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Supplementary Materials for

Structure-function covariation with nonfeeding ecological variables influences evolution of feeding specialization in Carnivora

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This PDF file includes:

- fig. S12. Contour plot of the first two PC axes against life history and environmental variables.
- fig. S13. 3D plots of PC scores of cranial shape data.
- fig. S14. Plot of mean annual precipitation versus mean annual temperature of species studied.
- References (*69*–*72*)

Additional Methodological Details and Results

1. **Branch length and tree topology sensitivity analyses for phylogenetic comparative analyses.**

The tree topology and branch length configurations assessed in the sensitivity analyses are as follows:

- Main Analysis (Table 1): Based on tree topology of (*61*); uniform branch lengths.
- Sensitivity Analysis 1: Tree topology as in Main Analysis, but with euplerid polytomy resolved according to (*69*); uniform branch lengths.
- Sensitivity Analysis 2: Tree topology as in Main Analysis; fossil calibrations and branch lengths using data from (*62*), unpublished data from JJF and J. Finarelli, and PBDB (Paleobiology Database) (*71*); no age/node interpolations, so contains some zero branch lengths (same estimated divergence ages at adjacent nodes, when the oldest age calibration fossils for a clade occur in later-diverging nodes/lineages; all other nodes collapsed to the nearest older node with a fossil calibration age).
- Sensitivity Analysis 3: As in Sensitivity Analysis 2, but without PBDB node calibration data; no age/node interpolation, so contains some zero branch lengths.
- Sensitivity Analysis 4: As in Sensitivity Analysis 2, but with age/node interpolations (expanded by interpolating node ages in equal intervals along the branches between nodes previously having the same fossil-calibration ages, using the oldest and youngest bracketing ages).
- Sensitivity Analysis 5: As in Sensitivity Analysis 2, adding Meredith *et al*. (*70*) fossil calibrations (with priority to those, if in conflict with calibrations used in Sensitivity Analysis 2); with age/node interpolations.
- Sensitivity Analysis 6: Main Analysis tree topology; only Meredith *et al*. fossil calibrations; no age/node interpolations.
- Sensitivity Analysis 7: Main Analysis tree topology; only Meredith *et al*. fossil calibrations; with age/node interpolations.
- Sensitivity Analysis 8: Main Analysis tree topology; only Meredith *et al*. interfamilial molecular clock node age estimates (no direct fossil calibrations, although the Meredith *et al*. clock estimates rely on various fossil calibrations to derive the tree-wide nodal age estimates); no age/node interpolations.
- Sensitivity Analysis 9: Main Analysis tree topology; only Meredith *et al*. interfamilial molecular clock node age estimates; with age/node interpolations**.**

2. **Comparisons of PGLS regression analyses between Main Analysis and Sensitivity Analyses (significance at $p \leq 0.05$).**

- **Sensitivity Analysis 1** compared to Main Analysis:
  a) lost significance in feeding ecology correlations for Carnivora (FE1 [dietary breadth] and FE1+2 [dietary breadth + trophic level]).
  b) lost significance in Feliformia FE2 only.
  c) gained significance in Carnivora and Feliformia EV1 (mean precipitation).
  d) retained significance in Carnivora GMM/CS (cranial centroid size), FE2 (trophic level; significant only when herbivore species included), and LH2 (age at sexual maturity); in Caniformia LH2; and in Feliformia GMM/CS, and FE1 (significant only between narrow and broad ecology species) and FE1+2.
- **Sensitivity Analysis 2** compared to Main Analysis:
  a) lost significance in Carnivora GMM/CS, and LH2.

b) lost significance in Caniformia LH2.
c) lost significance in Feliformia GMM/CS, FE1, and FE1+2.
d) retained significance in Carnivora FE1, FE2, and FE1+2; and in Feliformia FE2.

- **Sensitivity Analysis 3** differs from Main Analysis in:
  a) lost significance in Carnivora FE1, FE2, and FE1+2; and LH2.
  b) lost significance in Caniformia LH2.
  c) gained significance in Feliformia EV1 and EV1+2 (mean precipitation + mean temperature).
  d) retained significance in Carnivora GMM/CS; and in Feliformia GMM/CS, FE1, FE2, and FE1+FE2.
- **Sensitivity Analysis 4** differs from Main Analysis in:
  a) lost significance in Carnivora FE1, FE2, and FE1+2.
  b) lost significance in Caniformia LH2.
  c) retained significance in Carnivora GMM/CS; and in Feliformia GMM/CS, FE1, FE2, and FE1+2.
- **Sensitivity Analysis 5** differs from Main Analysis in:
  a) lost significance in Carnivora FE1, FE2, and FE1+2, and LH2.
  b) lost significance in Caniformia LH2.
  c) lost significance in Feliformia GMM/CS.
  d) retained significance in Carnivora GMM/CS; and in Feliformia FE1, FE2, and FE1+2.
- **Sensitivity Analysis 6** differs from Main Analysis in:
  a) lost significance in Carnivora LH2.
  b) lost significance in Caniformia LH2.
  c) gained significance in Carnivora EV1 and EV1+2.
  d) gained significance in Feliformia EV1 and EV1+2.
  e) retained significance in Carnivora and Feliformia GMM/CS, FE1, FE2, and FE1+2.
- **Sensitivity Analysis 7** differs from Main Analysis in:
  a) lost significance in Carnivora FE1 and FE2, and LH2.
  b) lost significance in Caniformia LH2.
  c) retained significance in Carnivora GMM/CS, and FE1+2; and in Feliformia GMM/CS, FE1, FE2, and FE1+2.
- **Sensitivity Analysis 8** differs from Main Analysis in:
  a) lost significance in Carnivora LH2.
  b) lost significance in Caniformia LH2.
  c) gained significance in Carnivora EV1 and EV1+2.
  d) gained significance in Feliformia EV1 and EV1+2.
  e) retained significance in Carnivora and Feliformia GMM/CS, FE1, FE2, and FE1+2.
- **Sensitivity Analysis 9** differs from Main Analysis in:
  a) lost significance in Carnivora FE1 and FE2, and LH2.
  b) lost significance in Caniformia LH2.
  c) retained significance in Carnivora GMM/CS and FE1+2; and in Feliformia GMM/CS, FE1, FE2, and FE1+2.

table S1. List of specimens used in the study. Abbreviations: AMNH, American Museum of Natural history; CMNH, Cleveland Museum of Natural History; LACM, Natural History Museum of Los Angeles County; MVZ, Museum of Vertebrate Zoology, University of California; SAM, South African Museum (Iziko Museums); USNM, National Museum of Natural History (Smithsonian Institution). For specimens used in previous publications, see methods section of main text.

Taxon	Specimen Number or Publication
Acinonyx_jubatus	AMNH FM 145071
Ailuropoda_melanoleuca	Figueirido *et al.* (2014) (*30*)
Ailurus_fulgens	AMNH 185346
Aonyx_capensis	CMNH 17620 (*58*)
Arctonyx_collaris	AMNH 57373
Atilax_paludinosus	AMNH 42840
Bassariscus_astutus	AMNH 135964
Callorhinus_ursinus	AMNH 71169
Canis_lupus	LACM 23010
Canis_mesomelas	Slater *et al*. (2009) (*56*)
Civettictis_civetta	AMNH 51818
Crocuta_crocuta	MVZ 164506
Cryptoprocta_ferox	AMNH 100463
Cynogale_bennetti	AMNH 173509
Eira_barbara	AMNH 32065
Enhydra_lutris	AMNH 24186
Erignathus_barbatus	AMNH 98
Eupleres_goudoti	AMNH 100484
Felis_silvestris	AMNH 81233
Fossa_fossa	AMNH 188210
Galidictis_fasciata	AMNH 100479
Genetta_piscivora	AMNH 51514
Gulo_gulo	AMNH 182936
Herpestes_javanicus	AMNH 101655
Hydrurga_leptonyx	AMNH 34920
Lontra_canadensis	AMNH 254476
Lutra_lutra	AMNH 206592
Lycaon_pictus	SAM-ZM 12245
Mellivora_capensis	AMNH 89011
Mephitis_mephitis	AMNH 172133
Mungos_mungo	AMNH 185177
Mustela_frenata	AMNH 60508
Mydaus_javanensis	AMNH 106635
Nandinia_binotata	AMNH 51452
Neofelis_nebulosa	AMNH 22919
Odobenus_rosmarus	AMNH 19270

table S1 (continued)

Panthera_pardus	AMNH 113745
Paradoxurus_hermaphroditus	AMNH 163162
Parahyaena_brunnea	MVZ 117842
Phoca_vitulina	AMNH 100
Potos_flavus	AMNH 239990
Prionodon_linsang	USNM 303036
Procyon_lotor	AMNH 24815
Proteles_cristata	AMNH 165121
Spilogale_putorius	AMNH 35207
Suricata_suricatta	AMNH 81756
Taxidea_taxus	AMNH 120577
Tremarctos_ornatus	AMNH 99308
Ursus_arctos	AMNH 34408
Ursus_maritimus	Slater *et al*. (2010) (*55*)
Viverra_tangalunga	AMNH 207582
Vulpes_vulpes	AMNH 88713
Zalophus_californicus	AMNH 63946

table S2. List of anatomical landmarks and semilandmarks used in the GMM analyses. Column with heading "Fixed" indicates whether a particular landmark is treated as a fixed landmark ('Yes') or sliding semi-landmark ('No').

Landmark	Label in Fig. S1	Fixed?	Patch Zone	Anatomical Description
1	s0	Yes	Face	anterior meeting point of premax
2	s1	Yes	Face	anterior meeting point @ tip of nasals
3	s2	Yes	Face	half way between tip of nasals and edge of frontal landmark patch
4	s3	Yes	Basicranium	dorsal edge of foramen magnum
5	s4	Yes	Basicranium	ventral edge of foramen magnum
6	s5	Yes	Basicranium	tip of mastoid process left
7	s6	Yes	Basicranium	tip of mastoid process right
8	s7	Yes	Basicranium	midsagittal location on basicranium at anterior edge of bullae
9	s8	Yes	Basicranium	left centroid point of TMJ
10	s9	Yes	Basicranium	right centroid point of TMJ
11	s10	Yes	Cranial vault	point on parasagittal crest at postorbital constriction, left side
12	s11	No	Cranial vault	between previous and next point
13	s12	No	Cranial vault	between 11 and 15
14	s13	No	Cranial vault	between previous and next point
15	s14	Yes	Cranial vault	Meeting point between sagittal and occipital crests, left side
16	s15	Yes	Cranial vault	postorbital constriction lateral wall, left side
17	s16	No	Cranial vault	between previous and next point
18	s17	No	Cranial vault	between previous and next point
19	s18	No	Cranial vault	between previous and next point
20	s19	No	Cranial vault	between 15 and 25
21	s20	No	Cranial vault	between 16 and 26
22	s21	No	Cranial vault	between previous and next point
23	s22	No	Cranial vault	between 13 and 33
24	s23	No	Cranial vault	between previous and next point
25	s24	Yes	Cranial vault	between 15 and 35 on the occipital crest, left side

table S2 (continued)

26	s25	No	Cranial vault	between 16 and 31
27	s26	No	Cranial vault	between previous and next point
28	s27	No	Cranial vault	between previous and next point
29	s28	No	Cranial vault	between previous and next point
30	s29	No	Cranial vault	between 25 and 35
31	s30	Yes	Cranial vault	medial and anterior-most point of the zygomatic process of temporal, left side
32	s31	No	Cranial vault	between previous and next point
33	s32	Yes	Cranial vault	between 31 and 35
34	s33	No	Cranial vault	between previous and next point
35	s34	Yes	Cranial vault	most medial point on the dorsal edge of external auditory meatus
36	s35	Yes	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
37	s36	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
38	s37	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
39	s38	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
40	s39	Yes	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
41	s40	Yes	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
42	s41	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
43	s42	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
44	s43	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
45	s44	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
46	s45	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
47	s46	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
48	s47	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
49	s48	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side

table S2 (continued)

50	s49	Yes	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
51	s50	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
52	s51	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
53	s52	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
54	s53	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
55	s54	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
56	s55	Yes	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
57	s56	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
58	s57	Yes	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
59	s58	No	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
60	s59	Yes	Cranial vault	36 to 60 are mirrored landmarks of 11 to 35 on the right side
61	s60	Yes	Zygoma	Highest point of the postorbital process of zygomatic, left side
62	s61	No	Zygoma	between previous and next point
63	s62	No	Zygoma	between 61 and 65
64	s63	No	Zygoma	between previous and next point
65	s64	Yes	Zygoma	Highest point of the temporal process of zygoma, left side
66	s65	No	Zygoma	between 61 and 71
67	s66	No	Zygoma	between previous and next point
68	s67	No	Zygoma	between 63 and 73
69	s68	No	Zygoma	between previous and next point
70	s69	No	Zygoma	between 65 and 75
71	s70	No	Zygoma	between 61 and 81
72	s71	No	Zygoma	between previous and next point
73	s72	No	Zygoma	between 63 and 83
74	s73	No	Zygoma	between previous and next point
75	s74	No	Zygoma	between 65 and 85
76	s75	No	Zygoma	between 71 and 81
77	s76	No	Zygoma	between previous and next point
78	s77	No	Zygoma	between 73 and 83
79	s78	No	Zygoma	between previous and next point
80	s79	No	Zygoma	between 75 and 85
81	s80	Yes	Zygoma	Base of zygomatic arch above tooth row, left side

table S2 (continued)

