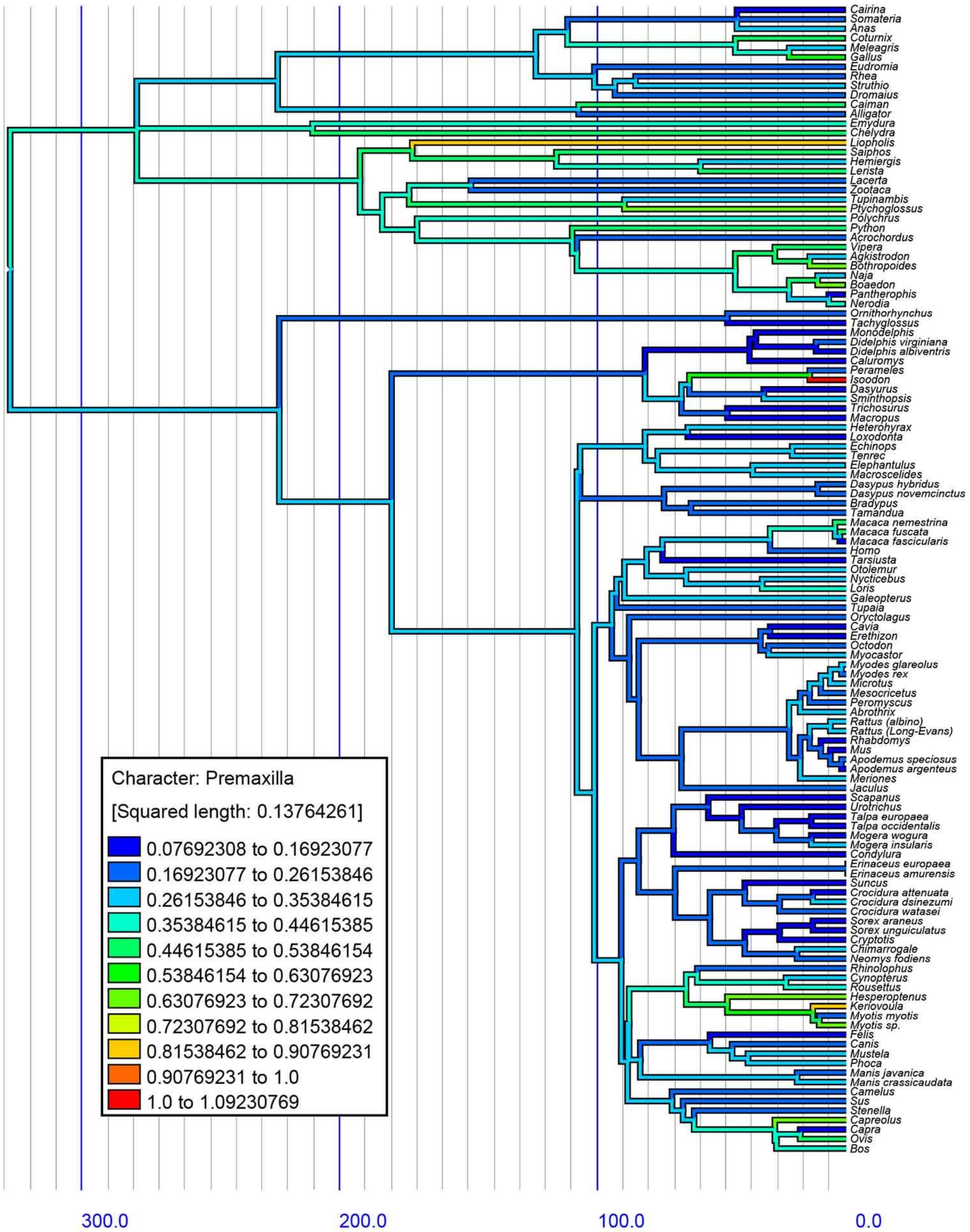
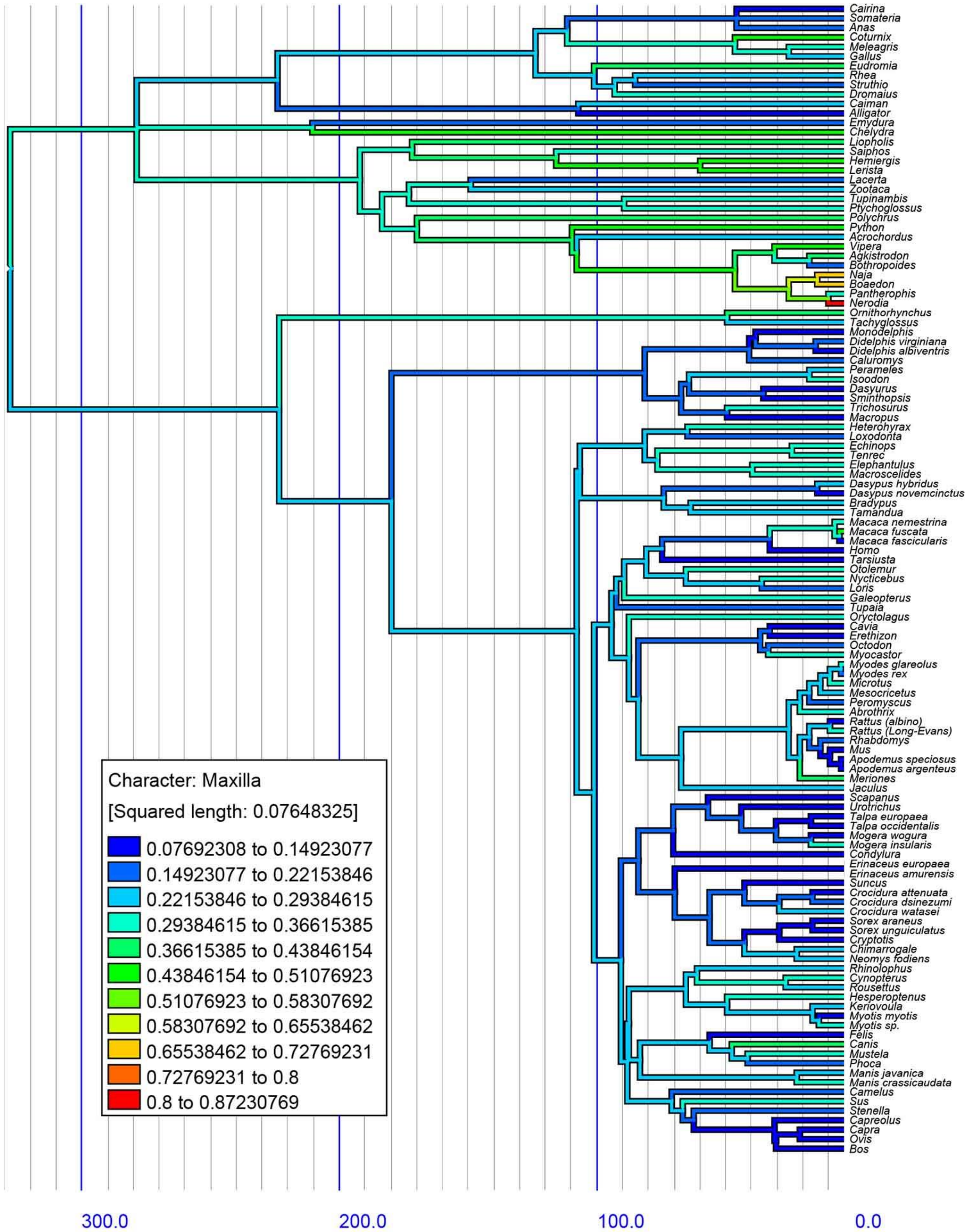
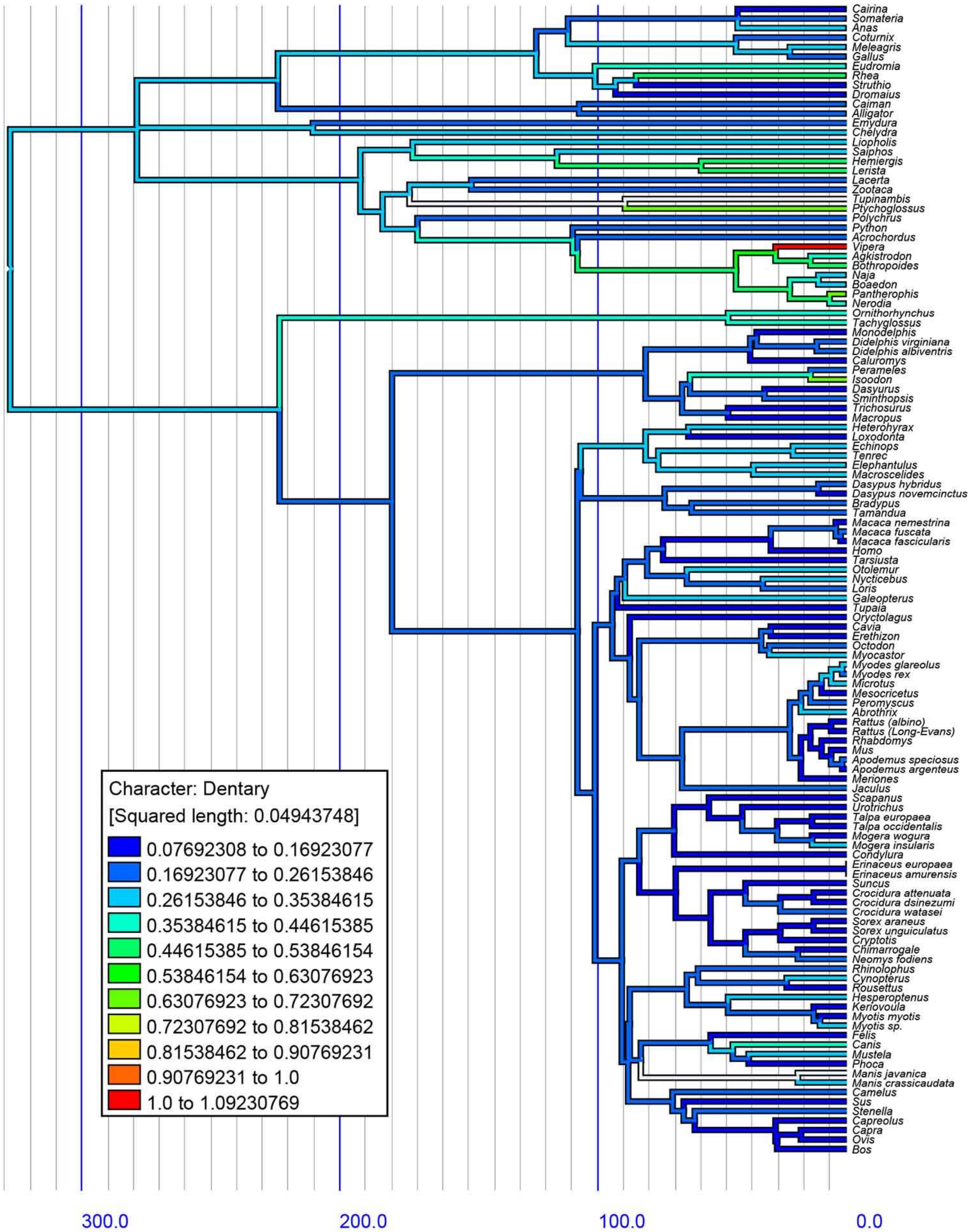


