartiodactyla	Bovidae	<i>Eudorcas rufifrons</i>	-0.119	0.714 **	-0.548	0.452	0.119	-0.31	-0.429	0.786 ***	-0.762 **	8	8
Mammalia	Cetartiodactyla	Bovidae	<i>Eudorcas thomsonii</i>	-0.482 **	-0.095	-0.136	0.409 **	-0.011	0.177	-0.46 **	0.468 **	-0.49 **	24	10
Mammalia	Cetartiodactyla	Bovidae	<i>Gazella bennettii</i>	0.258 **	-0.168	-0.037	-0.195 **	0.449 ***	-0.32 ***	-0.248 ***	0.367 ***	-0.248 ***	41	7
Mammalia	Cetartiodactyla	Bovidae	<i>Gazella gazella</i>	-0.838 ***	-0.547	0.228	0.065	0.304	0.455 *	0.736 ***	-0.314	0.364	10	9
Mammalia	Cetartiodactyla	Bovidae	<i>Hippotragus equinus</i>	0.16	0.133	-0.111	0.181 *	0.214 **	0.067	0.322 ***	-0.159 *	0.279 ***	63	52
Mammalia	Cetartiodactyla	Bovidae	<i>Hippotragus niger</i>	-0.137	0.084	-0.126	0.297 **	-0.185	-0.163	0.028	0.105	-0.092	52	37

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg
Mammalia	Cetartiodactyla	Bovidae	<i>Kobus ellipsiprymnus</i>	0.202	0.015	0.04	-0.475 ***	0.108	-0.021	0.039	0.007	-0.015	43	29
Mammalia	Cetartiodactyla	Bovidae	<i>Kobus kob</i>	-0.081	-0.211	0.063	-0.247	0.39 **	-0.185	0.448 ***	-0.245	0.316 *	27	26
Mammalia	Cetartiodactyla	Bovidae	<i>Kobus vardonii</i>	0	0.168	-0.203	0.032	-0.189	-0.161	0.07	0.327	-0.189	12	12
Mammalia	Cetartiodactyla	Bovidae	<i>Litocranius walleri</i>	-0.341	0.142	-0.132	0.159	0.422	0.406	0.19	0.163	0.028	12	10
Mammalia	Cetartiodactyla	Bovidae	<i>Madoqua kirkii</i>	-0.165	0.246	-0.248	-0.035	-0.664	-0.156	-0.915 ***	0.83 ***	-0.915 **	10	6
Mammalia	Cetartiodactyla	Bovidae	<i>Nanger granti</i>	-0.046	0.12	-0.114	0.17	-0.238 *	-0.138	-0.252	0.367 **	-0.279	37	23
Mammalia	Cetartiodactyla	Bovidae	<i>Oreotragus oreotragus</i>	0.289 *	-0.467 ***	0.527 ***	-0.167	-0.022	-0.343 ***	0.294 ***	-0.324 **	0.308 **	26	19
Mammalia	Cetartiodactyla	Bovidae	<i>Oryx beisa</i>	0.36	0.075	-0.075	-0.186	0.106	-0.012	-0.089	0.247	-0.19	19	15
Mammalia	Cetartiodactyla	Bovidae	<i>Ourebia ourebi</i>	0.386 ***	0.036	0.093	-0.271	-0.064	0.132	-0.092	0.241 *	-0.206	34	28
Mammalia	Cetartiodactyla	Bovidae	<i>Ovibos moschatus</i>	0	0.214	0.095	-0.143	0.381	0.143	-0.143	0.048	-0.286	8	8
Mammalia	Cetartiodactyla	Bovidae	<i>Pelea capreolus</i>	-0.632	0.47	-0.549	0.549	-0.573	-0.294	-0.525	-0.726 **	0.47	8	6
Mammalia	Cetartiodactyla	Bovidae	<i>Philantomba monticola</i>	0.703 ***	-0.094	0.224	-0.343 **	0.703 ***	-0.789 **	-0.671 ***	0.551 *	-0.671 ***	13	7
Mammalia	Cetartiodactyla	Bovidae	<i>Raphicerus campestris</i>	0.183	-0.423 ***	0.314 ***	0.192	0.001	-0.334 *	-0.318 ***	0.239 *	-0.306 **	29	21
Mammalia	Cetartiodactyla	Bovidae	<i>Raphicerus sharpei</i>	-0.787 ***	0.422	-0.751 ***	0.354	0.548 *	-0.281	0.049	0.052	-0.019	9	7