82	s81	No	Zygoma	between previous and next point
83	s82	No	Zygoma	between 81 and 85
84	s83	No	Zygoma	between previous and next point
85	s84	Yes	Zygoma	inflection point between zygomatic arch and TMJ, left side
86	s85	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
87	s86	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
88	s87	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
89	s88	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
90	s89	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
91	s90	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
92	s91	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
93	s92	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
94	s93	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
95	s94	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
96	s95	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
97	s96	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
98	s97	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
99	s98	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
100	s99	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
101	s100	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
102	s101	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
103	s102	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
104	s103	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
105	s104	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
106	s105	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side

table S2 (continued)

107	s106	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
108	s107	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
109	s108	Yes	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
110	s109	No	Zygoma	86-110 are mirrored landmarks of 61 to 85 on right side
111	s110	Yes	Frontal	Half way point along orbital rim between posortibal process and inflection point on ventral orbital rim, right side
112	s111	No	Frontal	between previous and next point
113	s112	No	Frontal	between 111 and 115
114	s113	No	Frontal	between previous and next point
115	s114	Yes	Frontal	tip of postorbital process of frontal, right side
116	s115	No	Frontal	between 111 and 121
117	s116	No	Frontal	between previous and next point
118	s117	No	Frontal	between previous and next point
119	s118	No	Frontal	between previous and next point
120	s119	No	Frontal	between 115 and 125
121	s120	No	Frontal	between 111 and 131
122	s121	No	Frontal	between previous and next point
123	s122	No	Frontal	between 121 and 125
124	s123	No	Frontal	between previous and next point
125	s124	No	Frontal	between 115 and 135
126	s125	No	Frontal	betweeen 121 and 131
127	s126	No	Frontal	between previous and next point
128	s127	No	Frontal	between previous and next point
129	s128	No	Frontal	between previous and next point
130	s129	No	Frontal	between 125 and 135
131	s130	Yes	Frontal	131 to 135 are mirrored landmarks of 111 to 115 on left side
132	s131	No	Frontal	131 to 135 are mirrored landmarks of 111 to 115 on left side
133	s132	No	Frontal	131 to 135 are mirrored landmarks of 111 to 115 on left side
134	s133	No	Frontal	131 to 135 are mirrored landmarks of 111 to 115 on left side
135	s134	Yes	Frontal	131 to 135 are mirrored landmarks of 111 to 115 on left side
136	s135	Yes	Palate	edge of canine alveolus halfway between anterior and posterior borders of canine, right side
137	s136	No	Palate	between previous and next point

table S2 (continued)

138	s137	No	Palate	between 136 and 140
139	s138	No	Palate	between previous and next point
140	s139	Yes	Palate	inflection point on the posterior edge of the hard palate, right side
141	s140	No	Palate	between 136 and 146
142	s141	No	Palate	between previous and next point
143	s142	No	Palate	between previous and next point
144	s143	No	Palate	between previous and next point
145	s144	No	Palate	between 140 and 150
146	s145	Yes	Palate	Anterior edge of palate psoterior to suture between first incisors
147	s146	No	Palate	between previous and next point
148	s147	No	Palate	between 146 and 150
149	s148	No	Palate	between previous and next point
150	s149	Yes	Palate	Posterior-most point on mid-sagittal axis of palate
151	s150	Yes	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
152	s151	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
153	s152	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
154	s153	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
155	s154	Yes	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
156	s155	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
157	s156	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
158	s157	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
159	s158	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
160	s159	No	Palate	151 to 160 are mirrored landmarks of 136 to 145 on left side
161	s160	Yes	Face	Mid-point on edge of rostral opening on premaxilla, left side
162	s161	Yes	Face	Dorsal edge of infraorbital foramen, left side
163	s162	Yes	Face	Ventral-most point on the orbital rim, left side
164	s163	No	Face	between 161 and 167
165	s164	No	Face	between 162 and 168

table S2 (continued)

166	s165	Yes	Face	Anterior point of canine at the edge of alveolus, left side
167	s166	No	Face	between 164 and 170
168	s167	No	Face	between 162 and 174
169	s168	No	Face	between 163 and 175
170	s169	No	Face	between 167 and 173
171	s170	No	Face	between 168 and 174
172	s171	No	Face	between 169 and 175
173	s172	Yes	Face	Posterior edge of canine at the alveolus, left side
174	s173	No	Face	between 173 and 175
175	s174	Yes	Face	Edge between bone and tooth at the position of the last tooth, left side
176	s175	Yes	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
177	s176	Yes	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
178	s177	Yes	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
179	s178	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
180	s179	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
181	s180	Yes	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
182	s181	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
183	s182	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
184	s183	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
185	s184	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
186	s185	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
187	s186	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
188	s187	Yes	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
189	s188	No	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side
190	s189	Yes	Face	176 to 190 are mirrored landmarks of 161 to 175 on the right side

table S3. Ecological attributes of species analyzed. Data compiled from the PanTHERIA database (*28*).

Taxon	Clade	Family	Activity Cycle*	Terrestriality/ Arboreality†	Habitat Breadth[1]	Diet Breadth [2]	Trophic Level[3]	Max. Longevity (months)	Sexual Maturity Age (days)	Mean Monthly Preccipitation (mm)	Mean Monthly Temperature (0.1°C)
Acinonyx_jubatus	Feliformia	Felidae	3	1	1	1	3	228	741.97	51.26	230.83
Ailuropoda_melanoleuca	Caniformia	Ursidae	2	1	1	3	1	360	2413.02	101.81	65.51
Ailurus_fulgens	Caniformia	Ailuridae	2	1	1	3	1	168	604.05	131.93	44.73
Aonyx_capensis	Caniformia	Mustelidae	2	1	2	6	2	132	371.23	100.07	233.07
Arctonyx_collaris	Caniformia	Mustelidae	1	1	1	6	2	167		124.48	169.67
Atilax_paludinosus	Feliformia	Herpestidae	2	1	2	6	2	209	234.83	99.93	233.39
Bassariscus_astutus	Caniformia	Procyonidae	1	1	1	6	2	198	278.08	45.32	153.99
Callorhinus_ursinus	Caniformia	Otariidae	2	1	2	6	2	420	1683.65		
Canis_lupus	Caniformia	Canidae	2	1	1	1	3	354	679.37	34.79	4.82
Canis_mesomelas	Caniformia	Canidae	2	1	1	6	2	168	241.4	49.27	213.33
Civettictis_civetta	Feliformia	Viverridae	1	1	1	6	2	336	286.24	101.3	237.14
Crocuta_crocuta	Feliformia	Hyaenidae	1	1	1	1	3	493.2	789.54	78.32	238.46
Cryptoprocta_ferox	Feliformia	Eupleridae	2	2	3	2	3	240	1262.74	125.27	221.98
Cynogale_bennetti	Feliformia	Viverridae	2	1	2	6	2	60		235.45	254.4
Eira_barbara	Caniformia	Mustelidae	2	2	2	2	2	216	766.15	149.9	235.82
Enhydra_lutris	Caniformia	Mustelidae	3	1	1	6	2	360	1022.33		
Erignathus_barbatus	Caniformia	Phocidae		2	1	2		377.43	2199.16		
Eupleres_goudoti	Feliformia	Eupleridae	2	1	1	6	2			163.67	207.15
Felis_silvestris	Feliformia	Felidae	2	1	1	1	3	336	350.76	46.98	192.78
Fossa_fossa	Feliformia	Eupleridae	1	2	2	6	2	132	533.97	168.03	202.81
Galidictis_fasciata	Feliformia	Eupleridae	2	1	1	2	3			178.59	197.78
Genetta_piscivora	Feliformia	Viverridae	1	1	2	1	3			144.85	236.26

table S3 (continued)

Gulo_gulo	Caniformia	Mustelidae	1	1	1	1	3	216	756.6	32.21	-72.05
Herpestes_javanicus	Feliformia	Herpestidae	3	1	1	6	2	120	166.84	96.01	208.18
Hydrurga_leptonyx	Caniformia	Phocidae	2	1	2	6	2	312	1389.01		
Lontra_canadensis	Caniformia	Mustelidae	2	1	2	1	3	300	729.99	55.55	10.63
Lutra_lutra	Caniformia	Mustelidae	1	1	2	1	3	264	700.76	56.63	50.26
Lycaon_pictus	Caniformia	Canidae	3	1	1	1	3	132	817.15	68.95	235.55
Mellivora_capensis	Caniformia	Mustelidae	2	1	1	6	2	318		66.13	236.56
Mephitis_mephitis	Caniformia	Mephitidae	1	1	1	6	2	155	355.18	52.67	75.97
Mungos_mungo	Feliformia	Herpestidae	3	1	1	1	3	144	349.33	78.76	238.55
Mustela_frenata	Caniformia	Mustelidae	2	2	2	1	3	85.23	200.69	78.21	130.93
Mydaus_javanensis	Caniformia	Mephitidae	1	1	1	6	2			242.37	248.86
Nandinia_binotata	Feliformia	Nandiniidae	1	2	2	2	1	222	1015	130.21	239.97
Neofelis_nebulosa	Feliformia	Felidae	2	2	2	1	3	204	753.48	178.64	218.29
Odobenus_rosmarus	Caniformia	Odobenidae	2	1	2	6	2	480	2315.02		
Panthera_pardus	Feliformia	Felidae	2	1	1	1	3	276	810.68	88.01	207.63
Paradoxurus_hermaphroditus	Feliformia	Viverridae	1	1	1	6	2	269	397.85	152.93	232.59
Parahyaena_brunnea	Feliformia	Hyaenidae	1	1	2	6	2	204	807.23	34.35	186.6
Phoca_vitulina	Caniformia	Phocidae	2	1	2	1	3	480	1526.85		
Potos_flavus	Caniformia	Procyonidae	1	2	2	4	2	348	858.41	153.67	241.49
Prionodon_linsang	Feliformia	Prionodontidae	1	1	1	6	2	128.4		236.46	249.83
Procyon_lotor	Caniformia	Procyonidae	2	2	2	6	2	252	561.28	63.25	111.84
Proteles_cristata	Feliformia	Hyaenidae	1	1	1	1	3	300	631.37	46.96	210.08
Spilogale_putorius	Caniformia	Mephitidae	1	1	1	6	2	120	196.96	72.47	134.16
Suricata_suricatta	Feliformia	Herpestidae	3	1	1	1	3	150	377.37	26.55	175.81
Taxidea_taxus	Caniformia	Mustelidae	1	1	1	1	3	312	365	41.62	91.54
Tremarctos_ornatus	Caniformia	Ursidae	2	1	1	5	2	437		125.36	179.82
Ursus_arctos	Caniformia	Ursidae	2	1	1	6	2	600	1327.95	35.01	-46.56

table S3 (continued)

Ursus_maritimus	Caniformia	Ursidae	3	1	1	3	2	458.4	1850.26		
Viverra_tangalunga	Feliformia	Viverridae	1	1	1	6	2	144		244.56	248.46
Vulpes_vulpes	Caniformia	Canidae	1	1	1	1	3	180	321.07	46.58	34.32
Zalophus_californicus	Caniformia	Otariidae	2	1	2	6	2	360	2023.55		

*activity cycle: nocturnal (1), cathemeral or crepuscular (2), diurnal (3).

†Terrestriality: fossorial and/or ground dwelling [terrestrial] (1), above ground dwelling [arboreal] (2).

[1]Habitat Breadth: number of habitat categories out of: above ground dwelling, aquatic, fossorial and ground dwelling

[2]Diet Breadth: number of dietary categories out of: vertebrate, invertebrate, fruit, flowers/nectar/pollen, leaves/branches/bark, seeds, grass and roots/tubers

[3]Trophic Level: herbivore (1), omnivore (2), carnivore (3)

table S4. Summary of sensitivity analyses of PGLS regression using different phylogenetic tree topology and branch length configurations. Statistically significant PGLS regressions are marked in bold font. Green shades indicate significant results in the Main Analysis or in a Sensitivity Analysis and shared with the Main Analysis. Yellow shades indicate lack of significant correlation in a Sensitivity Analysis relative to the Main Analysis. Blue shades indicate presence of significant correlation in a Sensitivity Analysis that is not observed in the Main Analysis. For details of configuration in each analysis, see Supplementary Materials text.