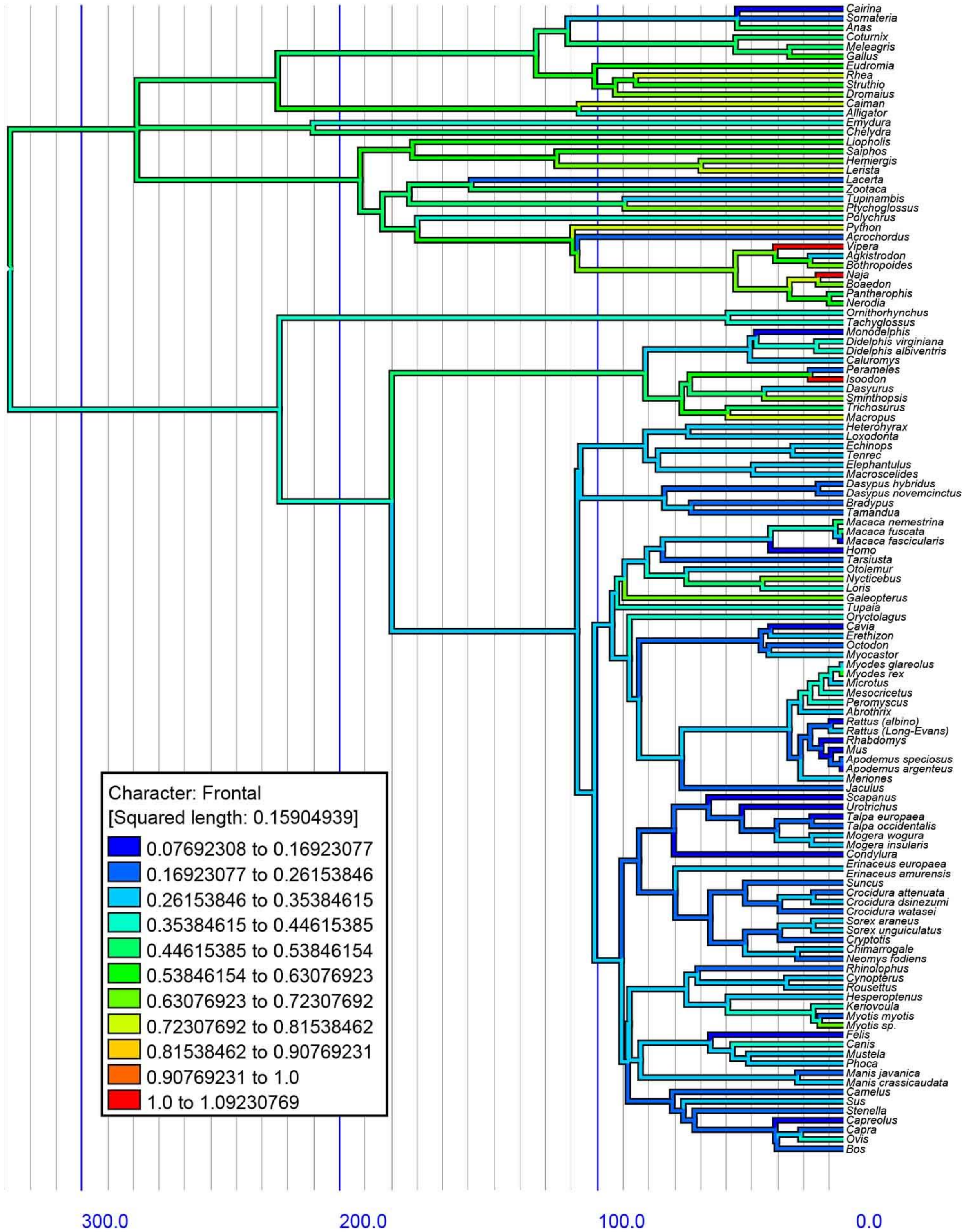
Supplementary Fig. 1. Reconstructed heterochrony of relative timing of the premaxilla, using squared-change parsimony. Blue numbers indicate divergence time (in MYA).



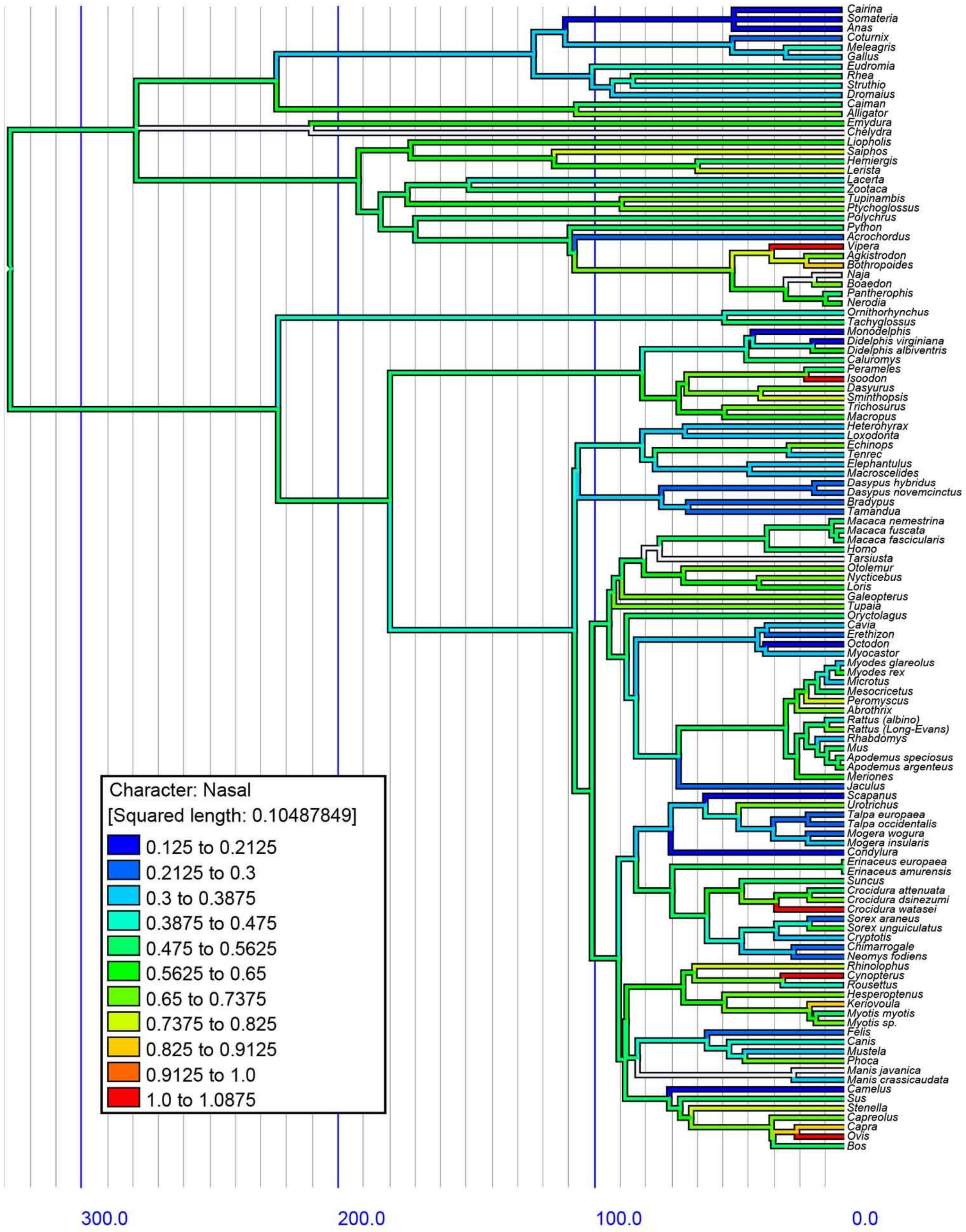
Supplementary Fig. 2. Reconstructed heterochrony of relative timing of the maxilla, using squared-change parsimony.



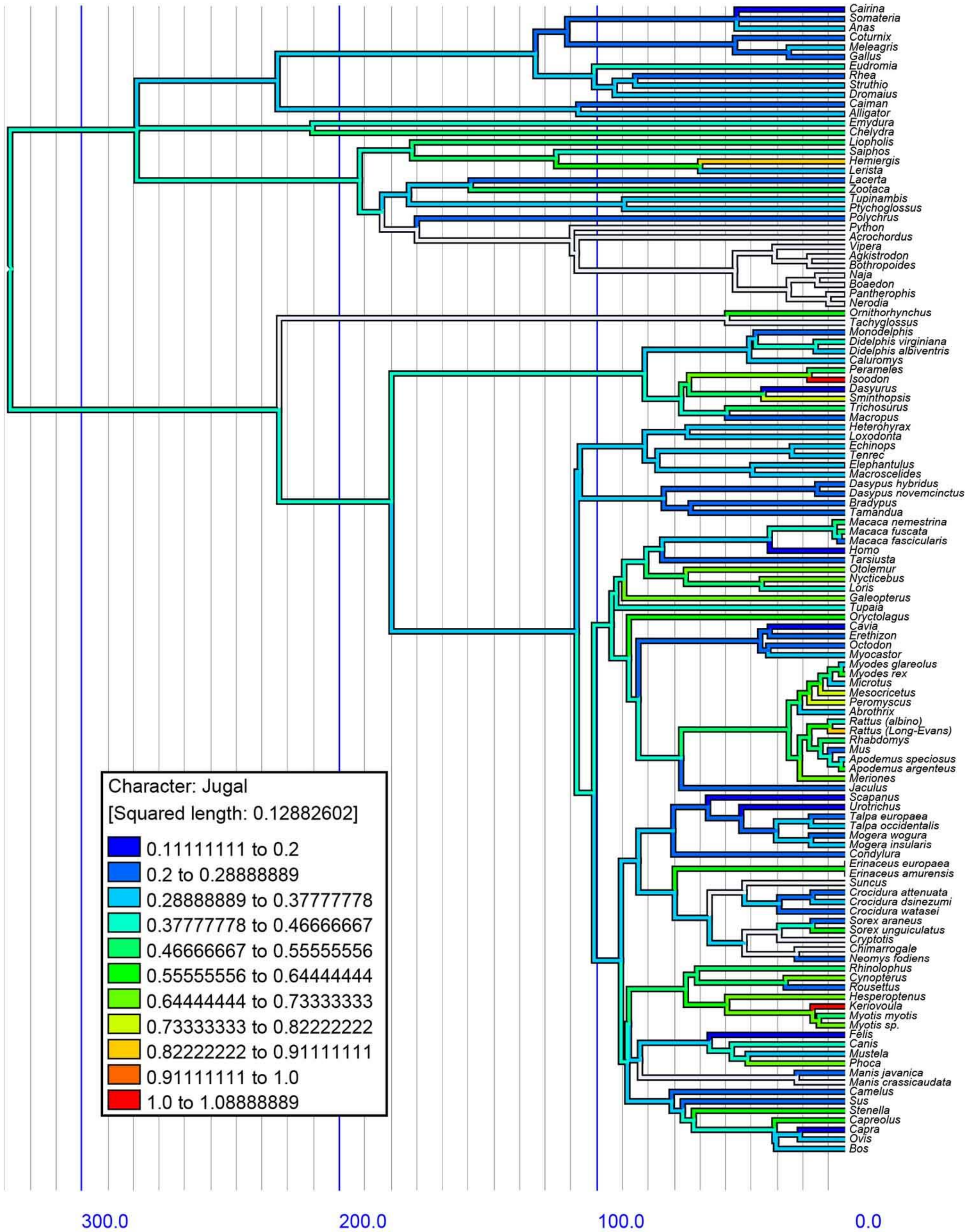
Supplementary Fig. 3. Reconstructed heterochrony of relative timing of the dentary, using squared-change parsimony.