Mammalia	Cetartiodactyla	Bovidae	<i>Redunca fulvorufula</i>	0.131	-0.161	0.135	0.448 ***	-0.168	-0.163	-0.232	-0.018	0.002	34	29
Mammalia	Cetartiodactyla	Bovidae	<i>Redunca redunca</i>	-0.081	0.016	-0.025	-0.013	0.058	0.193 *	0.007	-0.02	0.007	53	42
Mammalia	Cetartiodactyla	Bovidae	<i>Sylvicapra grimmia</i>	0.337 ***	0.013	0.125	-0.214 *	0.154	-0.218 *	0.172 *	-0.214 **	0.209 *	51	45
Mammalia	Cetartiodactyla	Bovidae	<i>Syncerus caffer</i>	-0.154 **	0.125 *	-0.171 ***	0.3 ***	-0.21 **	0.066	-0.276 ***	0.299 ***	-0.281 ***	129	89
Mammalia	Cetartiodactyla	Bovidae	<i>Taurotragus derbianus</i>	0.061	0.637 ***	-0.433 *	-0.318	-0.308	-0.238	-0.531 **	0.335	-0.436	14	11
Mammalia	Cetartiodactyla	Bovidae	<i>Taurotragus oryx</i>	0.298 ***	-0.361 ***	0.382 ***	0.102	-0.007	-0.15	0.023	0.03	-0.023	93	67
Mammalia	Cetartiodactyla	Bovidae	<i>Tetracerus quadricornis</i>	-0.226	0.222	-0.196	0.227	-0.455 *	-0.477 ***	-0.367 ***	0.205 **	-0.416 ***	54	11

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus angasii</i>	0.722 ***	-0.572 ***	0.664 ***	-0.008	0.662	-0.463	-0.006	0.08	0.095	12	6
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus scriptus</i>	0.285 ***	-0.076	0.172 *	-0.179	0.066	-0.131 *	0.275 ***	-0.182 **	0.261 ***	62	46
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus spekii</i>	0.346	-0.347	0.365	-0.275	0.338	0.412	0.402	-0.277	0.402	9	8
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus strepsiceros</i>	0.23 ***	-0.012	0.11	0.057	-0.109	-0.521 ***	-0.049	-0.018	-0.012	68	52
Mammalia	Cetartiodactyla	Cervidae	<i>Axis axis</i>	0.249 ***	-0.307 ***	0.31 ***	-0.28 ***	0.168 ***	0.125	0.282 ***	-0.296 **	0.336 ***	89	20
Mammalia	Cetartiodactyla	Cervidae	<i>Hippocamelus bisulcus</i>	-0.401	-0.272	0.216	0.177	0.58 *	0.511 *	0.135	-0.139	0.289	17	8
Mammalia	Cetartiodactyla	Cervidae	<i>Rangifer tarandus</i>	-0.121	-0.192	0.159	0.341 *	0.115	-0.066	-0.434 *	0.478 **	-0.445 **	13	13
Mammalia	Cetartiodactyla	Cervidae	<i>Rusa unicolor</i>	-0.147	0.035	-0.054	-0.244 **	0.027	-0.237 ***	-0.078	-0.019	-0.039	102	23
Mammalia	Cetartiodactyla	Giraffidae	<i>Giraffa camelopardalis</i>	-0.589 ***	0.217	-0.491 **	-0.23	-0.268	-0.214	-0.249	0.293	-0.325	25	15
Mammalia	Cetartiodactyla	Hippopotamidae	<i>Hippopotamus amphibius</i>	-0.727 ***	-0.444 ***	0.234	-0.104	0.058	0.376 *	0.142 *	-0.221 **	0.153 *	29	16
Mammalia	Cetartiodactyla	Suidae	<i>Phacochoerus africanus</i>	-0.313 **	-0.287	0.112	-0.085	-0.071	-0.268	-0.19	0.478 ***	-0.285 *	28	17
Mammalia	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	0.092	-0.324 ***	0.297 ***	0.09	-0.14 *	0.087	0.051	0.137 *	-0.054	160	62