	Carnivora	Caniformia	Feliformia	Carnivora	Caniformia	Feliformia
		Main Analysis			Sensitivity Analysis 1	
GMM Data (G)						
G1. CS	**0.03**	0.17	**0.04**	**0.02**	0.17	**0.02**
Locomotion & Activity (LA)						
LA1. Activity Cycle	0.36	0.60	0.67	0.49	0.60	0.58
LA2. Terrestriality	0.62	0.47	0.61	0.60	0.46	0.52
LA3. Habitat Breadth	0.64	0.66	0.61	0.58	0.66	0.59
LA1+2+3	0.44/0.76/0.76	0.65/0.79/0.42	0.68/0.93/0.86	0.54/0.73/0.49	0.65/0.79/0.42	0.80/0.56/0.88
Feeding Ecology (FE)						
FE1. Dietary Breadth	**0.01**	0.31	**0.003**	0.09	0.31	**0.05**
FE2. Trophic Level	**0.03**	0.08	**0.03**	**0.04**	0.08	0.12
FE1+2	**0.03/0.03**	0.40/0.13	**0.01/0.04**	0.16/0.06	0.40/0.13	**0.02**/0.24
Life History (LH)						
LH1. Longevity	0.18	0.24	0.36	0.23	0.24	0.45
LH2. Age at Sexual Maturity	**0.02**	**0.03**	0.65	**0.02**	**0.03**	0.79
LH1+LH2	0.40/0.06	0.29/0.13	0.86/0.77	0.45/0.07	0.29/0.13	0.95/0.83
Environmental Variables (EV)						
EV1. Mean Precipitation	0.06	0.39	0.08	**0.05**	0.39	**0.05**
EV2. Mean Temperature	0.45	0.44	0.38	0.39	0.44	0.24
EV1+2	0.07/0.35	0.43/0.41	0.14/0.84	0.06/0.33	0.43/0.41	0.10/0.69

table S4 (continued)

	Carnivora	Caniformia	Feliformia	Carnivora	Caniformia	Feliformia
		Sensitivity Analysis 2			Sensitivity Analysis 3	
GMM Data (G)						
G1. CS	0.99	0.11	0.99	**0.03**	0.09	**0.002**
Locomotion & Activity (LA)						
LA1. Activity Cycle	0.97	0.73	0.97	0.42	0.65	0.17
LA2. Terrestriality	0.98	0.74	0.98	0.44	0.28	0.89
LA3. Habitat Breadth	0.99	0.51	0.99	0.17	0.19	0.45
LA1+2+3	0.99/0.99/0.99	0.72/0.78/0.28	0.99/0.99/0.98	0.47/0.84/0.17	0.71/0.91/0.20	0.36/0.89/0.63
Feeding Ecology (FE)						
FE1. Dietary Breadth	**0.02**	0.75	0.11	0.58	0.59	**0.001**
FE2. Trophic Level	**0.01**	0.32	**0.03**	0.45	0.33	**0.003**
FE1+2	**0.03/0.01**	0.51/0.44	0.13/0.23	0.52/0.56	0.47/0.58	**0.02**/0.35
Life History (LH)						
LH1. Longevity	0.26	0.77	0.16	0.36	0.43	0.13
LH2. Age at Sexual Maturity	0.47	0.33	0.52	0.21	0.20	0.53
LH1+LH2	0.48/0.43	0.68/0.36	0.61/0.66	0.45/0.29	0.38/0.28	0.58/0.72
Environmental Variables (EV)						
EV1. Mean Precipitation	0.13	0.39	0.99	0.26	0.50	**0.01**
EV2. Mean Temperature	1.00	0.42	0.99	0.81	0.61	0.06
EV1+2	0.99/0.99	0.43/0.49	1.00/0.61	0.30/0.36	0.55/0.57	**0.02**/0.61

table S4 (continued)

	Carnivora	Caniformia	Feliformia	Carnivora	Caniformia	Feliformia
		Sensitivity Analysis 4			Sensitivity Analysis 5	
GMM Data (G)						
G1. CS	**0.01**	0.14	**0.05**	**0.01**	0.13	0.06
Locomotion & Activity (LA)						
LA1. Activity Cycle	0.74	0.67	0.79	0.77	0.70	0.84
LA2. Terrestriality	0.76	0.57	0.68	0.76	0.59	0.66
LA3. Habitat Breadth	0.60	0.46	0.70	0.64	0.48	0.72
LA1+2+3	0.78/0.85/0.45	0.75/0.86/0.16	0.84/0.84/0.61	0.81/0.85/0.50	0.78/0.86/0.21	0.88/0.80/0.70
Feeding Ecology (FE)						
FE1. Dietary Breadth	0.44	0.71	**0.002**	0.46	0.72	**0.001**
FE2. Trophic Level	0.45	0.42	**0.01**	0.48	0.44	**0.004**
FE1+2	0.48/0.08	0.53/0.53	**0.02/0.02**	0.53/0.09	0.57/0.52	**0.01/0.02**
Life History (LH)						
LH1. Longevity	0.74	0.90	0.60	0.71	0.92	0.54
LH2. Age at Sexual Maturity	0.36	0.45	0.47	0.28	0.42	0.52
LH1+LH2	0.92/0.29	0.87/0.36	0.73/0.65	0.93/0.23	0.89/0.34	0.71/0.66
Environmental Variables (EV)						
EV1. Mean Precipitation	0.36	0.48	0.38	0.34	0.45	0.34
EV2. Mean Temperature	0.69	0.52	0.19	0.70	0.52	0.21
EV1+2	0.40/0.35	0.53/0.49	0.52/0.45	0.37/0.33	0.49/0.50	0.49/0.51

table S4 (continued)

	Carnivora	Caniformia	Feliformia	Carnivora	Caniformia	Feliformia
		Sensitivity Analysis 6			Sensitivity Analysis 7	
GMM Data (G)						
G1. CS	**0.01**	0.07	**0.01**	**0.01**	0.12	**0.01**
Locomotion & Activity (LA)						
LA1. Activity Cycle	0.26	0.85	0.28	0.47	0.79	0.77
LA2. Terrestriality	0.82	0.74	0.78	0.76	0.47	0.66
LA3. Habitat Breadth	0.45	0.20	0.59	0.59	0.48	0.75
LA1+2+3	0.30/0.88/0.27	0.88/0.96/0.06	0.50/0.80/0.66	0.58/0.81/0.72	0.86/0.92/0.23	0.92/0.82/0.96
Feeding Ecology (FE)						
FE1. Dietary Breadth	**0.03**	0.24	**0.01**	0.18	0.65	**0.004**
FE2. Trophic Level	**0.02**	0.08	**0.01**	0.38	0.39	**0.03**
FE1+2	**0.03**/0.44	0.13/0.49	**0.03**/0.43	0.40/**0.03**	0.51/0.52	0.07/**0.01**
Life History (LH)						
LH1. Longevity	0.19	0.27	0.16	0.82	0.82	0.57
LH2. Age at Sexual Maturity	0.37	0.13	0.69	0.17	0.29	0.51
LH1+LH2	0.62/0.72	0.36/0.47	0.75/0.77	0.95/0.27	0.84/0.31	0.91/0.69
Environmental Variables (EV)						
EV1. Mean Precipitation	**0.03**	0.43	**0.02**	0.22	0.47	0.19
EV2. Mean Temperature	0.32	0.52	0.18	0.78	0.65	0.47
EV1+2	**0.04**/0.49	0.47/0.44	**0.04**/0.62	0.25/0.56	0.51/0.59	0.31/0.83

table S4 (continued)

	Carnivora	Caniformia	Feliformia	Carnivora	Caniformia	Feliformia
		Sensitivity Analysis 8			Sensitivity Analysis 9	
GMM Data (G)						
G1. CS	**0.01**	0.15	**0.002**	**0.01**	0.13	**0.02**
Locomotion & Activity (LA)						
LA1. Activity Cycle	0.17	0.66	0.20	0.47	0.78	0.74
LA2. Terrestriality	0.85	0.76	0.89	0.73	0.48	0.7
LA3. Habitat Breadth	0.39	0.28	0.50	0.52	0.5	0.75
LA1+2+3	0.21/0.92/0.27	0.74/0.98/0.07	0.41/0.91/0.66	0.56/0.80/0.54	0.85/0.93/0.24	0.91/0.85/0.95
Feeding Ecology (FE)						
FE1. Dietary Breadth	**0.02**	0.26	**0.002**	0.26	0.68	**0.003**
FE2. Trophic Level	**0.01**	0.09	**0.002**	0.4	0.43	**0.02**
FE1+2	**0.02**/0.47	0.16/0.51	**0.01**/0.44	0.43/**0.04**	0.54/0.56	**0.03/0.01**
Life History (LH)						
LH1. Longevity	0.15	0.20	0.13	0.72	0.79	0.47
LH2. Age at Sexual Maturity	0.18	0.08	0.54	0.16	0.27	0.54
LH1+LH2	0.62/0.53	0.28/0.38	0.67/0.71	0.89/0.21	0.80/0.28	0.87/0.69
Environmental Variables (EV)						
EV1. Mean Precipitation	**0.02**	0.51	**0.01**	0.21	0.52	0.16
EV2. Mean Temperature	0.36	0.41	0.07	0.75	0.65	0.39
EV1+2	**0.02**/0.36	0.56/0.39	**0.01**/0.57	0.25/0.50	0.57/0.52	0.26/0.79

table S5. Area and volume attributes of the theoretical morphed models analyzed.

	surface area (mm2)	volume (mm3)
cs large	30813.2	24679.9
cs small	30287.5	23453.3
diet broad	27986.3	20759.2
diet narrow	29707.5	22910.9
maturity early	29591.7	22877.6
maturity late	32968.3	27065.9
precipitation high	28712.9	21055
precipitation low	30723.4	24351.4
trophic carnivore	30173.4	23609.8
trophic herbivore	29224.6	22924.6
trophic omnivore	30416.8	23690.5

table S6. Output values of FE simulations in the "bending test" analysis. SE, strain energy (in Joules); VM, von Mises (in Megapascals); hires= high resolution model; lowres= low resolution model.

	hires raw SE	medres raw SE	lores raw SE	hires VM stress	medres VM stress	lores VM stress
cs large	0.1482	0.1253	0.0958	32.24	28.21	24.22
cs small	0.0936	0.1527	0.1137	25.56	34.19	29.78
diet broad	0.1174	0.1287	0.1122	29.91	32.28	28.26
diet narrow	0.0929	0.1377	0.0971	25.26	32.02	24.76
maturity early	0.1104	0.0880	0.0887	29.09	25.30	25.71
maturity late	0.1054	0.1244	0.1290	24.68	26.77	27.29
precipitation high	0.1130	0.1101	0.1205	29.56	29.18	30.86
precipitation low	0.1461	0.1183	0.1271	32.86	29.06	29.61
trophic carnivore	0.0979	0.1016	0.1425	26.26	26.51	32.44
trophic herbivore	0.1058	0.0800	0.0983	28.66	25.58	27.96
trophic omnivore	0.1439	0.1305	0.0966	33.76	32.00	26.80

table S7. Output values of FE simulations in the "temporalis-driven" analysis. SE, strain energy (in Joules); VM, von Mises (in Megapascals); hi, high resolution model meshed using 'fine mesh' option; med, medium resolution model meshed using 'medium mesh' option; lo, low resolution model meshed using 'coarse mesh' option.

	hi raw SE	med raw SE	lo raw SE	hi VM stress	med VM stress	lo VM stress	hi bite force	med bite force	lo bite force
cs large	0.0086	0.0079	0.0075	6.215	6.669	6.312	101.14	101.15	101.14
cs small	0.0089	0.0083	0.0084	6.884	7.026	7.067	108.01	108.02	108.00
diet broad	0.0062	0.0062	0.0062	6.096	6.143	6.156	84.85	84.84	84.84
diet narrow	0.0064	0.0062	0.0061	5.509	5.566	5.608	90.61	90.60	90.60
maturity early	0.0066	0.0066	0.0065	5.964	6.039	6.038	96.03	96.03	96.04
maturity late	0.0116	0.0118	0.0119	7.924	8.064	8.076	141.14	141.12	141.13
precipitation high	0.0086	0.0088	0.0091	7.197	7.228	7.255	98.69	98.68	98.67
precipitation low	0.0087	0.0083	0.0082	6.793	6.867	6.861	116.65	116.63	116.64
trophic carnivore	0.0081	0.0081	0.0081	6.612	6.641	6.724	109.67	109.68	109.67
trophic herbivore	0.0071	0.0071	0.0071	6.204	6.267	6.299	99.30	99.30	99.30
trophic omnivore	0.0095	0.0096	0.0095	7.34	7.435	7.462	119.74	119.74	119.74

table S8. Output values of FE simulations in the "masseter-driven" analysis. Abbreviations as in Table S7.

	hi raw SE	med raw SE	lo raw SE	hi VM stress	med VM stress	lo VM stress	hi bite force	med bite force	lo bite force
cs large	0.0409	0.0370	0.0367	15.515	15.548	15.800	132.71	132.72	132.72
cs small	0.0359	0.0357	0.0358	16.646	16.995	17.109	124.23	124.24	124.22
diet broad	0.0355	0.0358	0.0358	16.351	16.715	16.918	119.91	119.90	119.90
diet narrow	0.0407	0.0408	0.0405	16.648	16.592	16.637	120.23	120.23	120.23
maturity early	0.0374	0.0375	0.0374	16.469	16.619	16.624	134.91	134.93	134.93
maturity late	0.0348	0.0349	0.0350	16.317	16.370	16.486	135.92	135.90	135.91
precipitation high	0.0357	0.0355	0.0362	16.881	17.049	17.345	104.96	104.97	104.96
precipitation low	0.0360	0.0353	0.0353	15.419	15.248	15.284	115.34	115.32	115.33
trophic carnivore	0.0399	0.0394	0.0393	16.688	16.630	16.752	114.40	114.41	114.40
trophic herbivore	0.0306	0.0306	0.0306	13.969	14.025	13.977	112.27	112.26	112.26
trophic omnivore	0.0395	0.0394	0.0392	17.216	17.377	17.554	110.18	110.18	110.18

table S9. List of the highest mechanical demands from food items experienced by each carnivoran species, ranked on the basis of stiffness and density.