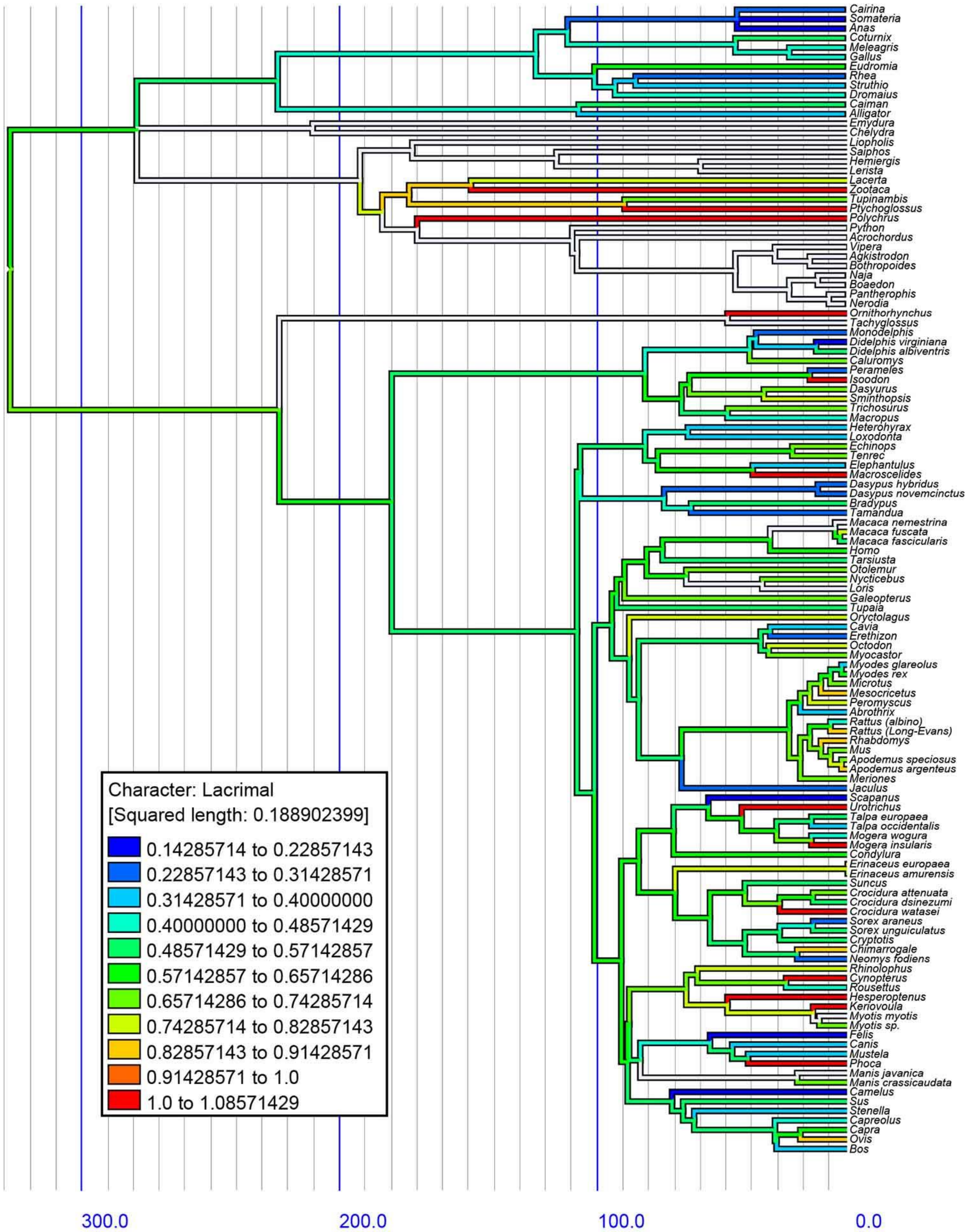
Supplementary Fig. 4. Reconstructed heterochrony of relative timing of the frontal, using squared-change parsimony.



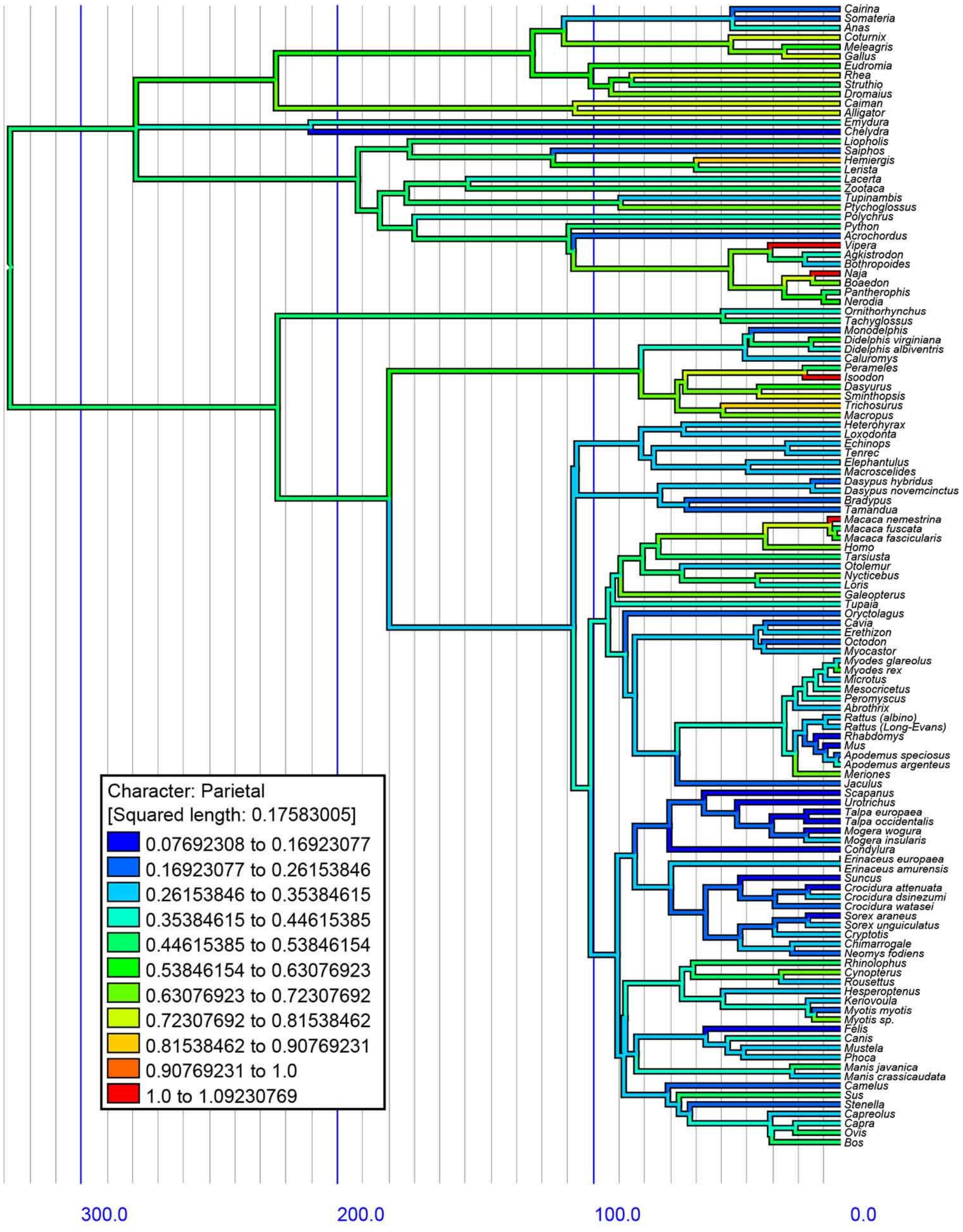
Supplementary Fig. 5. Reconstructed heterochrony of relative timing of the nasal, using squared-change parsimony.



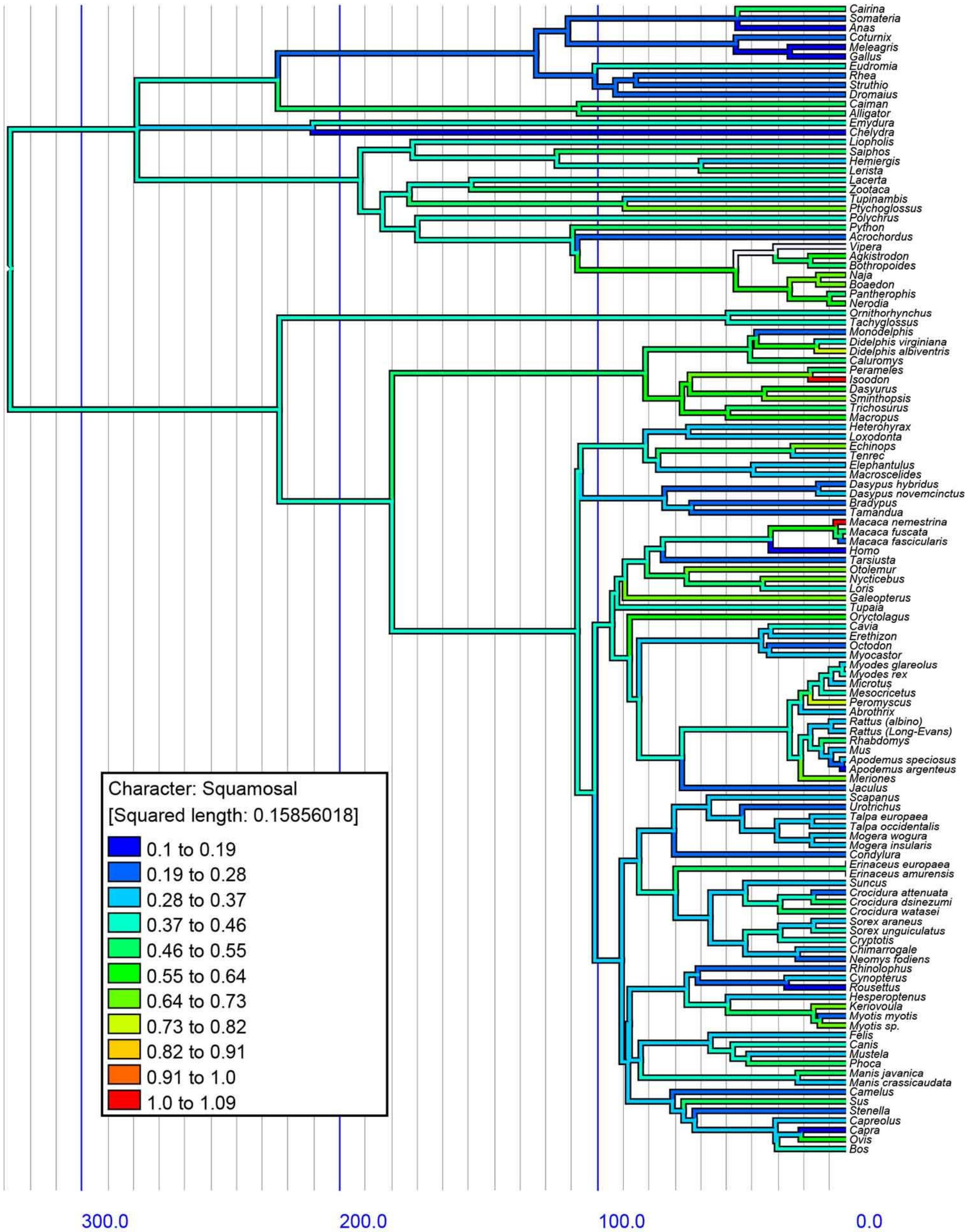
Supplementary Fig. 6. Reconstructed heterochrony of relative timing of the jugal, using squared-change parsimony.



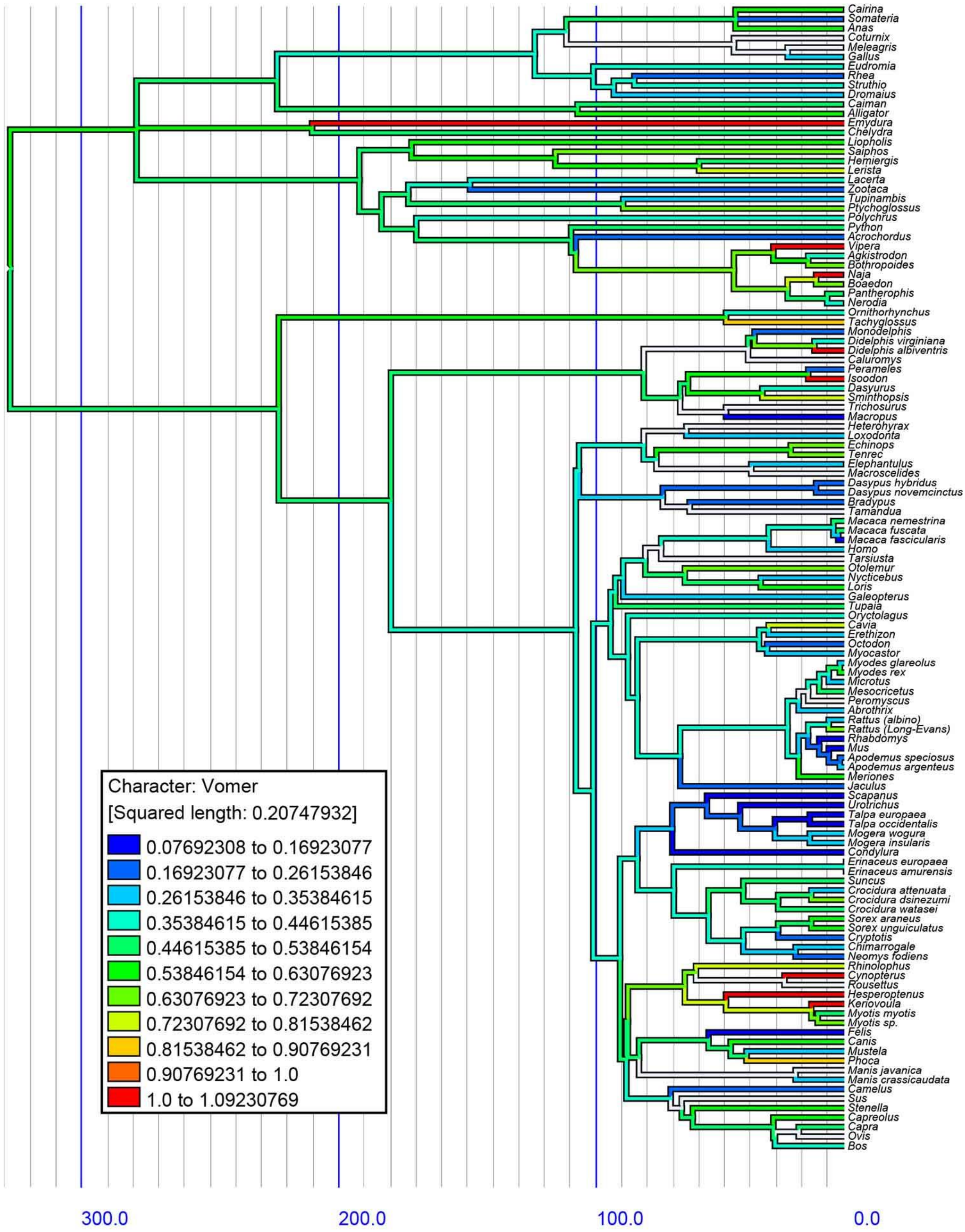
Supplementary Fig. 7. Reconstructed heterochrony of relative timing of the lacrimal, using squared-change parsimony.