Mammalia	Cetartiodactyla	Tayassuidae	<i>Pecari tajacu</i>	0.349	-0.171	0.327 *	-0.259	0.604 ***	-0.071	0.038	0.103	-0.093	26	11
Mammalia	Diprotodontia	Macropodidae	<i>Macropus rufus</i>	0.041	-0.143	0.258	0.113	-0.036	0.009	-0.614 ***	0.652 ***	-0.658 ***	38	11
Mammalia	Perissodactyla	Rhinocerotidae	<i>Diceros bicornis</i>	0.081	-0.517 **	0.504 *	-0.623 ***	0.357 **	-0.352 *	-0.038	0.301	-0.096	20	13
Mammalia	Primates	Aotidae	<i>Aotus nancymae</i>	0.409 **	0.603	-0.581	0.418 ***	0.479 ***	0.536 **	-0.578 ***	0.46 ***	-0.578 ***	10	6
Mammalia	Primates	Atelidae	<i>Alouatta caraya</i>	0.461	-0.658 *	0.693 *	-0.575 *	-0.067	-0.531	0.008	-0.007	0.011	11	7
Mammalia	Primates	Atelidae	<i>Alouatta guariba</i>	-0.317	0.17	-0.374 *	0.215	-0.176	-0.508 *	-0.595 ***	0.598 **	-0.722 ***	15	8
Mammalia	Primates	Atelidae	<i>Alouatta palliata</i>	-0.042	0.402	-0.288	-0.445	0.206	-0.096	0.229	-0.205	0.229	34	6
Mammalia	Primates	Atelidae	<i>Alouatta pigra</i>	-0.245	-0.089	-0.197	0.124	-0.401	0.474 *	-0.234	0.535 ***	-0.45 **	23	8

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg
Mammalia	Primates	Atelidae	<i>Ateles chamek</i>	-0.004	-0.262	0.244	0.32	0.277	-0.358	-0.068	-0.65 ***	0.564 ***	25	12
Mammalia	Primates	Atelidae	<i>Ateles geoffroyi</i>	-0.698 ***	0.402 *	-0.637 ***	-0.453	-0.151	0.151	-0.098	0.026	-0.054	19	8
Mammalia	Primates	Atelidae	<i>Lagothrix cana</i>	-0.405	0.306	-0.504	0.406	-0.327	0.456	0.049	-0.284	0.177	16	8
Mammalia	Primates	Callitrichidae	<i>Saguinus fuscicollis</i>	-0.662 ***	-0.467 **	0.373 **	0.243	0.297 *	-0.037	-0.148	0.226	-0.226	31	16
Mammalia	Primates	Callitrichidae	<i>Saguinus mystax</i>	-0.191	-0.11	-0.035	-0.007	-0.461 *	-0.085	0.224	-0.219	0.206	22	12
Mammalia	Primates	Cebidae	<i>Callithrix pygmaea</i>	0.198	-0.193	0.198	-0.42	-0.18	-0.256	0.114	-0.475	0.726 **	7	6
Mammalia	Primates	Cebidae	<i>Cebus apella</i>	-0.08	0.139	-0.159	-0.112	-0.222 *	0.016	-0.182	0.135	-0.143	52	25
Mammalia	Primates	Cebidae	<i>Cebus libidinosus</i>	0.429	-0.029	0.314	-0.714 *	0.771 **	-0.429	0.6	-0.029	0.314	6	6
Mammalia	Primates	Cebidae	<i>Cebus nigrinus</i>	-0.095	0	0.077	-0.168	-0.351	0.324	0.07	-0.41	0.234	20	10
Mammalia	Primates	Cebidae	<i>Saimiri boliviensis</i>	-0.116	0.079	-0.174	0.097	0.196	-0.302	0.117	-0.076	0.128	24	12
Mammalia	Primates	Cebidae	<i>Saimiri sciureus</i>	-0.012	-0.25	0.273	-0.257	-0.314	-0.598 ***	-0.497 **	0.404	-0.497 *	18	13
Mammalia	Primates	Cercopithecidae	<i>Cercopithecus albogularis</i>	-0.535	0.054	-0.386 *	0.004	0.348	0.531 *	0.018	-0.118	0.089	15	9
Mammalia	Primates	Cercopithecidae	<i>Cercopithecus ascanius</i>	0.424 *	-0.573 ***	0.579 ***	-0.275	-0.112	-0.1	-0.018	0.054	0.086	30	8