Taxon	Mechanical Demand*	Category†
Acinonyx_jubatus	Killing Large Prey	High
Ailuropoda_melanoleuca	Bamboo	High
Ailurus_fulgens	Bamboo	High
Aonyx_capensis	Crab	High
Arctonyx_collaris	Small mammals	Low
Atilax_paludinosus	Crab	High
Bassariscus_astutus	Arthropods	Low
Callorhinus_ursinus	Fish	Low
Canis_lupus	Killing Large Prey	High
Canis_mesomelas	Carcass Soft Tissue	Low
Civettictis_civetta	Crab	High
Crocuta_crocuta	Bone	High
Cryptoprocta_ferox	Killing Large Prey	High
Cynogale_bennetti	Shelled inverts	High
Eira_barbara	Small mammals	Low
Enhydra_lutris	Shelled inverts	High
Erignathus_barbatus	Shelled inverts	High
Eupleres_goudoti	Worms	Low
Felis_silvestris	Killing Large Prey	High
Fossa_fossa	Small mammals	Low
Galidictis_fasciata	Small mammals	Low
Genetta_piscivora	Fish	Low
Gulo_gulo	Killing Large Prey	High
Herpestes_javanicus	Insects	Low
Hydrurga_leptonyx	Krill	Low
Lontra_canadensis	Fish	Low
Lutra_lutra	Shelled inverts	High
Lycaon_pictus	Killing Large Prey	High
Mellivora_capensis	Killing Large Prey	High
Mephitis_mephitis	Small insects	Low
Mungos_mungo	Small insects	Low
Mustela_frenata	Small mammals	Low
Mydaus_javanensis	Small insects	Low
Nandinia_binotata	Small mammals	Low
Neofelis_nebulosa	Killing Large Prey	High
Odobenus_rosmarus	Soft inverts	Low
Panthera_pardus	Killing Large Prey	High
Paradoxurus_hermaphroditus	Fruit	Low

table S9 (continued)

Parahyaena_brunnea	Bone	High
Phoca_vitulina	Fish	Low
Potos_flavus	Fruit	Low
Prionodon_linsang	-	-
Procyon_lotor	Small mammals	Low
Proteles_cristata	Soft inverts	Low
Spilogale_putorius	Small mammals	Low
Suricata_suricatta	Insects	Low
Taxidea_taxus	Small mammals	Low
Tremarctos_ornatus	Bamboo	High
Ursus_arctos	Killing Large Prey	High
Ursus_maritimus	Seals	Low
Viverra_tangalunga	Small mammals	Low
Vulpes_vulpes	Small mammals	Low
Zalophus_californicus	Fish	Low

*Dietary and behavior observations are derived from Mammalian Species publications of the respective species and Animal Diversity Web (http://animaldiversity.org/, accessed 30 January 2017)
†Categorization based on relative Young's Modulus and density values reported in Chen *et al*. (*47*)

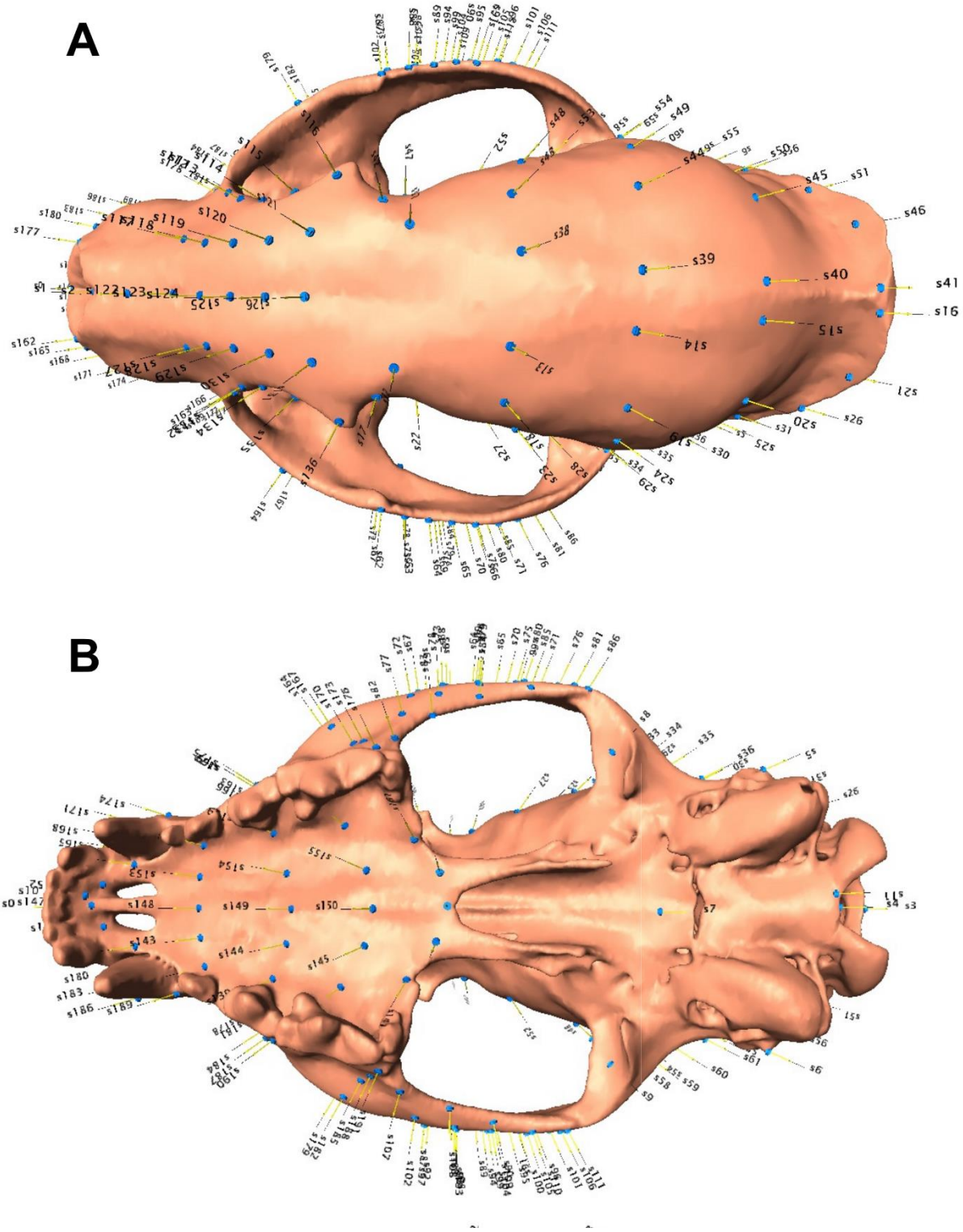
A
B

Figure S1. (continued)

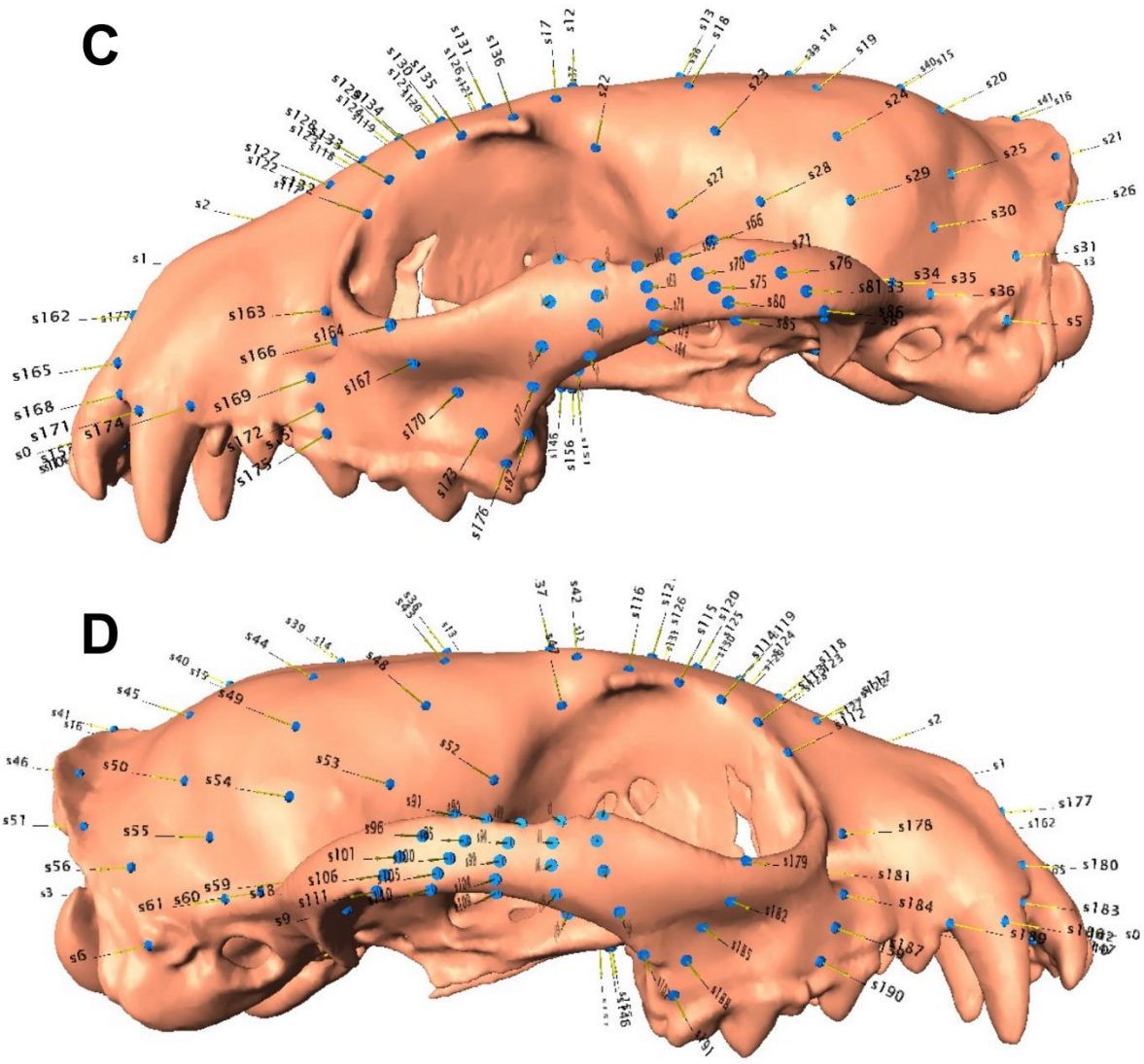

fig. S1. Anatomical landmarks used in the GMM analyses. A. Dorsal view. **B**. Ventral view. **C**. Left lateral view. **D**. Right lateral view. Note that landmark labels start with s0 and end with s189.