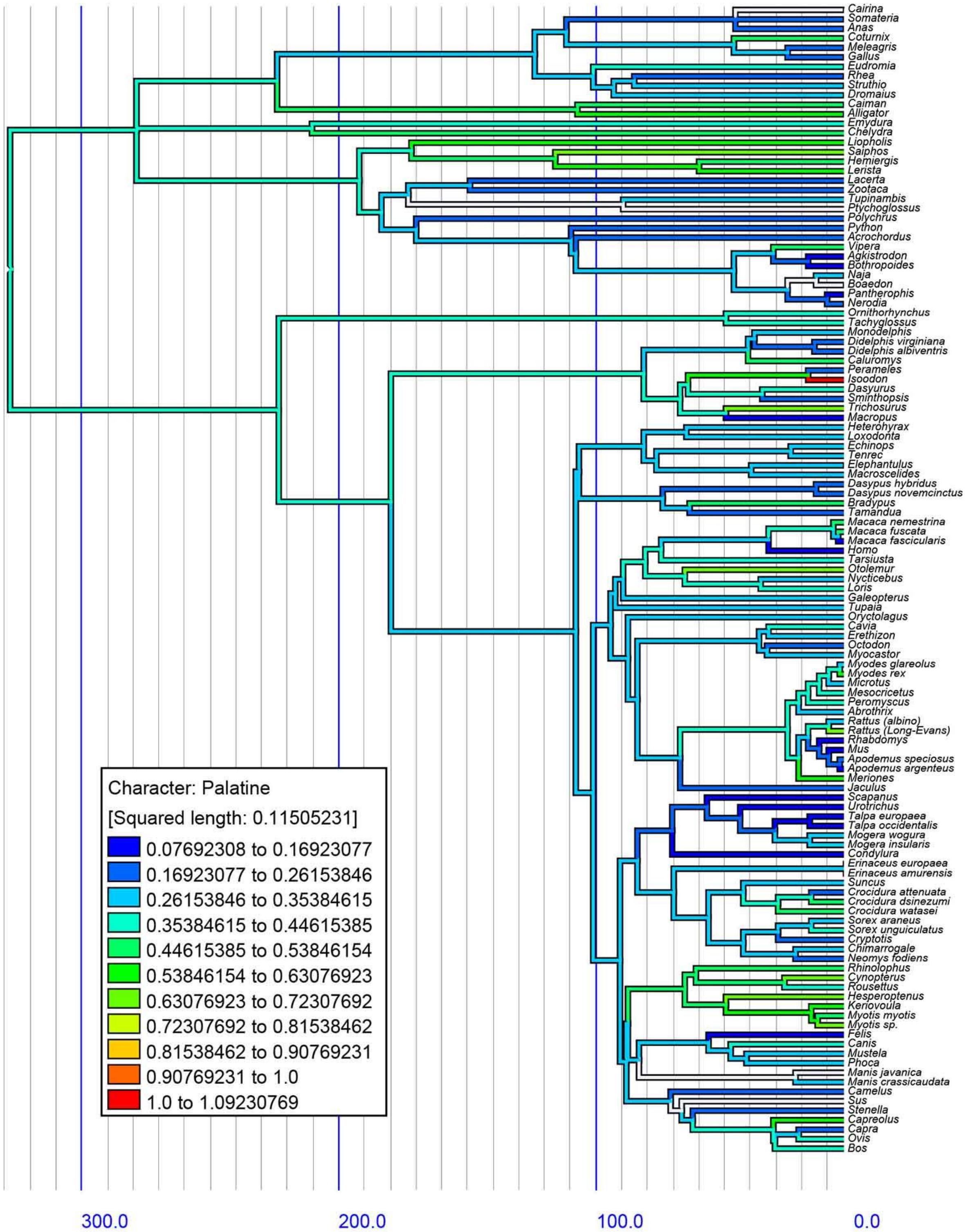
Supplementary Fig. 8. Reconstructed heterochrony of relative timing of the parietal, using squared-change parsimony.



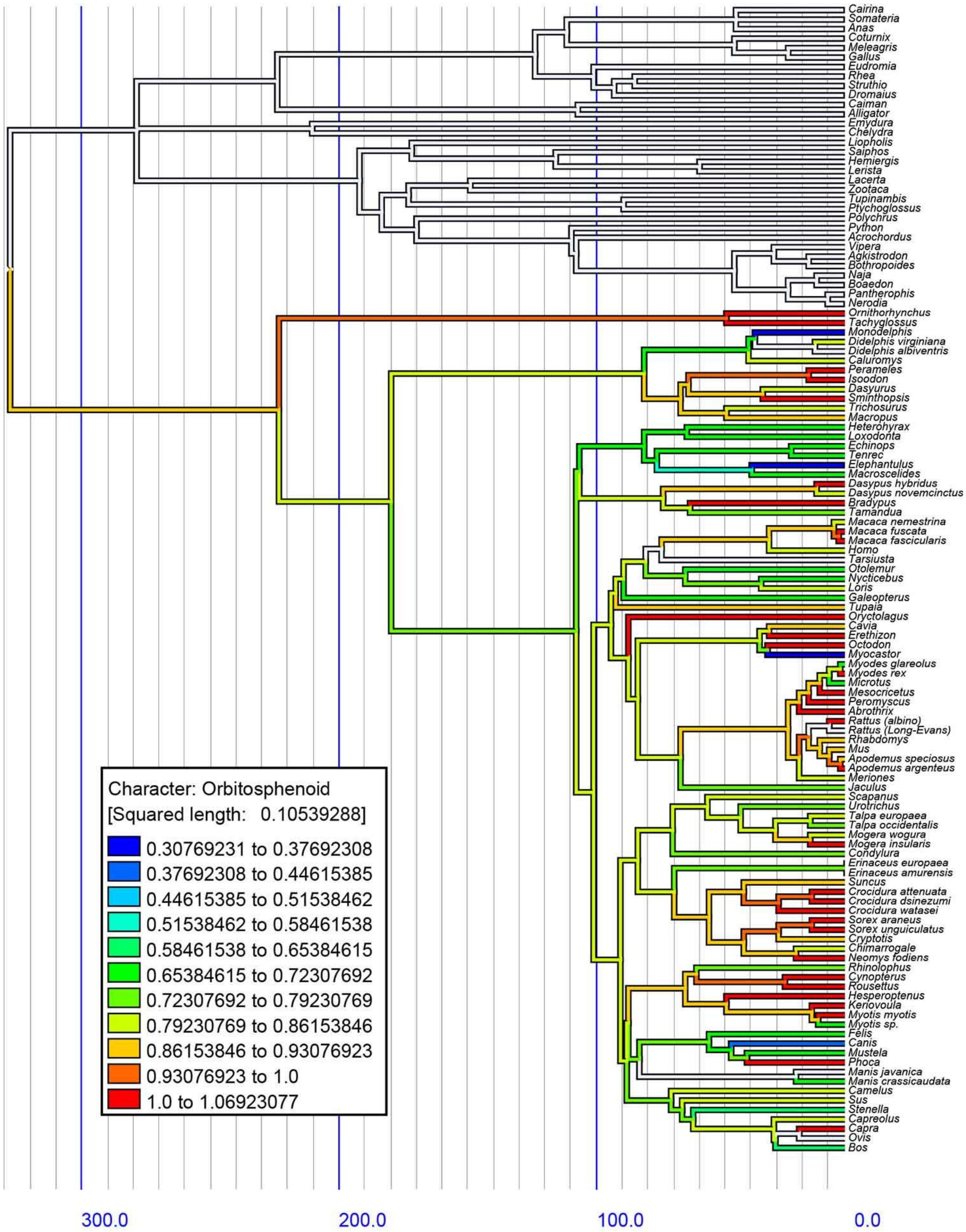
Supplementary Fig. 9. Reconstructed heterochrony of relative timing of the squamosal, using squared-change parsimony.



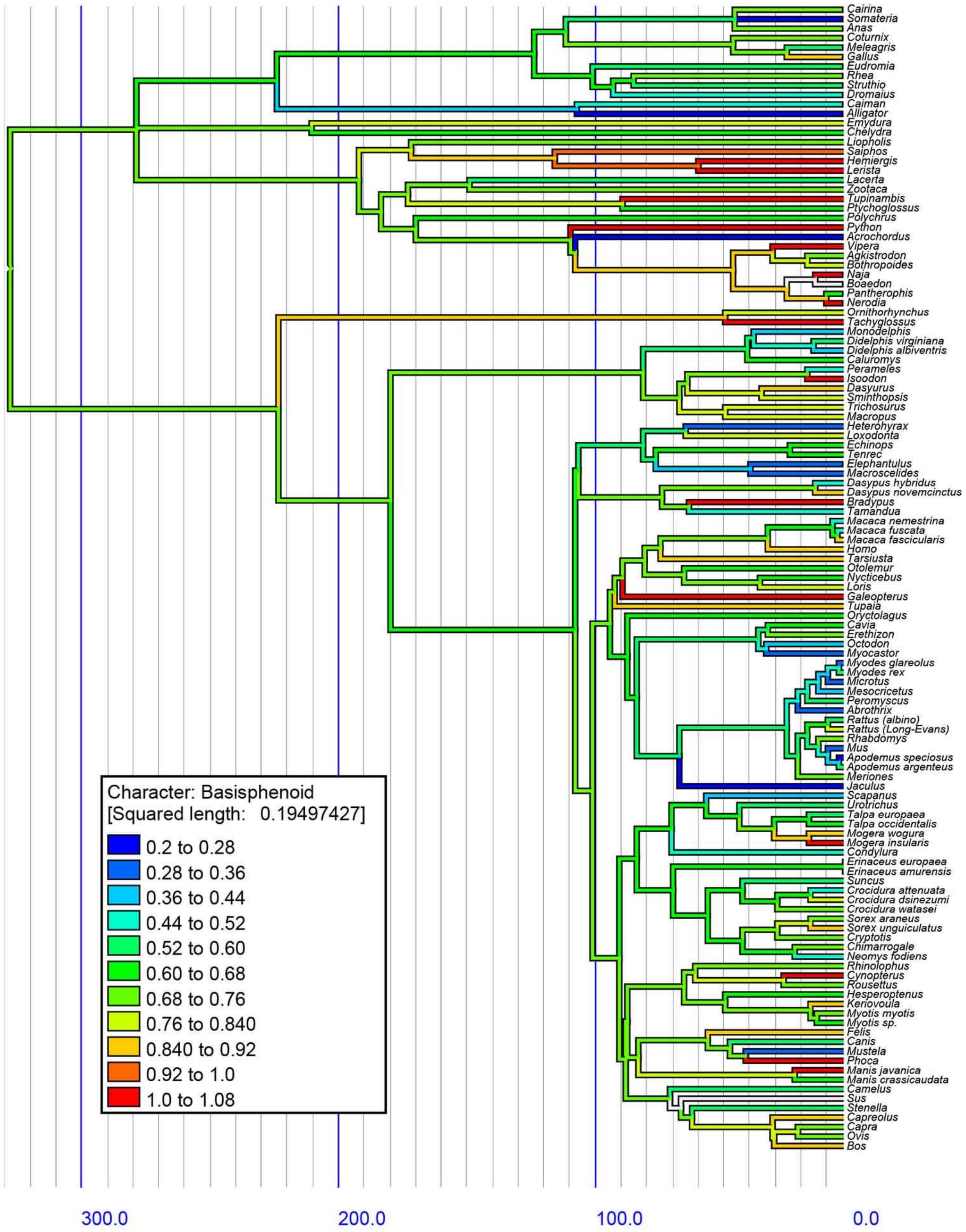
Supplementary Fig. 10. Reconstructed heterochrony of relative timing of the vomer, using squared-change parsimony.