Mammalia	Primates	Cercopithecidae	<i>Cercopithecus mitis</i>	0.681 ***	-0.517 **	0.795 ***	-0.036	0.201	-0.04	0.297	-0.338	0.487	21	6
Mammalia	Primates	Cercopithecidae	<i>Colobus angolensis</i>	0.494 *	-0.17	0.305	-0.301	-0.165	0.289	-0.691 **	0.798 **	-0.729 **	12	6
Mammalia	Primates	Cercopithecidae	<i>Colobus guereza</i>	0.268 *	-0.58 **	0.475 *	0.022	0.3	0.395 *	-0.181	0.143	-0.151	23	10
Mammalia	Primates	Cercopithecidae	<i>Lophocebus albigena</i>	0.119 *	-0.132	0.099	0.36	-0.054	0.486 ***	-0.114	-0.264	-0.059	16	6
Mammalia	Primates	Cercopithecidae	<i>Macaca mulatta</i>	-0.439 ***	-0.631 ***	0.11	-0.215	0.186	-0.23 **	0.295 *	-0.013	0.078	38	11
Mammalia	Primates	Cercopithecidae	<i>Papio anubis</i>	-0.596 ***	-0.087	-0.167	0.179 *	0.066	-0.14	0.151	0.021	0.104	16	10
Mammalia	Primates	Cercopithecidae	<i>Semnopithecus entellus</i>	0.158	-0.003	-0.084	-0.431	-0.148	-0.174	0.107	-0.161	0.107	12	8
Mammalia	Primates	Cervidae	<i>Alces americanus</i>	0.485 ***	-0.43 ***	0.528 ***	-0.444 ***	0.374 ***	0.374 ***	-0.123	0.259 **	-0.286 ***	37	25

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg
Mammalia	Primates	Hominidae	<i>Gorilla gorilla</i>	-0.069	-0.046	-0.03	0.066	-0.022	0.125	-0.245	0.05	-0.144	40	16
Mammalia	Primates	Hominidae	<i>Pan troglodytes</i>	0.206 ***	-0.137 *	0.119 *	-0.11	-0.065	0.412 ***	0.016	0.004	-0.031	104	41
Mammalia	Primates	Pitheciidae	<i>Cacajao calvus</i>	0.267	0.16	0.213	-0.077	-0.159	-0.31	-0.26	-0.164	0.131	9	7
Mammalia	Primates	Pitheciidae	<i>Callicebus cupreus</i>	-0.191	0.321 *	-0.271	0.349 **	-0.009	0.39 *	-0.177	0.225	-0.19	23	13
Mammalia	Proboscidea	Elephantidae	<i>Elephas maximus</i>	0.131	-0.301 **	0.266 **	-0.134	-0.168	0.285 **	-0.129	0.154	-0.154	22	9
Mammalia	Proboscidea	Elephantidae	<i>Loxodonta africana</i>	-0.197 ***	0.031	-0.069 *	0.197 ***	-0.018	-0.151 ***	0.077	-0.084 **	0.09 *	373	237
Mammalia	Rodentia	Cricetidae	<i>Peromyscus maniculatus</i>	-0.653 ***	0.247 ***	-0.322 *	0.761 ***	-0.707 ***	-0.102	-0.172	0.094	0.029	64	6

Table A2. Weighted Spearman’s correlation coefficients between population density estimates and the 9 centrality/marginality measures based on the restricted dataset. CD = Centroid distance; ED = Edge Distance, SUI = Suitability; MAR = Marginality; envCD = distance from the centroid of the environmental space; envED = distance from the edge of the environmental space; n = sample size; n_1deg = number of independent 1 degree cells in which the point fall; SM = Sampling method (CS = Census; DS = Distance Sampling; MCR = Mark Capture Recapture; IC = Incomplete counts; HR = Home range extrapolation). * = p-value<0.05; ** = p-value<0.01; *** = p-value<0.001.