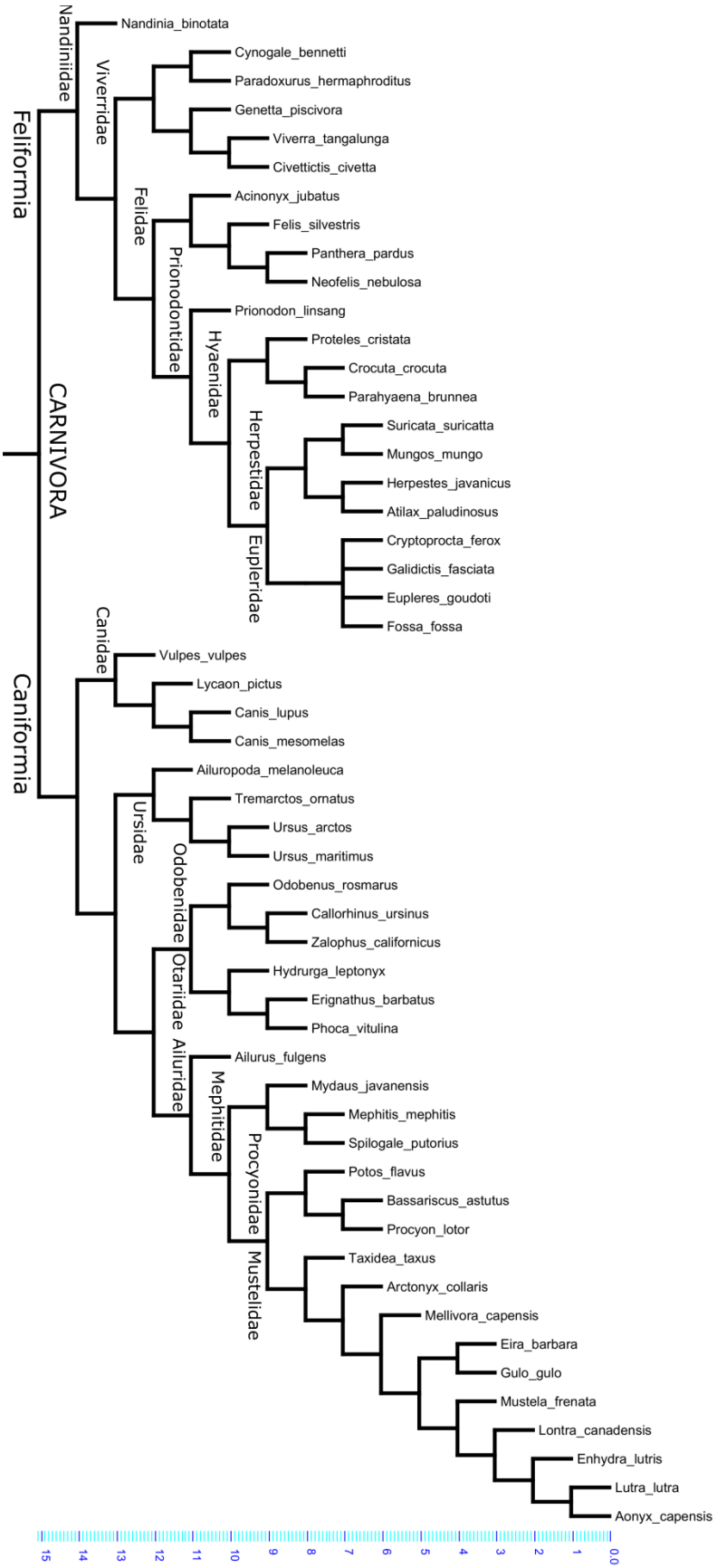

fig. S2. Main analysis. Based on tree topology of (*61*); uniform branch lengths. Scale is in arbitrary branch length units of one.

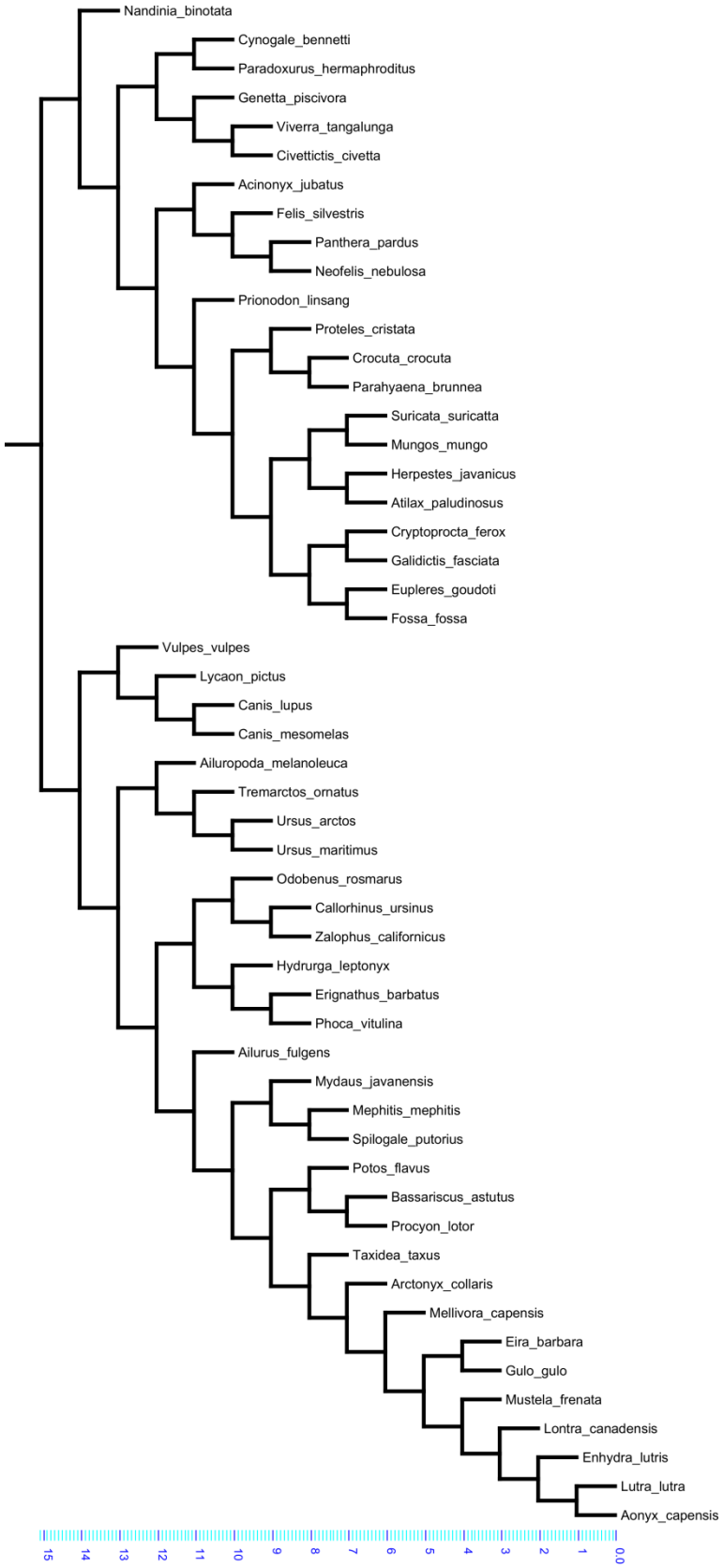

fig. S3. Sensitivity analysis 1. Tree topology as in Main Analysis, but with euplerid polytomy resolved according to (*69*); uniform branch lengths. Scale is in arbitrary branch length units of one.

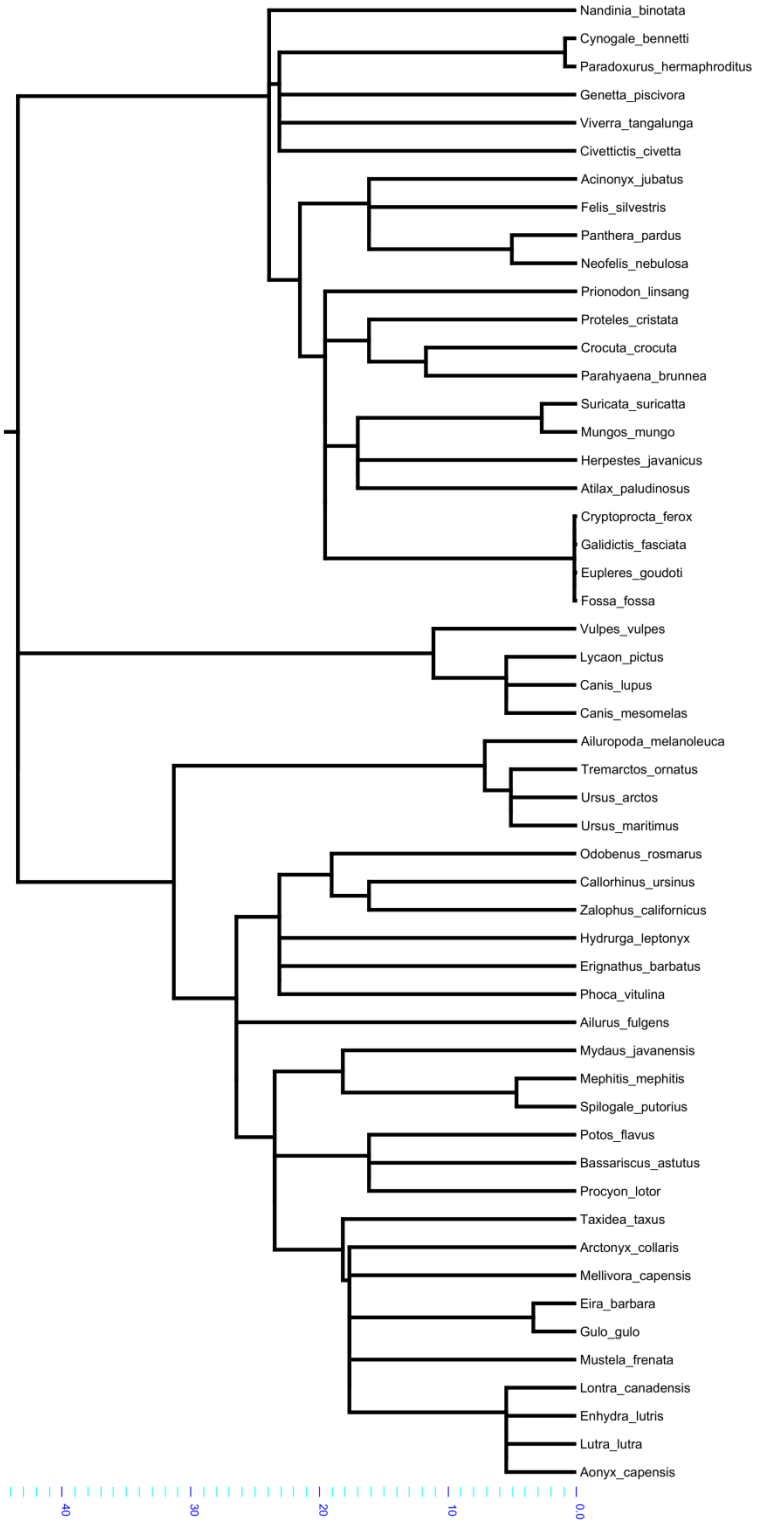

fig. S4. Sensitivity analysis 2. Tree topology as in Main Analysis; fossil calibrations and branch lengths using data from (*62*), unpublished data from JJF and J. Finarelli, and PBDB (Paleobiology Database) (*71*); no age/node interpolations, so contains some zero branch lengths (same estimated divergence ages at adjacent nodes, when the oldest age calibration fossils for a clade occur in later-diverging nodes/lineages; all other nodes collapsed to the nearest older node with a fossil calibration age). Branch lengths and scale in millions of years (Ma, megannum).