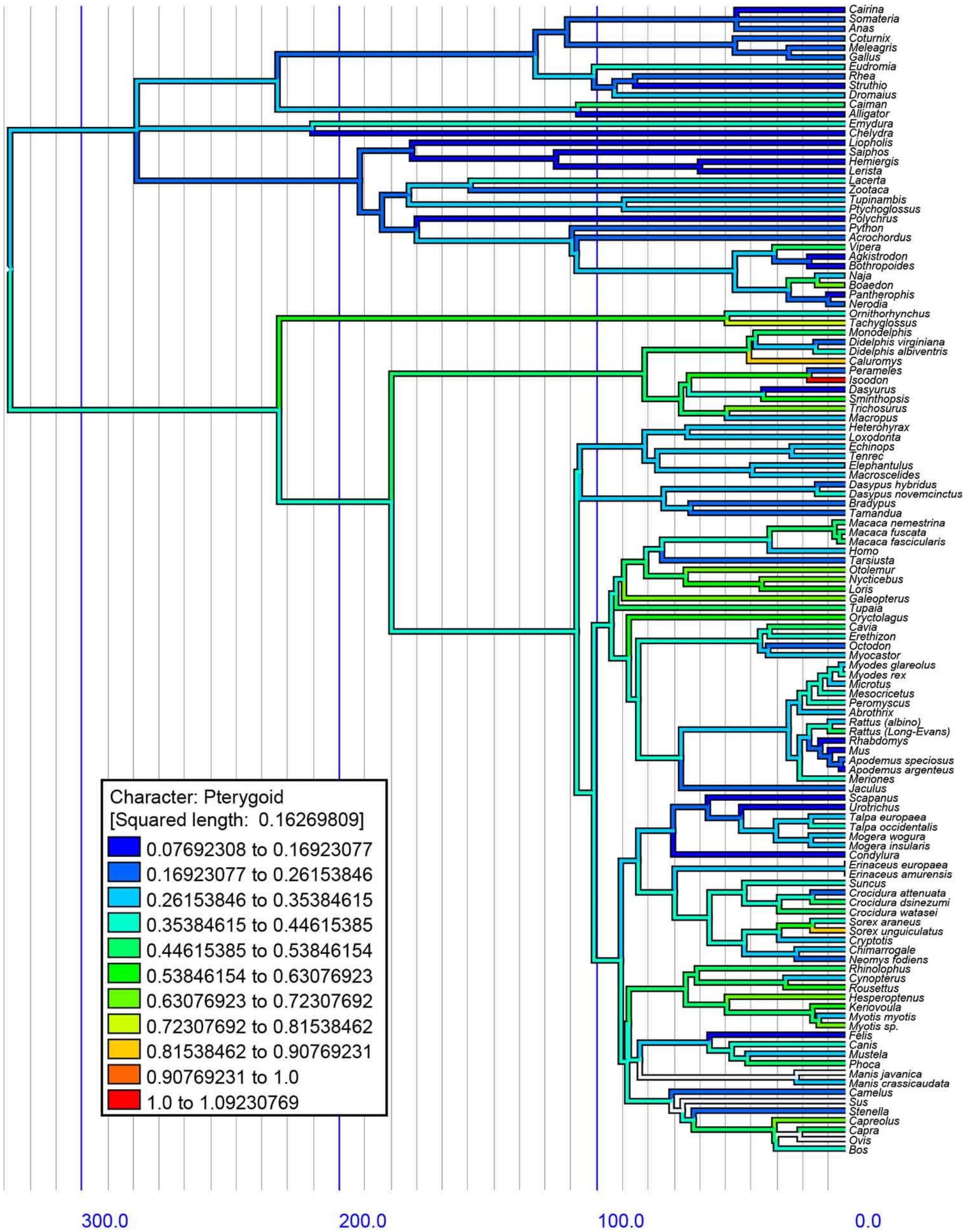
Supplementary Fig. 11. Reconstructed heterochrony of relative timing of the palatine, using squared-change parsimony.



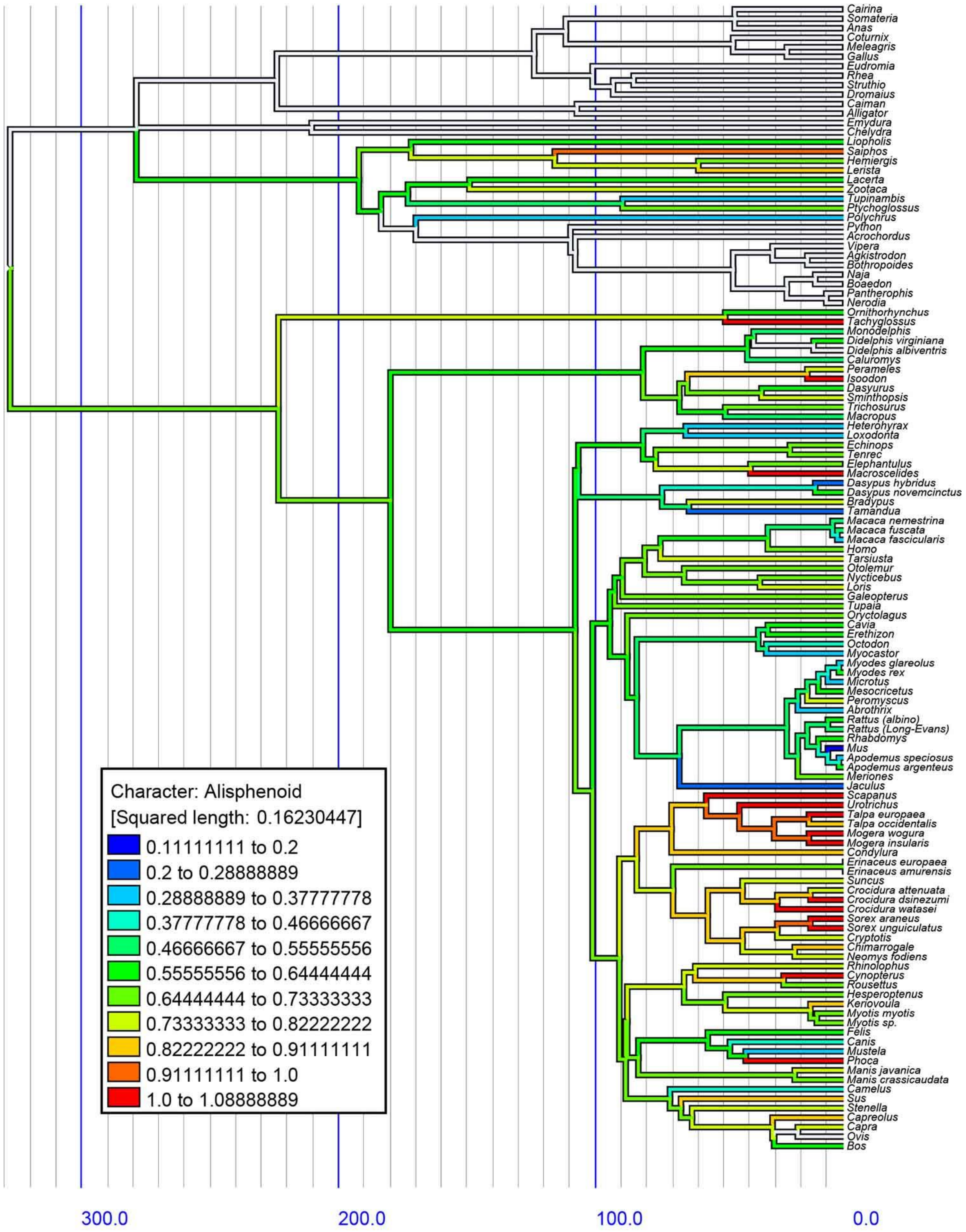
Supplementary Fig. 12. Reconstructed heterochrony of relative timing of the orbitosphenoid, using squared-change parsimony.



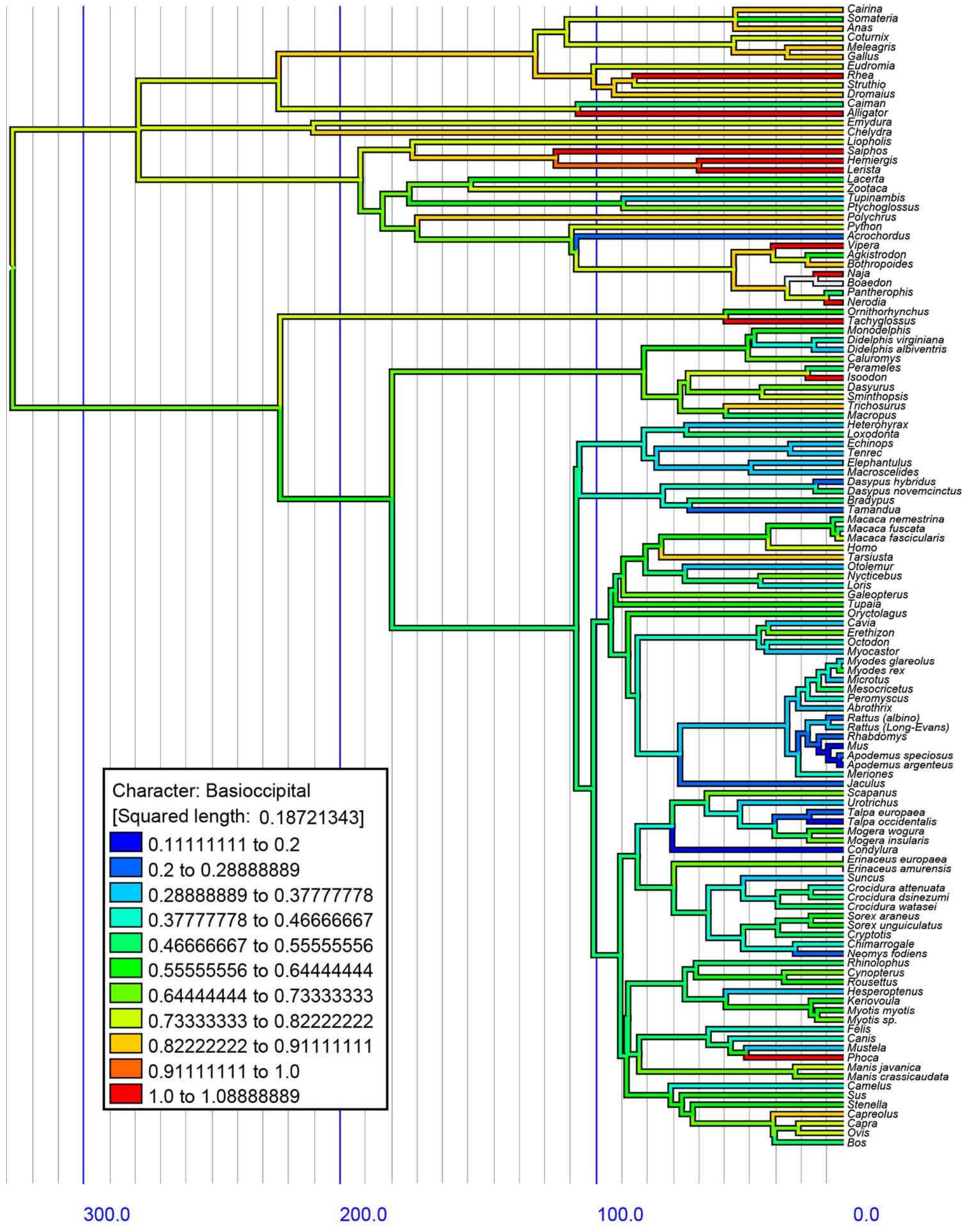
Supplementary Fig. 13. Reconstructed heterochrony of relative timing of the basisphenoid, using squared-change parsimony.