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg	SM
Aves	Galliformes	Cracidae	<i>Mitu tuberosum</i>	-0.474	-0.084	-0.104	0.677 **	0.302	-0.667 **	-0.304	0.435	-0.16	13	6	DS
Aves	Passeriformes	Paridae	<i>Parus major</i>	-0.079	-0.235	0.189	0.296	0.32	0.181	0.576 ***	-0.228	0.189	57	6	CS
Mammalia	Carnivora	Felidae	<i>Leopardus pardalis</i>	-0.615 **	0.354	-0.386	0.514 *	-0.771 **	0.143	0.1	-0.132	0.1	33	7	MCR
Mammalia	Carnivora	Felidae	<i>Panthera onca</i>	-0.178	0.71 **	-0.677 **	-0.31	0.08	0.599 *	0.621 **	-0.269	0.654 **	9	7	MCR
Mammalia	Carnivora	Mustelidae	<i>Martes martes</i>	-0.265	0.327	-0.298	-0.248	0.346	0.376	-0.15	-0.228	0.03	13	7	MCR
Mammalia	Carnivora	Ursidae	<i>Ursus arctos</i>	-0.019	-0.55 ***	0.416 **	-0.221	0.352	0.464 *	0.397 ***	-0.102	0.211	16	13	MCR
Mammalia	Cetartiodactyla	Bovidae	<i>Aepyceros melampus</i>	0.185 *	-0.224 **	0.23 **	-0.069	0.033	-0.115	-0.259 **	0.231 **	-0.216 **	60	49	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Alcelaphus buselaphus</i>	-0.039	-0.192	0.146	-0.19	0.24	-0.295	-0.086	-0.055	0.016	31	25	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Antidorcas marsupialis</i>	0.2	-0.039	-0.01	0.338	-0.465 **	-0.618 ***	-0.07	-0.302	0.302	17	17	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Cephalophus rufilatus</i>	0.45	0.667 ***	-0.083	0.433	0.033	-0.133	-0.4	0.5	-0.417	9	9	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Connochaetes gnou</i>	0.143	0.345	-0.235	0.191	0.142	0.219	-0.471 *	0.198	-0.273	12	10	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Connochaetes taurinus</i>	0.467 ***	-0.35 ***	0.399 ***	-0.34 ***	0.345 ***	-0.247 ***	-0.394 ***	0.365 ***	-0.385 ***	67	33	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Damaliscus lunatus</i>	-0.031	0.068	-0.044	-0.316 **	0.52 ***	-0.027	-0.034	0.058	-0.03	51	28	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Damaliscus pygargus</i>	-0.491	-0.152	-0.2	0.79 ***	0.401	-0.049	-0.219	-0.019	0.085	10	10	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Eudorcas rufifrons</i>	-0.119	0.714 **	-0.548	0.429	0.119	-0.31	-0.429	0.786 ***	-0.762 **	8	8	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Eudorcas thomsonii</i>	-0.567 *	0.202	-0.408	0.682	0.016	0.341	-0.241	0.163	-0.155	13	9	CS

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg	SM