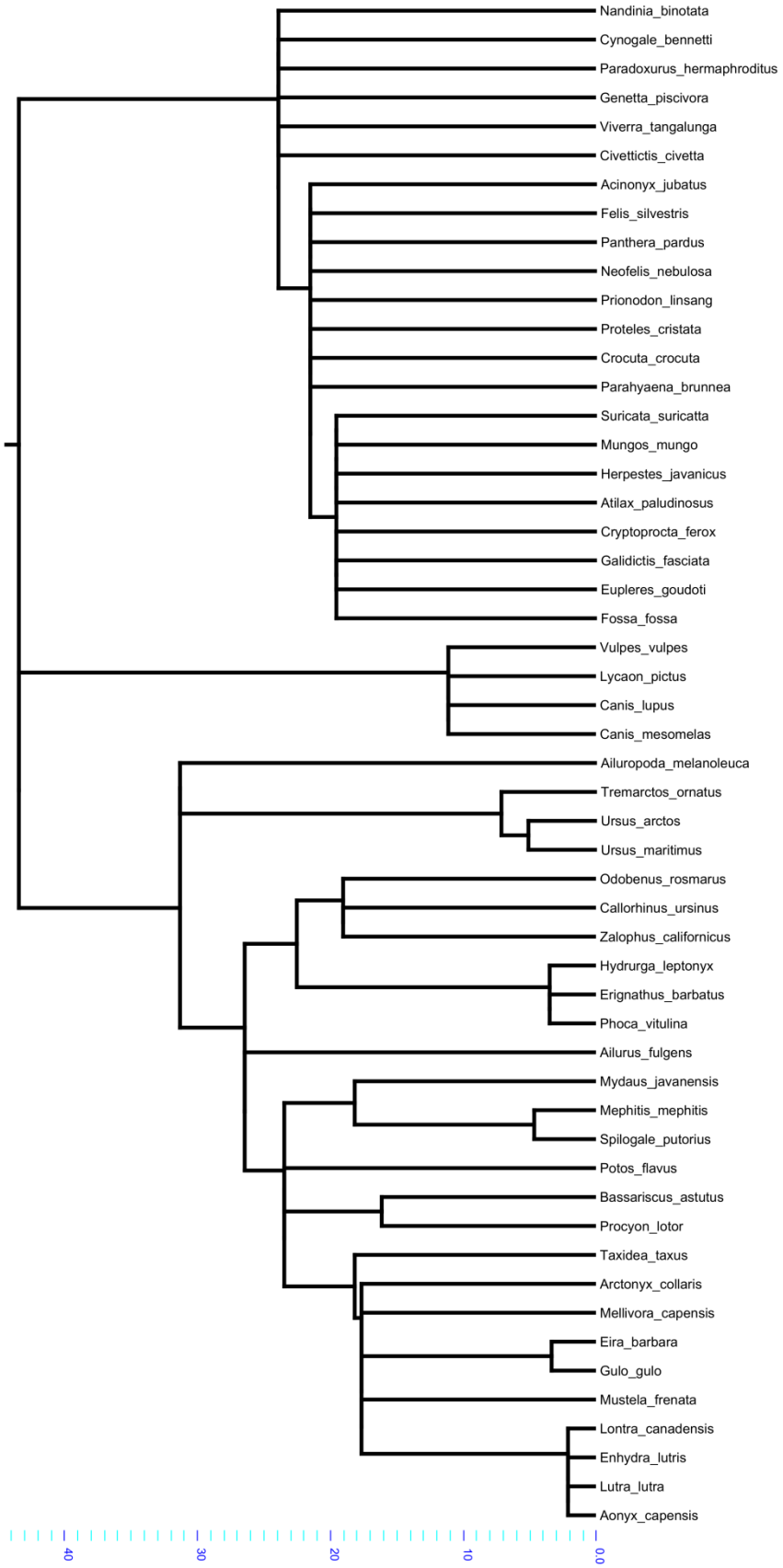

fig. S5. Sensitivity analysis 3. As in Sensitivity Analysis 2, but without PBDB node calibration data; no age/node interpolation, so contains some zero branch lengths. Branch lengths and scale in millions of years (Ma, megannum).

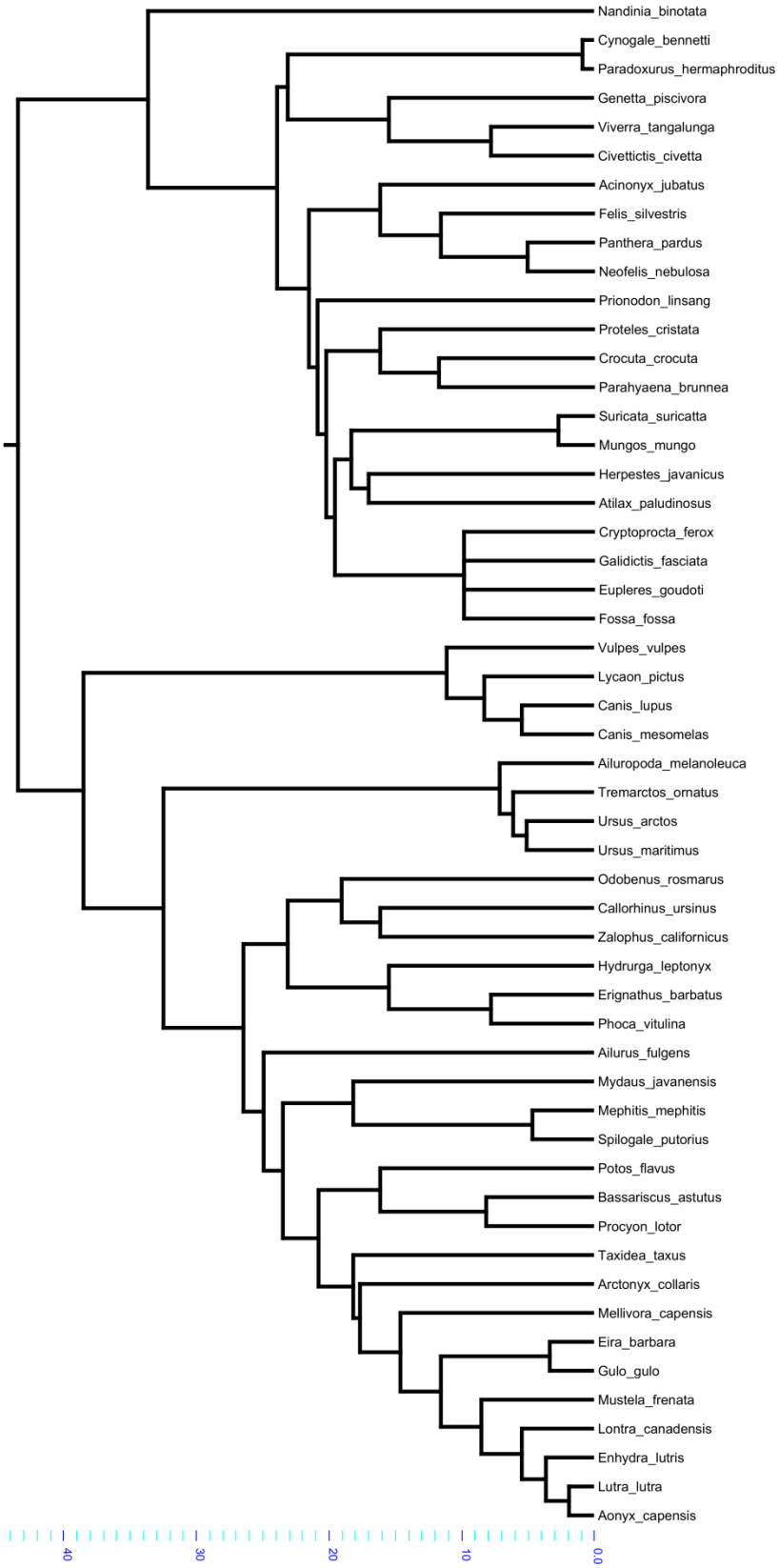

fig. S6. Sensitivity analysis 4. As in Sensitivity Analysis 2, but with age/node interpolations (expanded by interpolating node ages in equal intervals along the branches between nodes previously having the same fossil-calibration ages, using the oldest and youngest bracketing ages). Branch lengths and scale in millions of years (Ma, megannum).

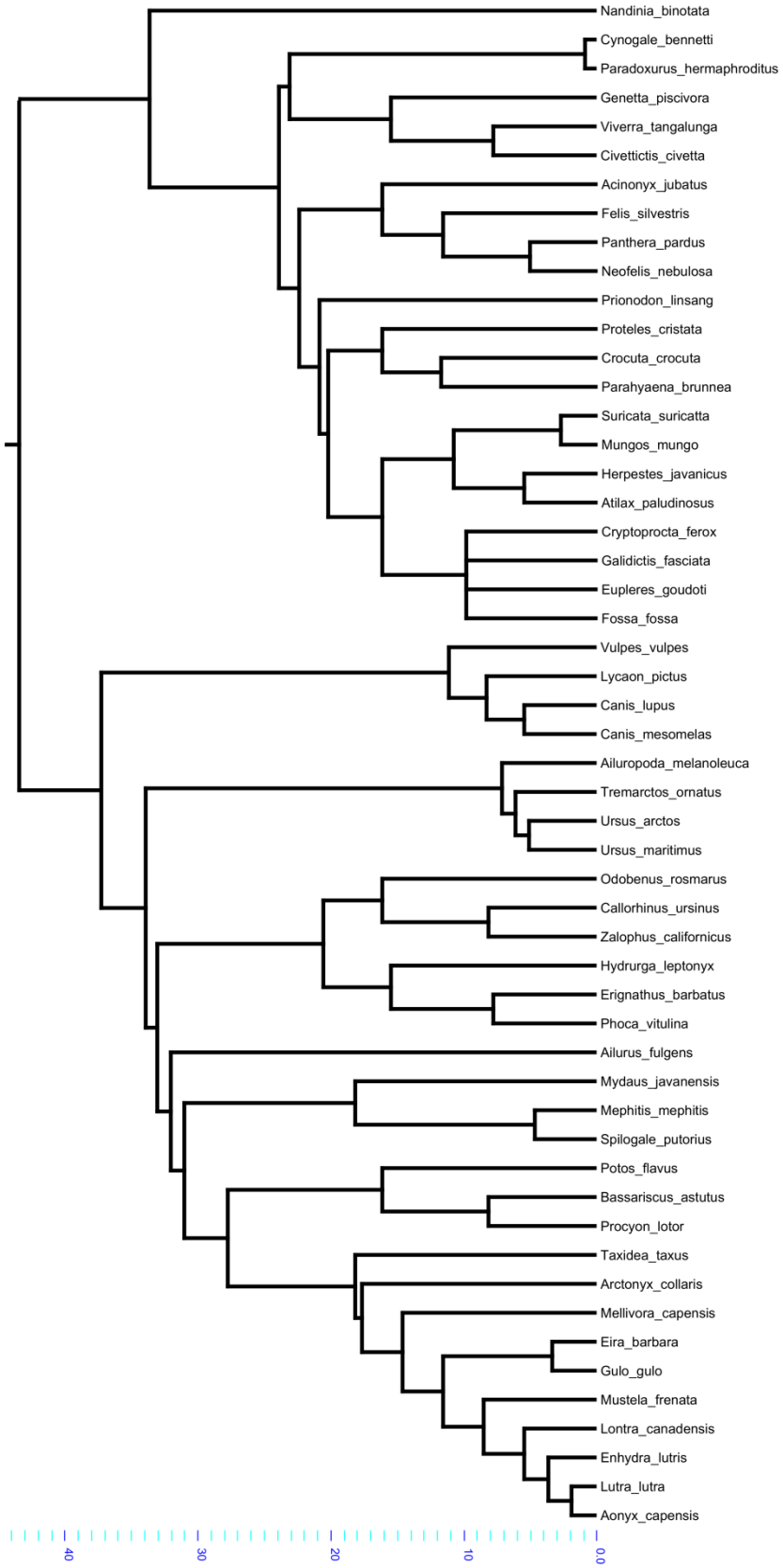

fig. S7. Sensitivity analysis 5. As in Sensitivity Analysis 2, adding Meredith *et al*. (*70*) fossil calibrations (with priority to those, if in conflict with calibrations used in Sensitivity Analysis 2); with age/node interpolations. Branch lengths and scale in millions of years (Ma, megannum).