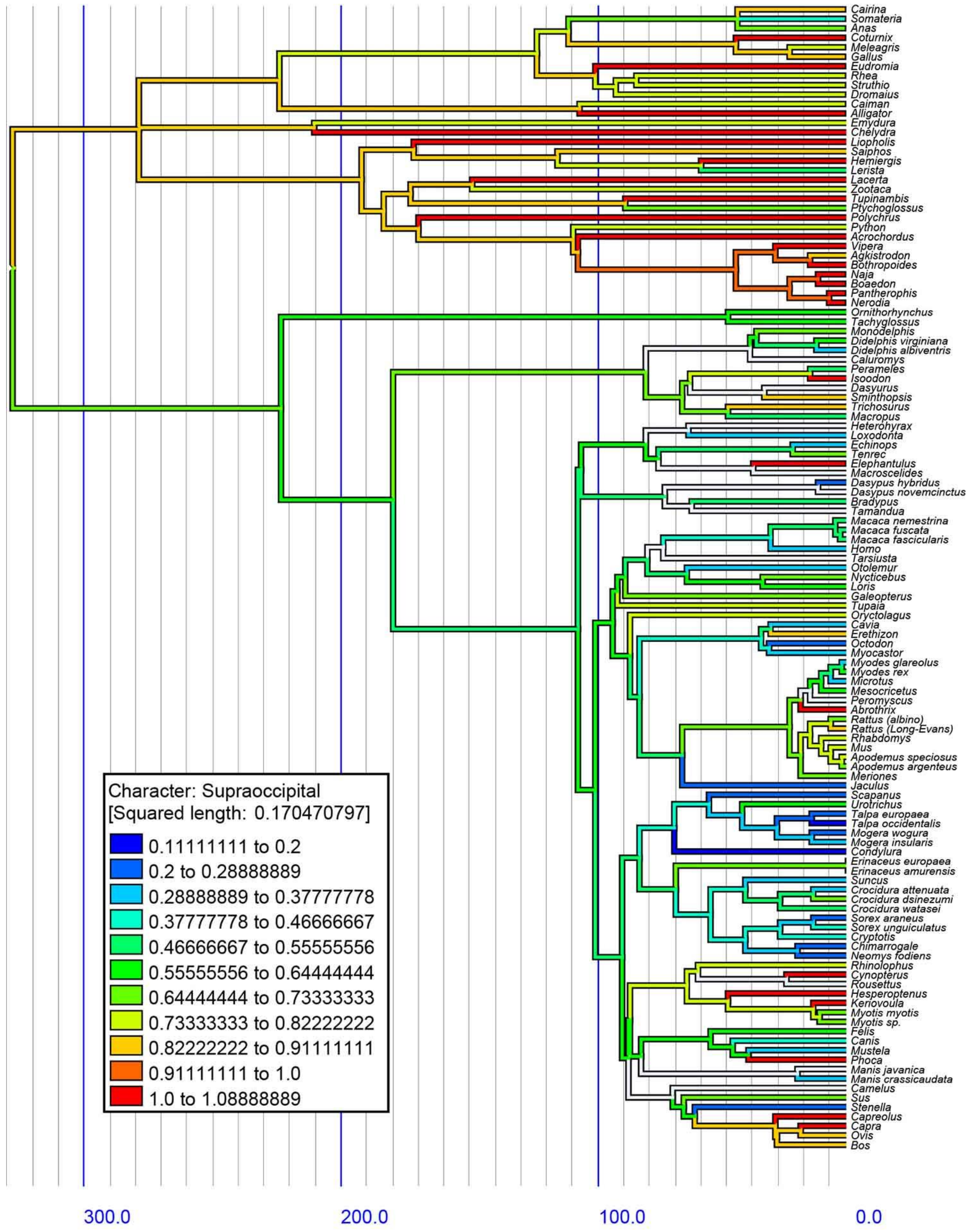
Supplementary Fig. 14. Reconstructed heterochrony of relative timing of the pterygoid, using squared-change parsimony.



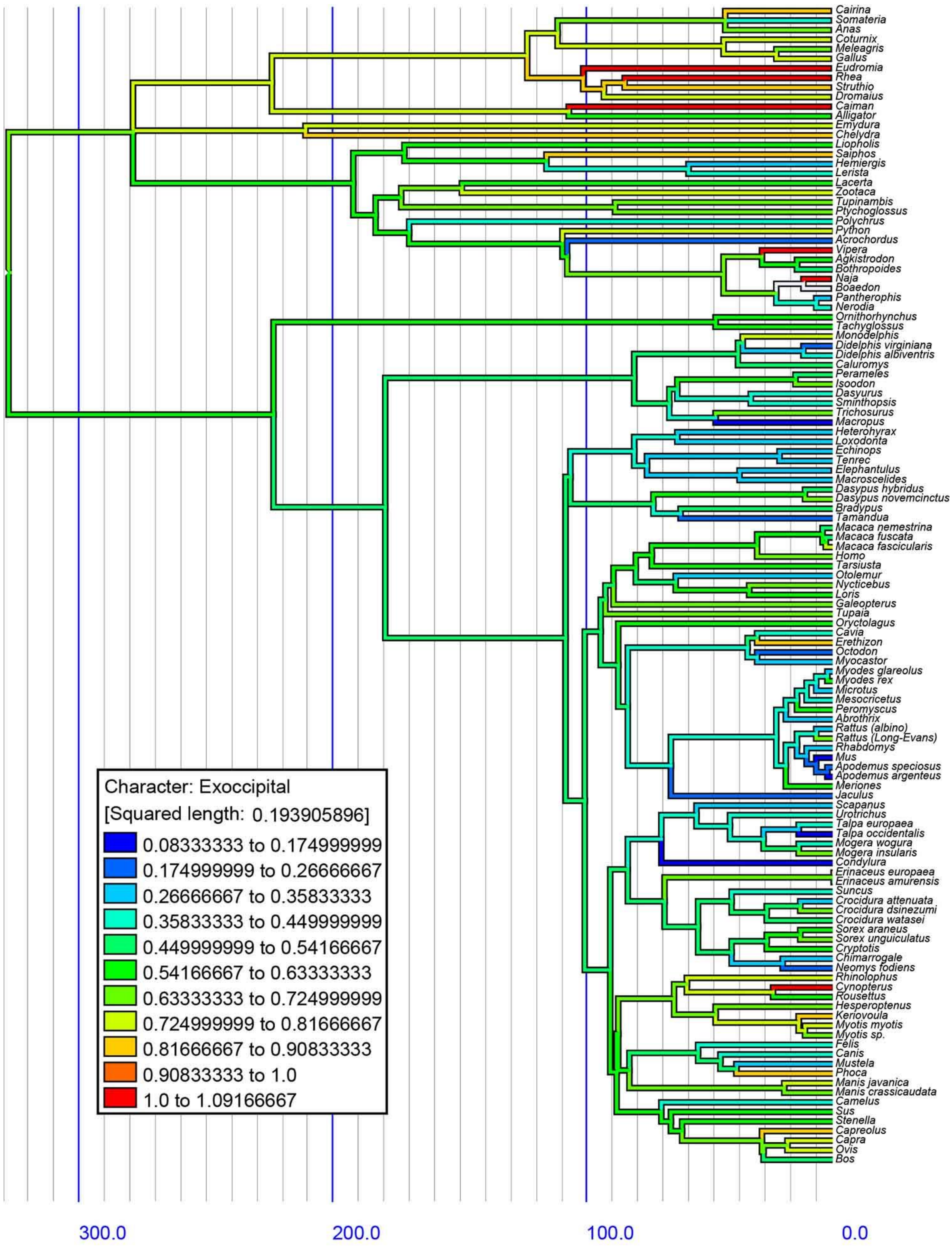
Supplementary Fig. 15. Reconstructed heterochrony of relative timing of the alisphenoid, using squared-change parsimony.



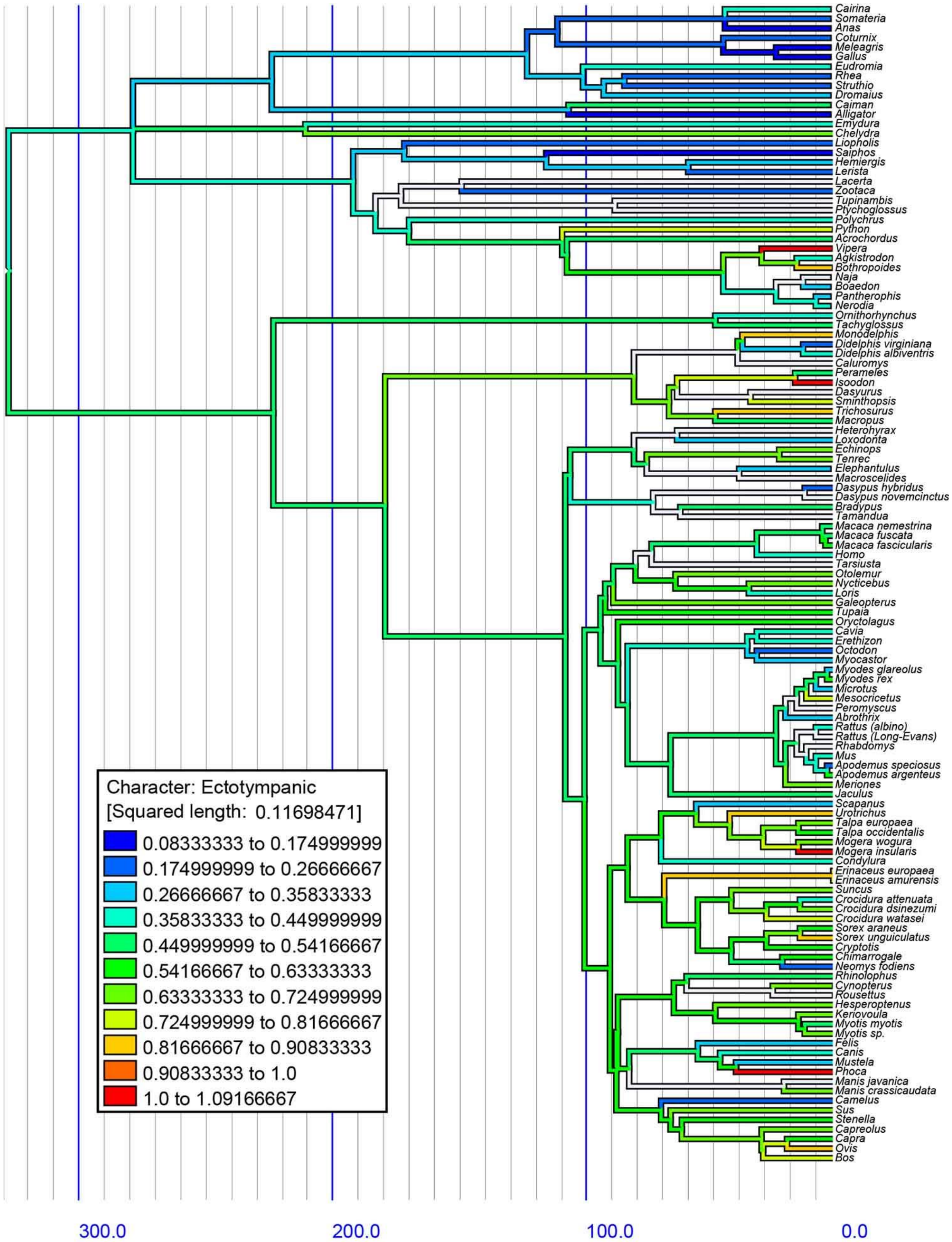
Supplementary Fig. 16. Reconstructed heterochrony of relative timing of the basioccipital, using squared-change parsimony.