Mammalia	Cetartiodactyla	Bovidae	<i>Hippotragus equinus</i>	0.177	0.112	-0.081	0.125	0.273 ***	0.155	0.276 ***	-0.201 *	0.27 ***	53	49	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Hippotragus niger</i>	-0.13	0.075	-0.116	0.292 **	-0.138	-0.126	0.025	0.108	-0.104	46	36	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Kobus ellipsiprymnus</i>	0.533 ***	-0.194	0.397 *	-0.02	0.246	0.225	0.195	-0.278	0.187	16	15	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Kobus kob</i>	-0.1	-0.146	-0.02	-0.234	0.53 ***	-0.202	0.395 **	-0.212	0.247	26	25	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Kobus vardonii</i>	0	0.168	-0.203	-0.158	-0.189	-0.161	0.07	0.327	-0.189	12	12	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Litocranius walleri</i>	-0.341	0.142	-0.132	0.095	0.422	0.406	0.19	0.163	0.028	12	10	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Nanger granti</i>	-0.098	0.049	-0.083	0.204	0.024	0.058	-0.236	0.282	-0.253	27	22	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Oreotragus oreotragus</i>	0.187	-0.31	0.376	-0.169	-0.081	-0.015	0.073	-0.178	0.138	14	14	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Oryx beisa</i>	0.226	-0.126	0.149	-0.225	0.281 *	0.119	-0.082	0.275	-0.248	16	13	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Ourebia ourebi</i>	0.372 **	-0.012	0.129	-0.267	-0.062	0.199	-0.117	0.248	-0.243	27	25	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Ovibos moschatus</i>	0	0.214	0.095	-0.095	0.381	0.143	-0.143	0.048	-0.286	8	8	DS
Mammalia	Cetartiodactyla	Bovidae	<i>Pelea capreolus</i>	-0.632	0.47	-0.549	0.236	-0.573	-0.294	-0.525	-0.726 **	0.47	8	6	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Raphicerus campestris</i>	0.61 **	-0.626 ***	0.67 ***	-0.385	0.121	-0.203	-0.462 *	0.505 **	-0.5 *	13	13	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Redunca fulvorufula</i>	0.073	-0.099	0.074	0.397 ***	-0.137	-0.184 *	-0.264	0.006	-0.025	31	27	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Redunca redunca</i>	-0.037	-0.096	0.074	-0.106	0.046	0.269 **	-0.044	0.069	-0.061	47	39	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Sylvicapra grimmia</i>	0.364 ***	0.067	0.076	-0.153	0.196	-0.128	0.194 *	-0.279 ***	0.26 **	45	42	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Syncerus caffer</i>	-0.128	0.101	-0.146 *	0.286 ***	-0.186 **	0.038	-0.244 ***	0.267 ***	-0.247 ***	103	87	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Taurotragus derbianus</i>	0.061	0.637 ***	-0.433 *	-0.235	-0.308	-0.238	-0.531 **	0.335	-0.436 *	14	11	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Taurotragus oryx</i>	0.338 ***	-0.388 ***	0.415 ***	0.079	0.091	-0.101	-0.004	0.062	-0.05	72	62	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus angasii</i>	0.829 **	-0.771	0.771 **	0.314	0.714 *	-0.6	-0.257	0.232	-0.086	6	6	CS

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg	SM
					**										