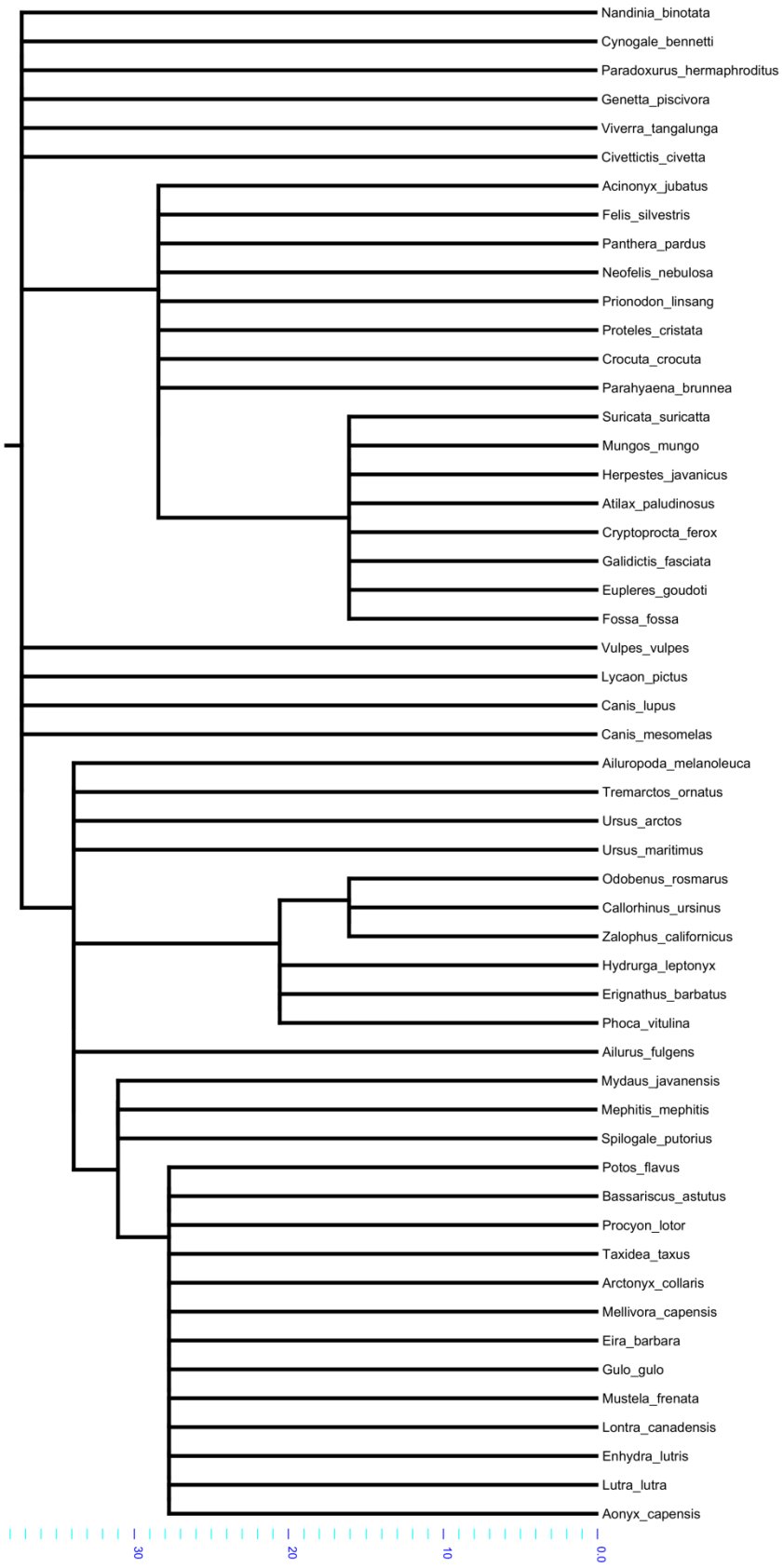

fig. S8. Sensitivity analysis 6. Main Analysis tree topology; only Meredith *et al*. fossil calibrations; no age/node interpolations. Branch lengths and scale in millions of years (Ma, megannum).

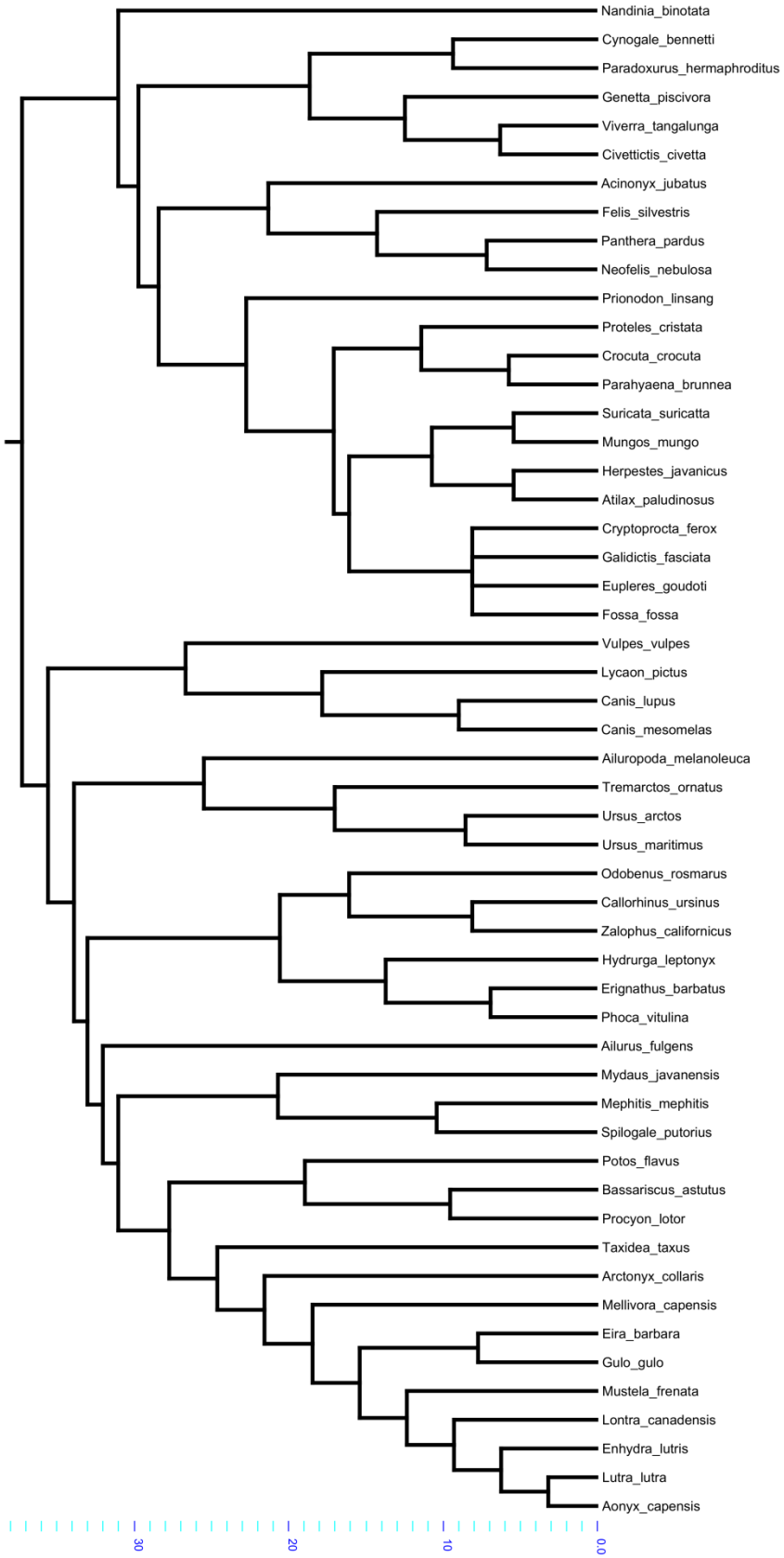

fig. S9. Sensitivity analysis 7. Main Analysis tree topology; only Meredith *et al*. fossil calibrations; with age/node interpolations. Branch lengths and scale in millions of years (Ma, megannum).

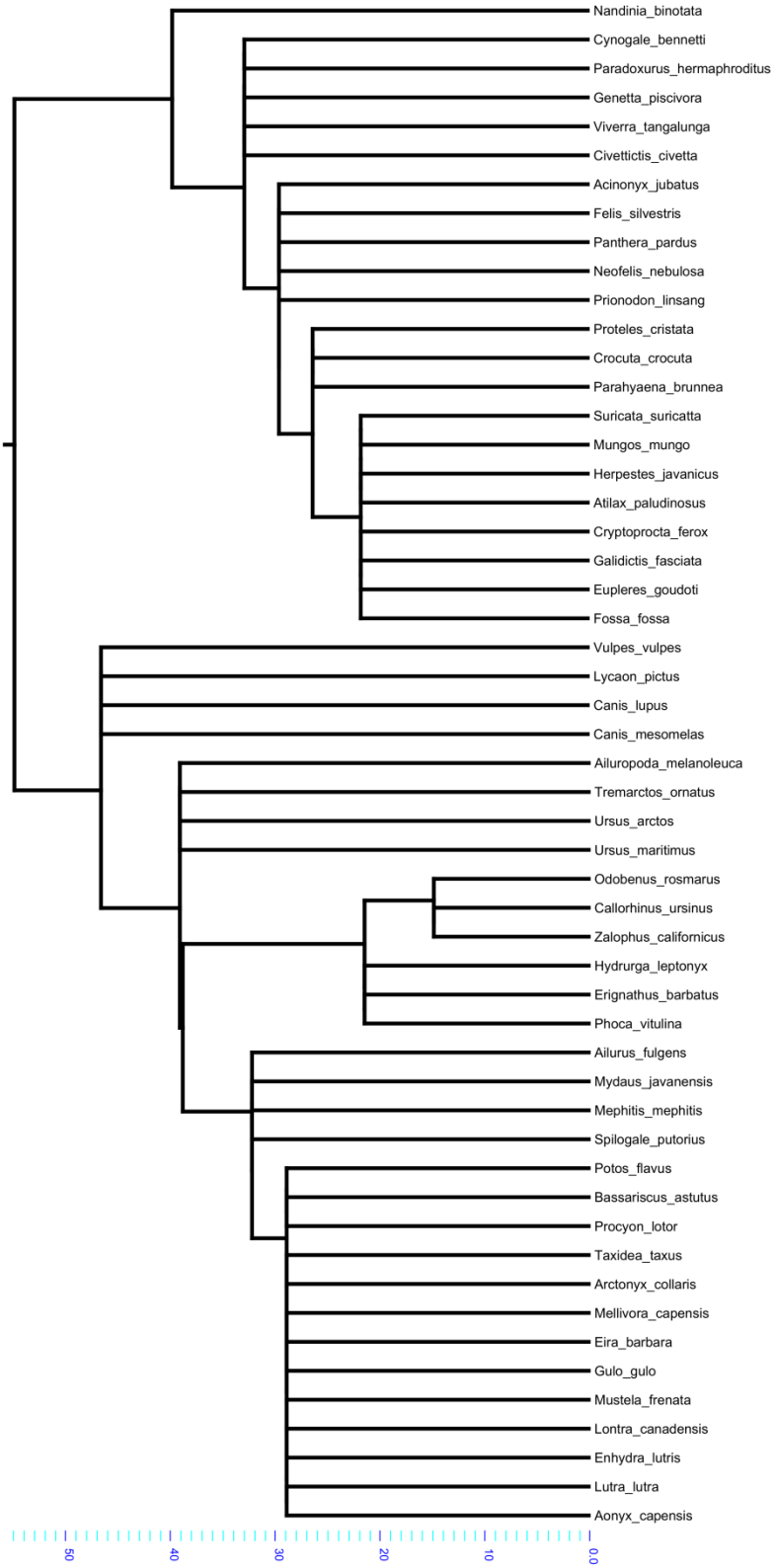

fig. S10. Sensitivity analysis 8. Main Analysis tree topology; only Meredith *et al*. interfamilial molecular clock node age estimates (no direct fossil calibrations, although the Meredith *et al*. clock estimates rely on various fossil calibrations to derive the tree-wide nodal age estimates); no age/node interpolations. Branch lengths and scale in millions of years (Ma, megannum).