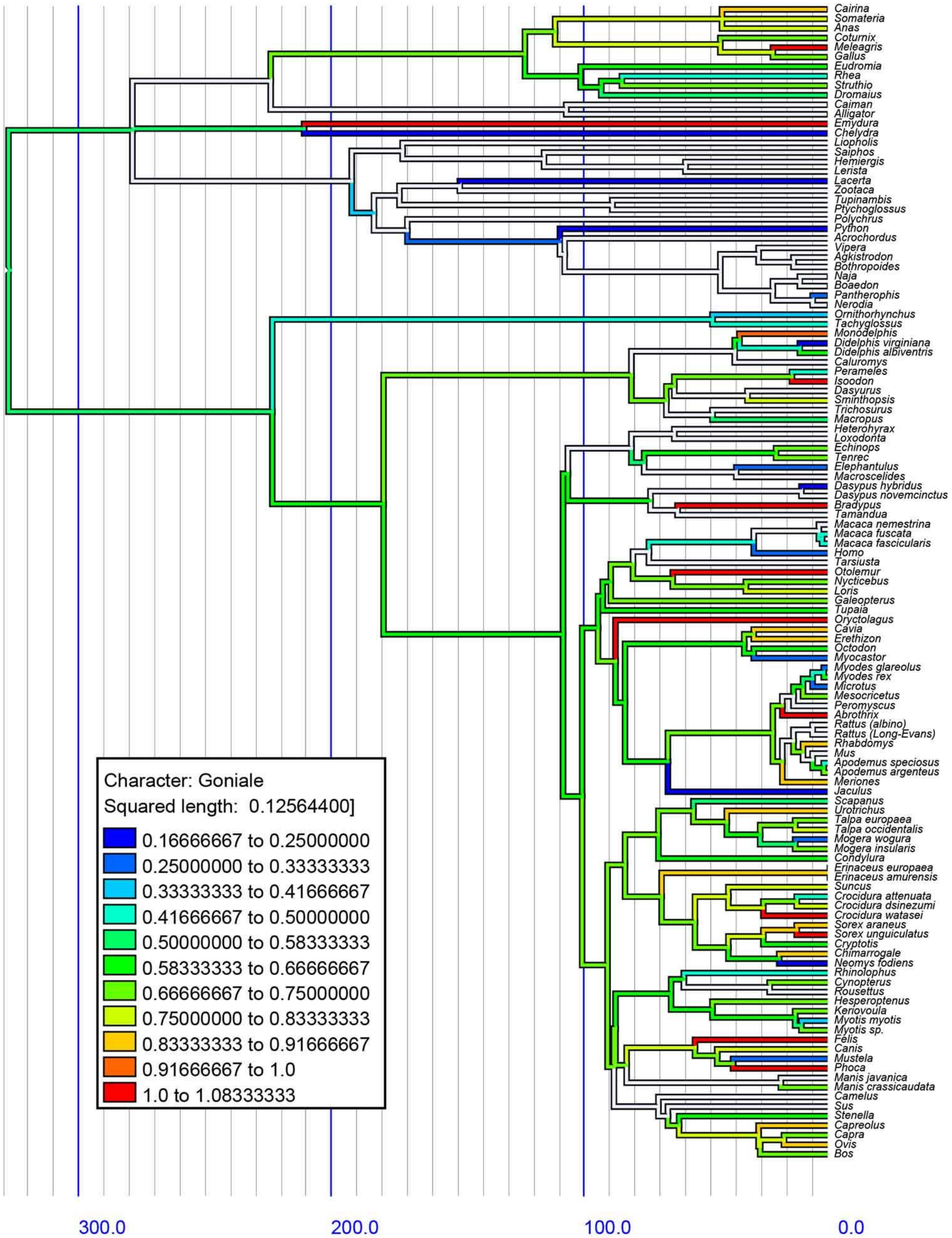
Supplementary Fig. 17. Reconstructed heterochrony of relative timing of the supraoccipital, using squared-change parsimony.



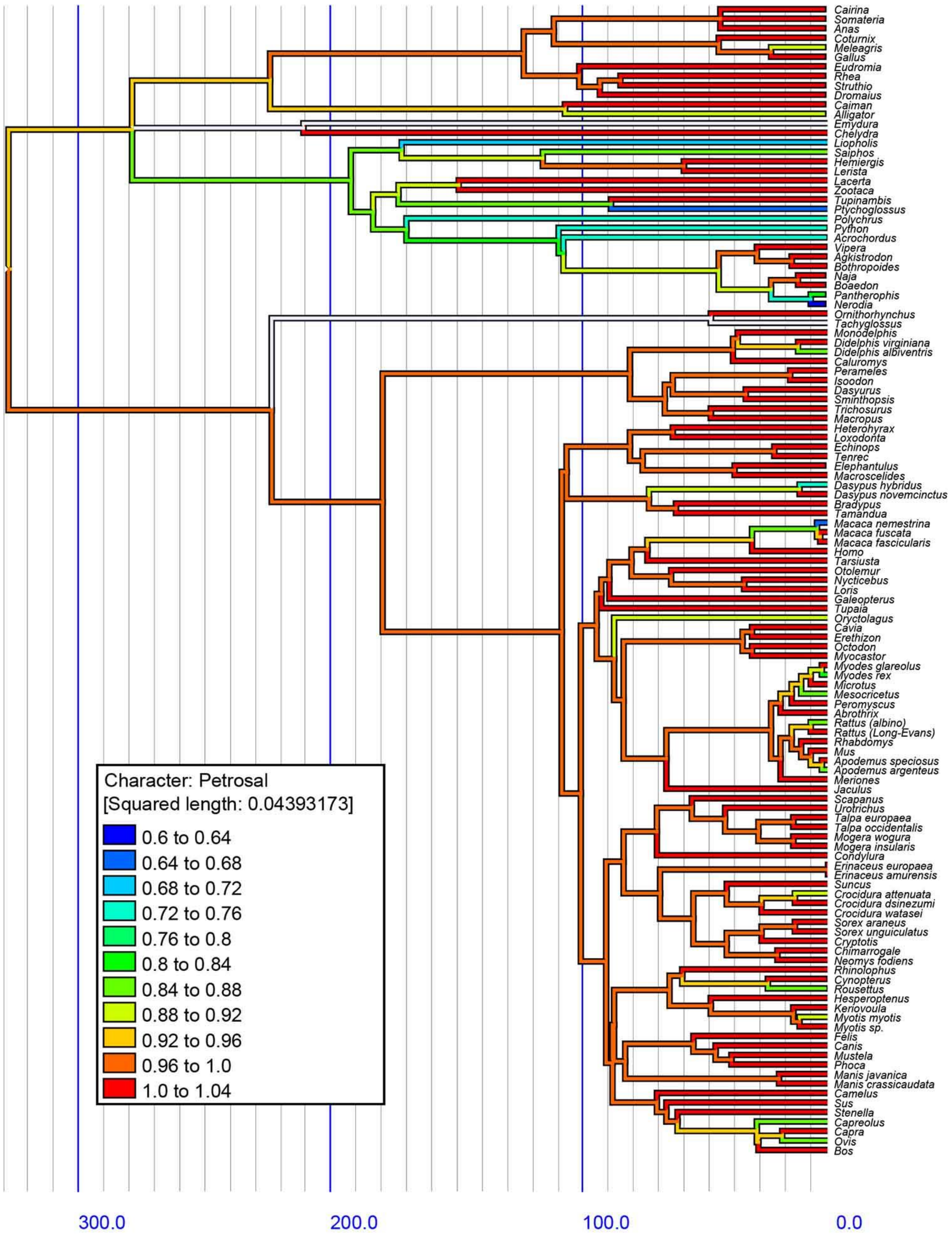
Supplementary Fig. 18. Reconstructed heterochrony of relative timing of the exoccipital, using squared-change parsimony.



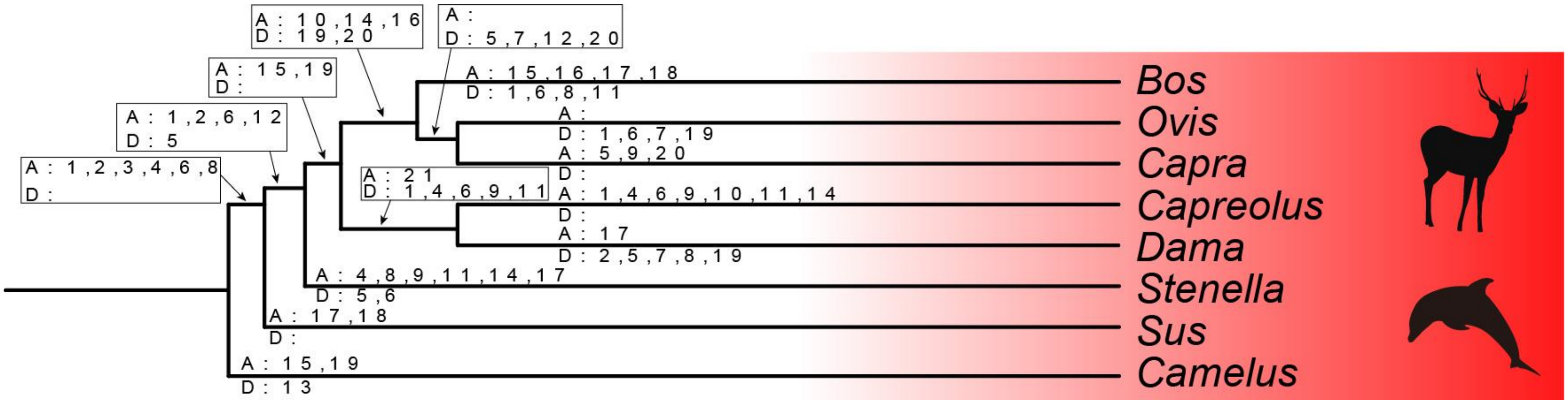
Supplementary Fig. 19. Reconstructed heterochrony of relative timing of the ectotympanic, using squared-change parsimony.



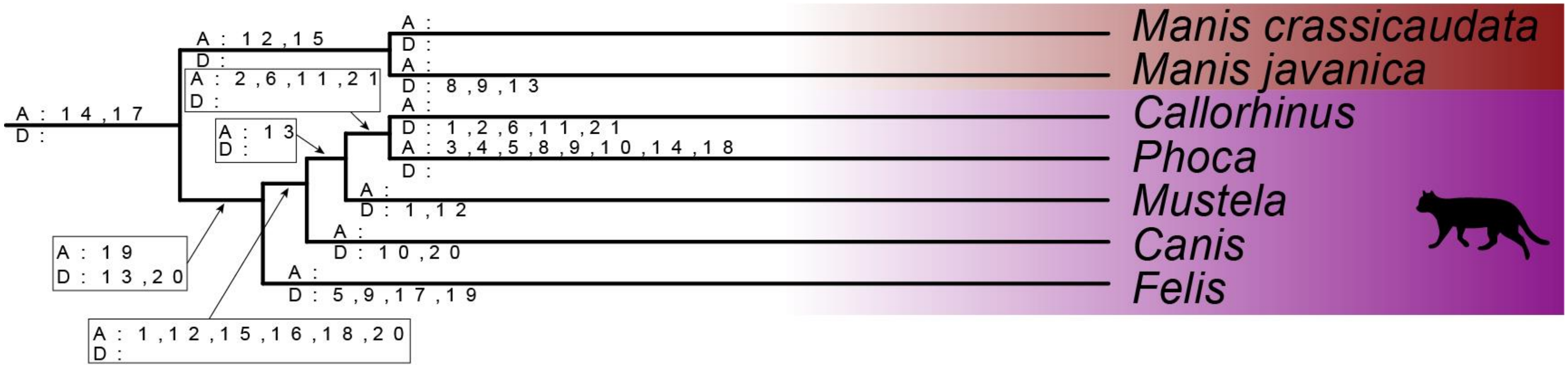
Supplementary Fig. 20. Reconstructed heterochrony of relative timing of the goniale, using squared-change parsimony.



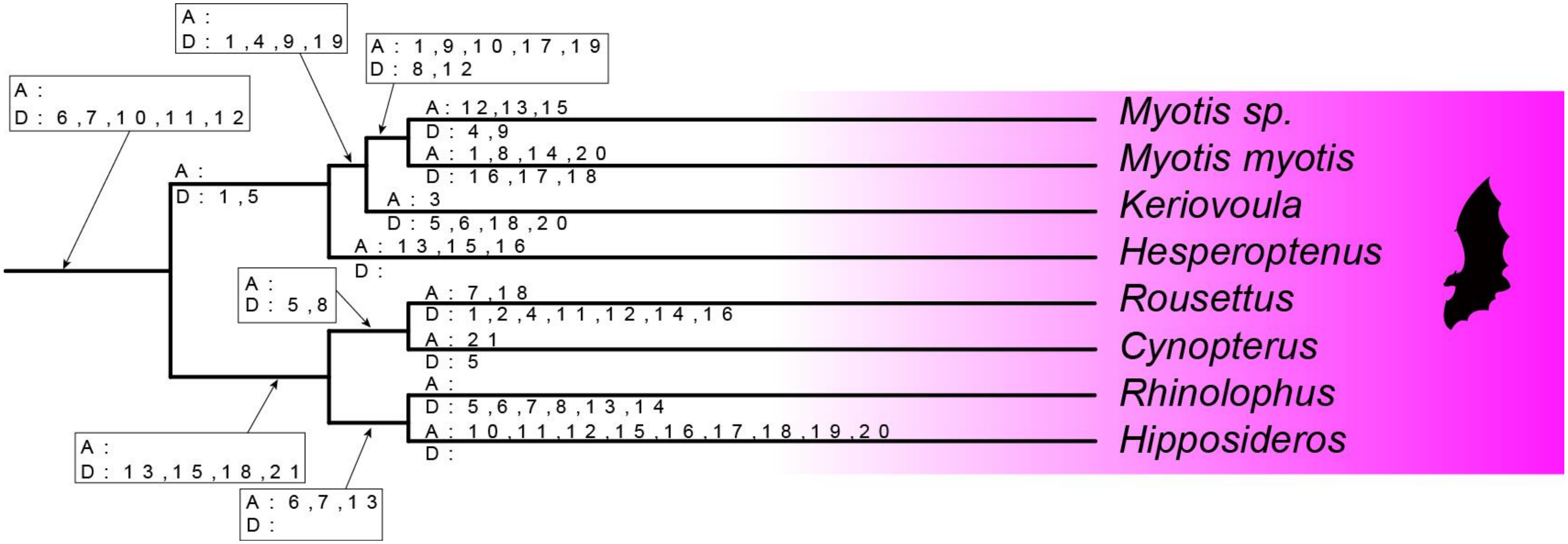
Supplementary Fig. 21. Reconstructed heterochrony of relative timing of the petrosal, using squared-change parsimony.