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus scriptus</i>	0.307 **	-0.084	0.205 **	-0.257 *	0.206 *	-0.136	0.419 ***	-0.355 ***	0.409 ***	45	39	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus spekii</i>	0.346	-0.347	0.365	-0.396	0.338	0.412	0.402	-0.277	0.402	9	8	CS
Mammalia	Cetartiodactyla	Bovidae	<i>Tragelaphus strepsiceros</i>	0.236 **	0.018	0.092	0.053	-0.025	-0.512 ***	-0.082	0.037	-0.057	56	49	CS
Mammalia	Cetartiodactyla	Cervidae	<i>Hippocamelus bisulcus</i>	-0.401	-0.272	0.216	0.177	0.58 *	0.511 **	0.135	-0.139	0.289	17	8	IC
Mammalia	Cetartiodactyla	Cervidae	<i>Rangifer tarandus</i>	-0.027	-0.027	-0.036	0.173	0.3	0	-0.845 ***	0.855 ***	-0.855 ***	11	11	DS
Mammalia	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	-0.696 ***	-0.77 ***	0.794 ***	-0.082	-0.642 ***	-0.089	-0.144	-0.406 **	0.104	18	10	MCR
Mammalia	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	0.407 ***	-0.371 ***	0.381 ***	-0.039	-0.049	-0.234	0.051	0.565 ***	-0.282 **	54	24	IC
Mammalia	Cetartiodactyla	Suidae	<i>Sus scrofa</i>	0.372	-0.149	0.458 *	0.727 **	-0.794 **	-0.461	-0.261	0.459	-0.261	10	6	DS
Mammalia	Diprotodontia	Macropodidae	<i>Macropus rufus</i>	-0.018	-0.138	0.115	0.463 **	-0.208	-0.087	-0.621 ***	0.723 ***	-0.708 ***	13	9	IC
Mammalia	Primates	Atelidae	<i>Alouatta pigra</i>	-0.022	-0.224	0.026	-0.067	-0.031	0.28	-0.487 **	0.575 ***	-0.487 **	18	6	CS
Mammalia	Primates	Atelidae	<i>Ateles chamek</i>	0.056	0.064	-0.087	0.42	0.177	-0.406 **	0.03	-0.252	0.361 **	21	10	DS
Mammalia	Primates	Atelidae	<i>Lagothrix cana</i>	-0.384	0.412	-0.563	0.169	-0.187	0.584	0.32	-0.561	0.505	13	6	DS
Mammalia	Primates	Callitrichidae	<i>Saguinus fuscicollis</i>	-0.642 ***	-0.286	0.23	0.318	0.272	0.145	-0.136	0.107	-0.126	23	15	DS
Mammalia	Primates	Callitrichidae	<i>Saguinus mystax</i>	-0.101	-0.169	0.002	-0.054	-0.008	-0.187	0.112	-0.102	0.205	17	11	DS
Mammalia	Primates	Cebidae	<i>Cebus apella</i>	-0.132	0.126	-0.168	-0.159	-0.337 **	-0.029	-0.165	0.111	-0.133	49	23	DS
Mammalia	Primates	Cebidae	<i>Cebus nigritus</i>	0.091	0.075	0.04	-0.542 **	-0.278 *	0.436	0.163	-0.536	0.395	16	8	DS
Mammalia	Primates	Cebidae	<i>Saimiri boliviensis</i>	-0.215	0.078	-0.21	0.22	0.092	-0.26	0.004	-0.101	0.06	22	11	DS
Mammalia	Primates	Cebidae	<i>Saimiri sciureus</i>	-0.072	-0.493 **	0.544 **	-0.24	-0.192	-0.693 ***	-0.541 **	0.191	-0.357	16	11	DS
Mammalia	Primates	Cercopithecidae	<i>Cercopithecus</i>	0.273	-0.237	0.292	-0.083	0.057	0.135	0.358	-0.404	0.358	18	6	DS

Class	Order	Family	Species	CD	ED	CD/ED	SUIT	MAR	MAH	envCD	envED	envCD/envED	n	n_1deg	SM
			<i>ascanius</i>												
Mammalia	Primates	Hominidae	<i>Gorilla gorilla</i>	-0.155	0.325	-0.341	0.345	-0.179	-0.293 *	-0.374	0.36	-0.367	21	7	DS