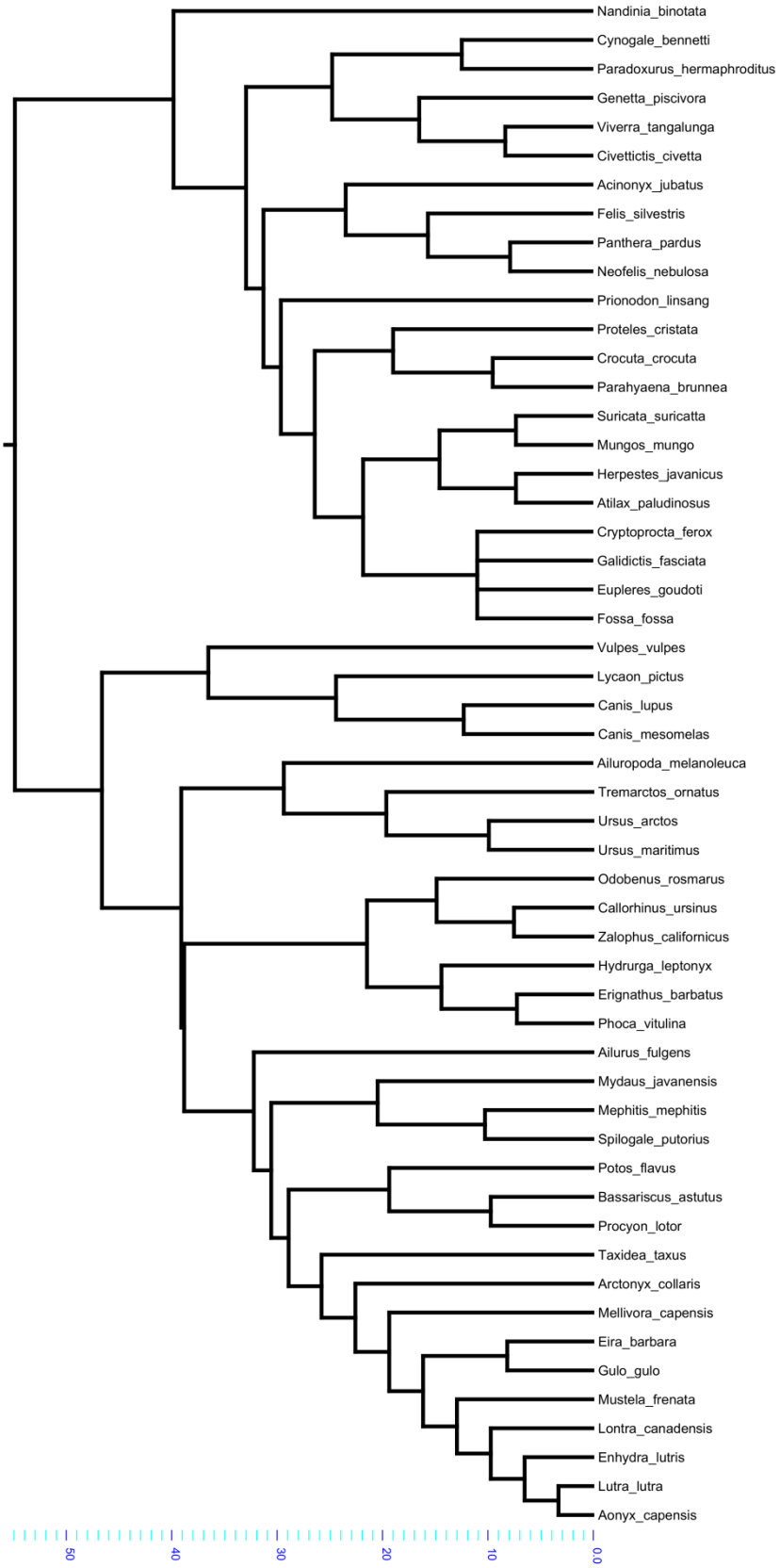

fig. S11. Sensitivity analysis 9. Main Analysis tree topology; only Meredith *et al*. interfamilial molecular clock node age estimates; with age/node interpolations. Branch lengths and scale in millions of years (Ma, megannum).

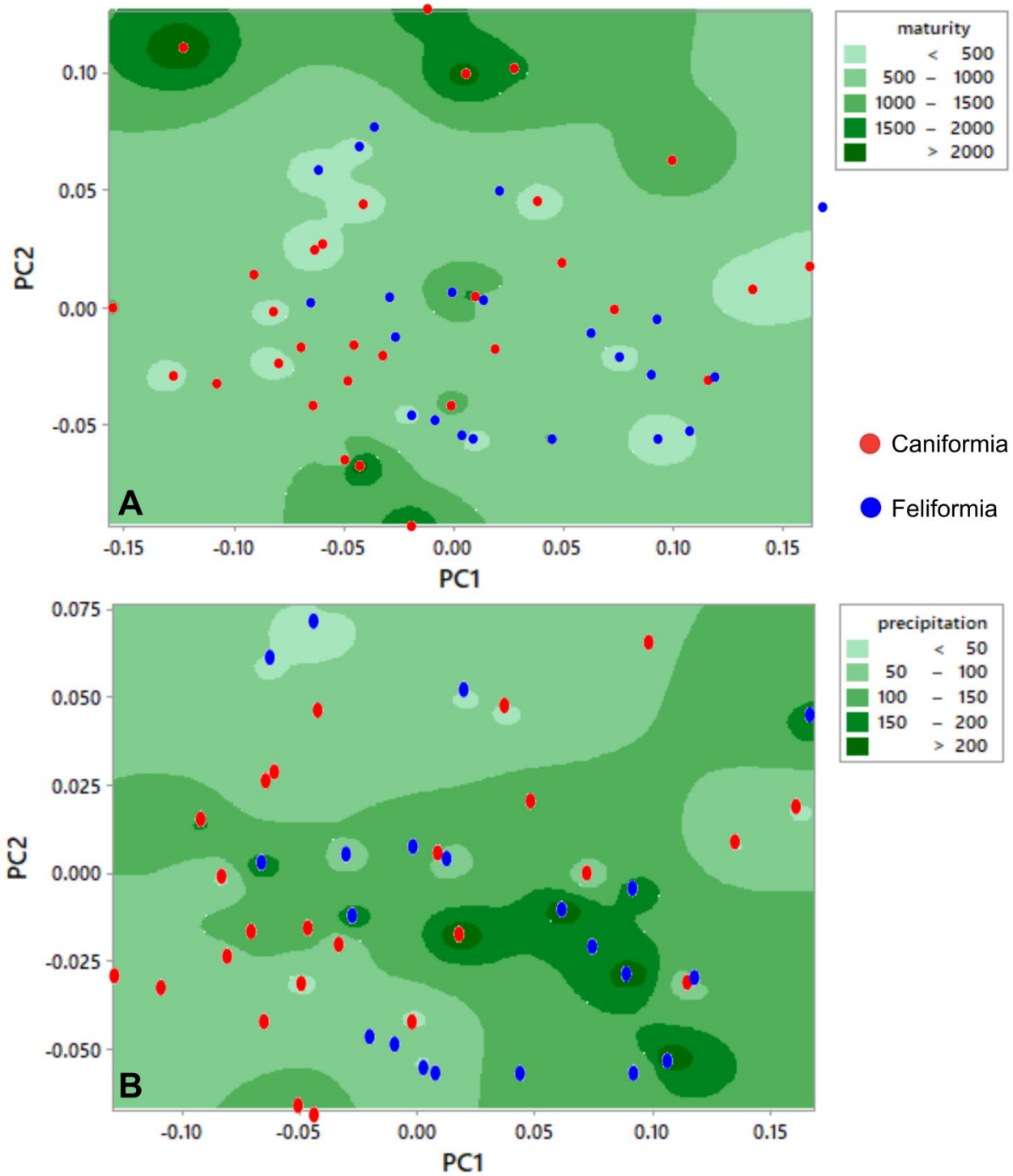

fig. S12. Contour plot of the first two PC axes against life history and environmental variables. A. Cranial shape PC scores superimposed on age at sexual maturity contour. **B**. Cranial shape PC scores superimposed on mean monthly precipitation.

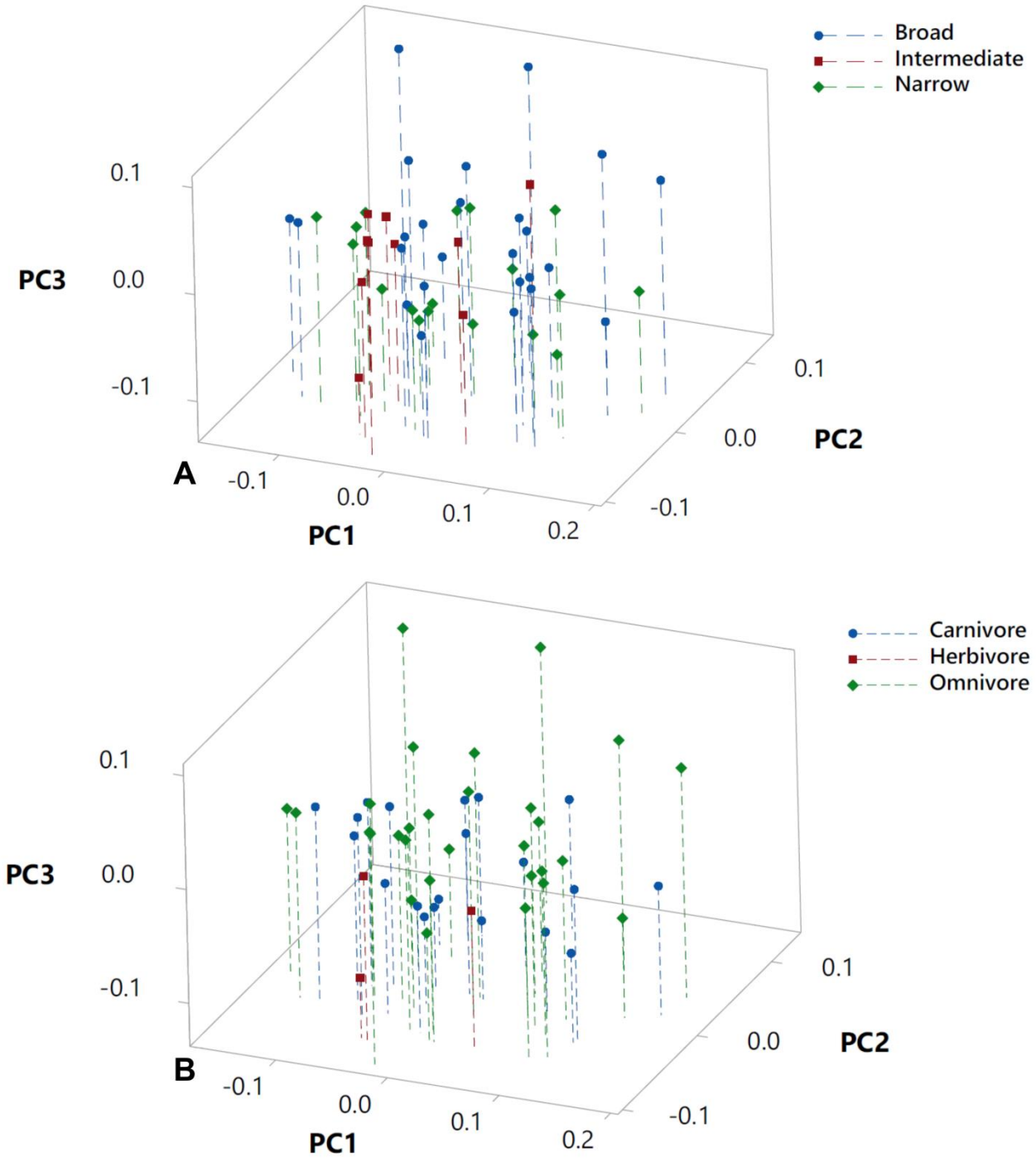

fig. S13. 3D plots of PC scores of cranial shape data. A. Data points color-coded by dietary breadth (blue= broad, red= intermediate, green= narrow). **B**. Data points color-coded by trophic level (blue= carnivore, red= herbivore, green= omnivore).

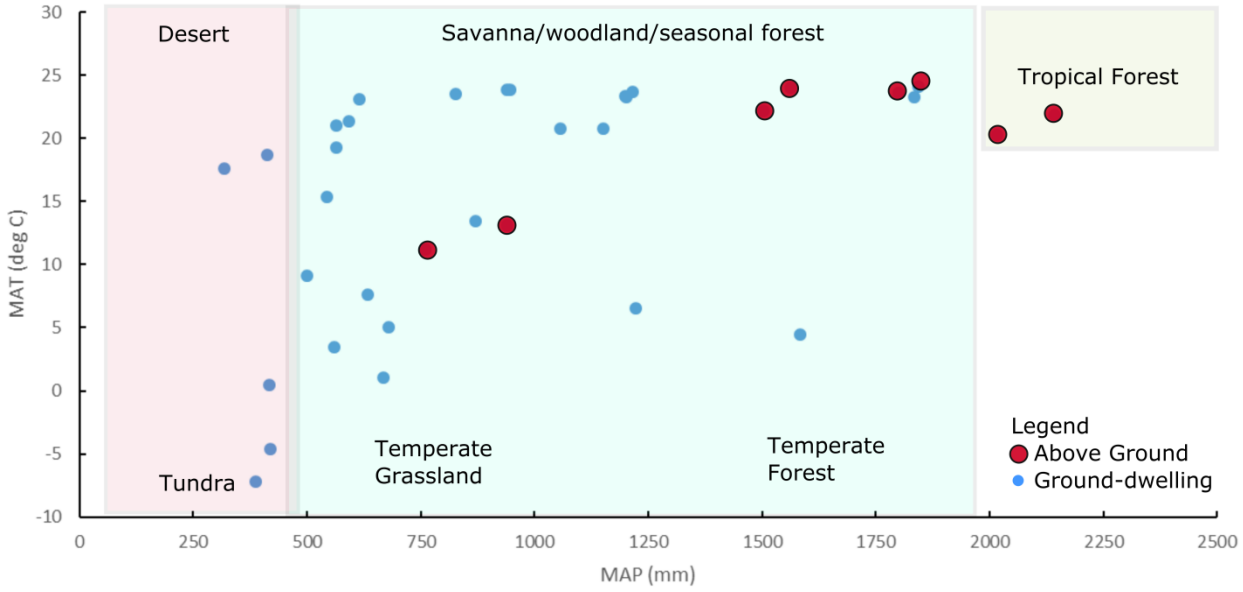

fig. S14. Plot of mean annual precipitation versus mean annual temperature of species studied. Data from the PanTHERIA database (*28*) and estimated biome coverage from (*72*). Terrestriality categories of the carnivoran species studied are color coded (red= above ground/arboreal, blue= ground-dwelling/terrestrial).