Mammalia	Primates	Hominidae	<i>Gorilla gorilla</i>	-0.231	0.043	-0.032	0.229	-0.325	0.318	-0.18	-0.115	0.074	17	10	IC
Mammalia	Primates	Hominidae	<i>Pan troglodytes</i>	0.38	0.13	-0.063	-0.103	-0.236	0.342	-0.419	0.525	-0.483	13	6	HR
Mammalia	Primates	Hominidae	<i>Pan troglodytes</i>	0.328 **	0.073	-0.011	-0.121	-0.171	0.64 ***	0.124	-0.023	0.048	35	24	IC
Mammalia	Primates	Hominidae	<i>Pan troglodytes</i>	0.093	-0.526 ***	0.26 ***	-0.002	0.134 *	0.341 ***	-0.352 **	0.403 ***	-0.421 ***	44	15	DS
Mammalia	Primates	Hominidae	<i>Pan troglodytes</i>	-0.011	0.352	-0.435	-0.254	-0.38	-0.031	-0.441 *	0.689 **	-0.685 **	8	6	CS
Mammalia	Primates	Pitheciidae	<i>Cacajao calvus</i>	0.336	0.221	0.325	-0.437	0.375	-0.158	-0.217	-0.026	-0.085	8	6	DS
Mammalia	Primates	Pitheciidae	<i>Callicebus cupreus</i>	-0.33 **	0.353 *	-0.363 **	0.299 *	-0.096	0.369 *	-0.115	0.195	-0.164	22	12	DS
Mammalia	Proboscidea	Elephantidae	<i>Loxodonta africana</i>	-0.19 ***	0.029	-0.066	0.205 ***	0.004	-0.167 ***	0.082	-0.087 **	0.094 *	344	234	CS

Table A3. Z coefficients (SE) of the mixed effect meta-analyses based on the restricted dataset. QE = QE statistic for the test of residual heterogeneity; P-values: * = p <0.05; ** = p <0.01; *** = p <0.001.

Measure	Expected relationship	Intercept (SE)	QE
CD	Negative	-0.106 (0.075)	159.103 ***
ED	Positive	-0.044 (0.037)	125.644 ***
CD/ED	Negative	0.020 (0.054)	123.31 ***
SUIT	Positive	0.201 (0.202)	125.556 ***
MAR	Negative	0.080 (0.158)	143.956 ***
MAH	Negative	0.020 (0.089)	138.887 ***
envCD	Negative	0.070 (0.176)	136.814 ***
envED	Positive	0.060 (0.04)	150.005 ***
envCD/envED	Negative	-0.046 (0.039)	128.876 ***

Table A4. Z coefficients (SE) of the mixed effect meta-regressions based on the restricted dataset. QE = QE statistic for the test of residual heterogeneity; QM= test statistic for the omnibus test of coefficients; P-values: * = p <0.05; ** = p <0.01; *** = p <0.001. CD = Centroid distance; ED = Edge Distance, SUIT = Suitability; MAR = Marginality; MAH = Mahalanobis distance; envCD = distance from the centroid of the environmental space; envED = distance from the edge of the environmental space.

Measure	Expected relationship	Intercept (SE)	Tolerance (SE)	QE	QMp
CD	Negative	-0.106 (0.075)		159.103 ***	2.022
ED	Positive	-0.187 (0.074) *	-0.222 (0.102) *	116.243 ***	4.706 *
CD/ED	Negative	0.172 (0.083) *	0.232 (0.103) *	110.721 ***	5.075 *
SUIT	Positive	0.201 (0.202)		125.556 ***	0.988
MAR	Negative	0.080 (0.158)		143.956 ***	0.253
MAH	Negative	0.008 (0.078)		138.887 ***	0.011
envCD	Negative	0.070 (0.176)		136.814 ***	0.157
envED	Positive	0.060 (0.04)		150.005 ***	2.178
envCD/envED	Negative	-0.046 (0.039)		128.876 ***	1.394