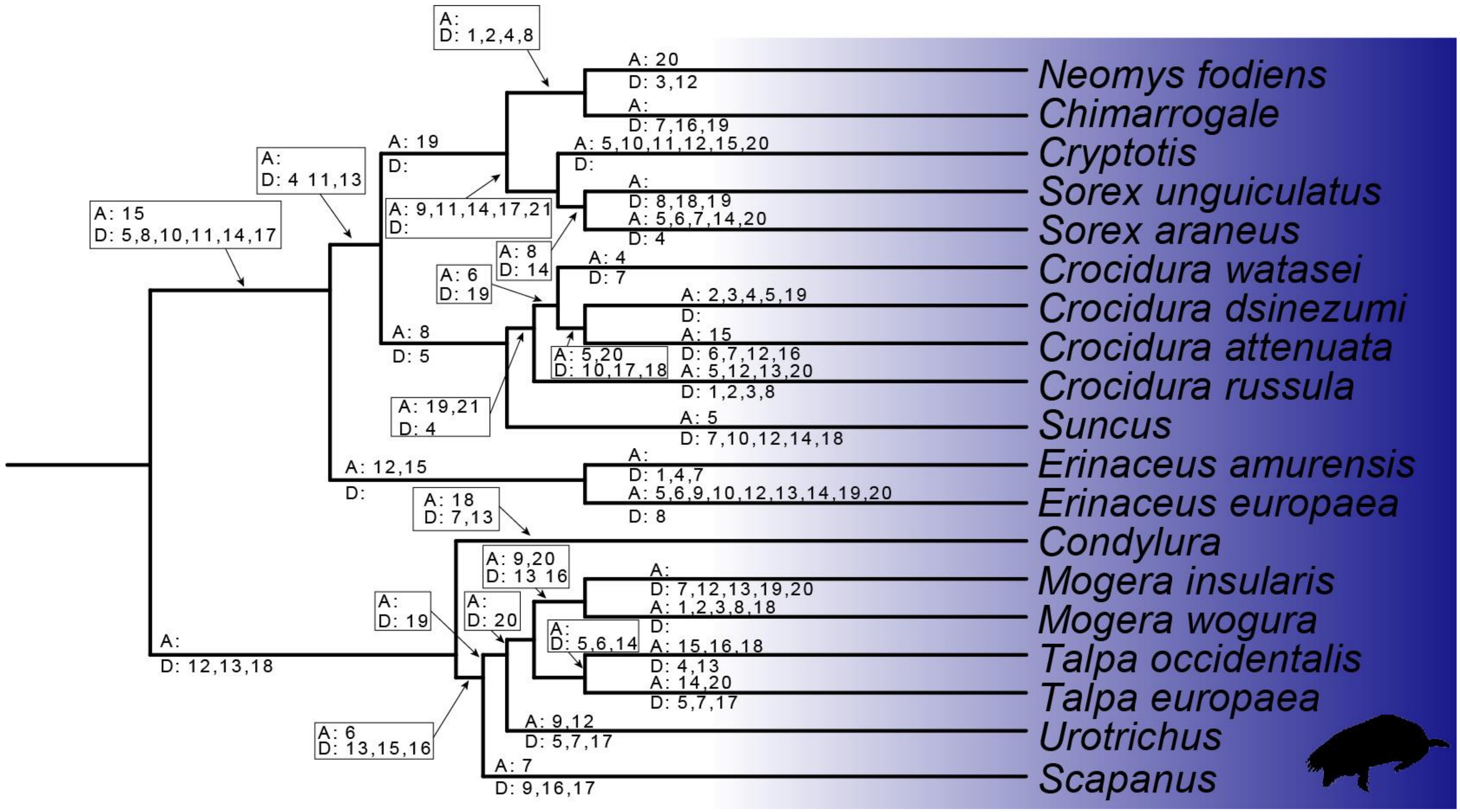
Supplementary Fig. 22. Sequence shifts recovered by the PGi analysis for inclusive clades (Cetartiodactyls). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.



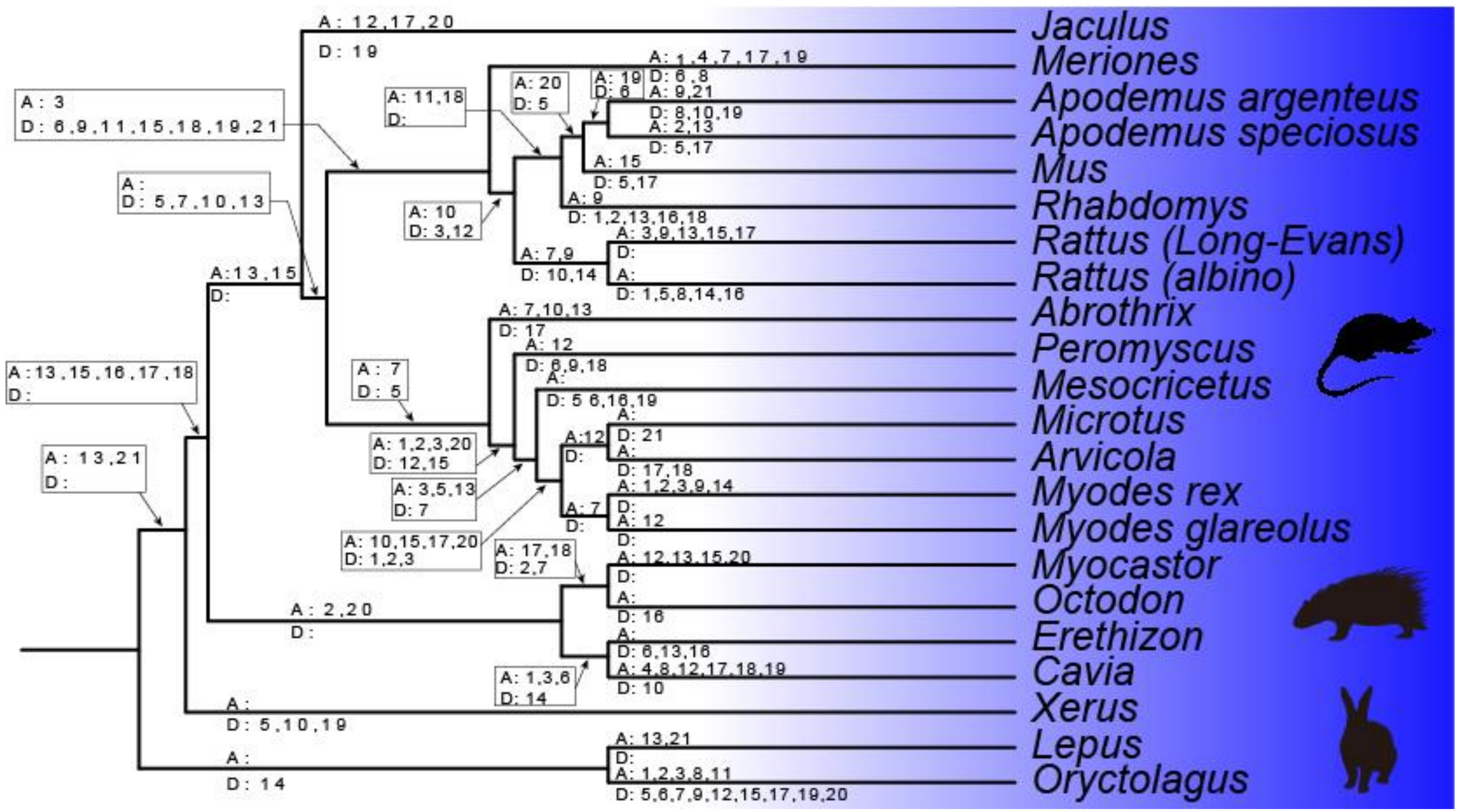
Supplementary Fig. 23. Sequence shifts recovered by the PGi analysis for inclusive clades (Carnivora and Pholidota). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.



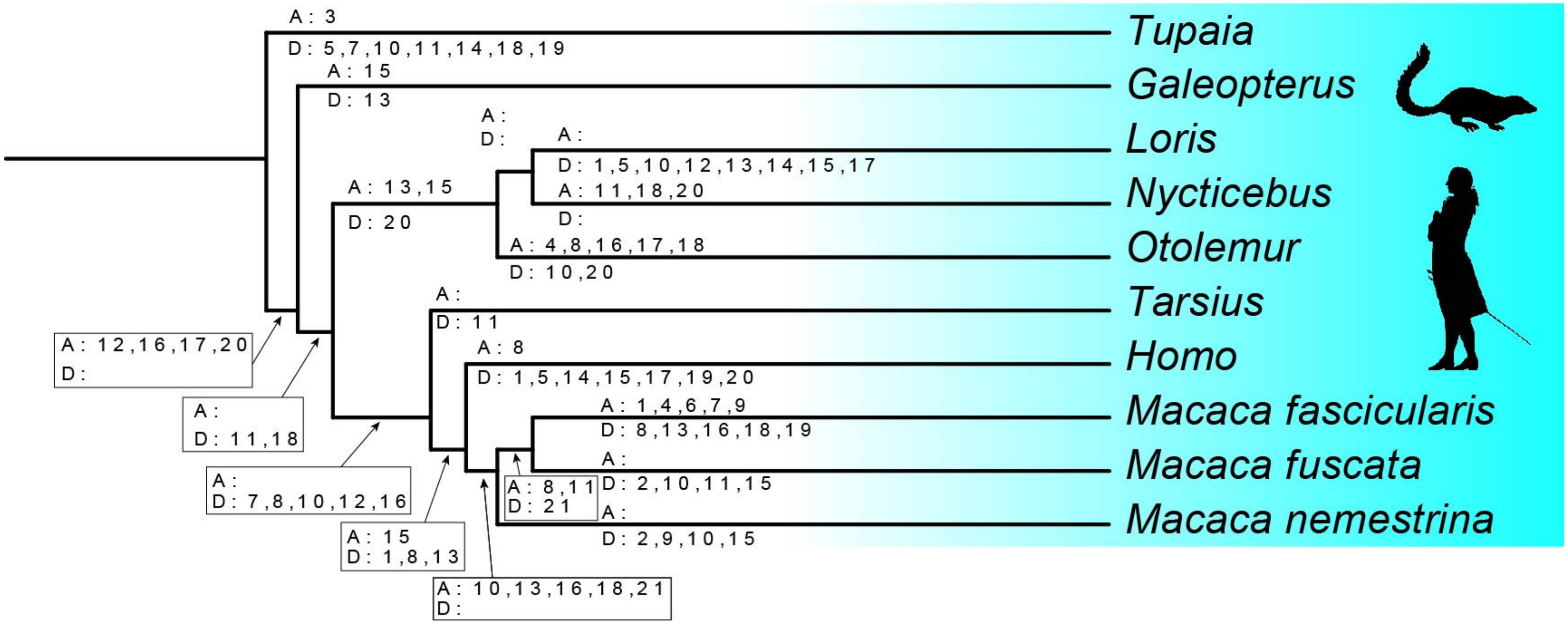
Supplementary Fig. 24. Sequence shifts recovered by the PGi analysis for inclusive clades (Chiroptera). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.



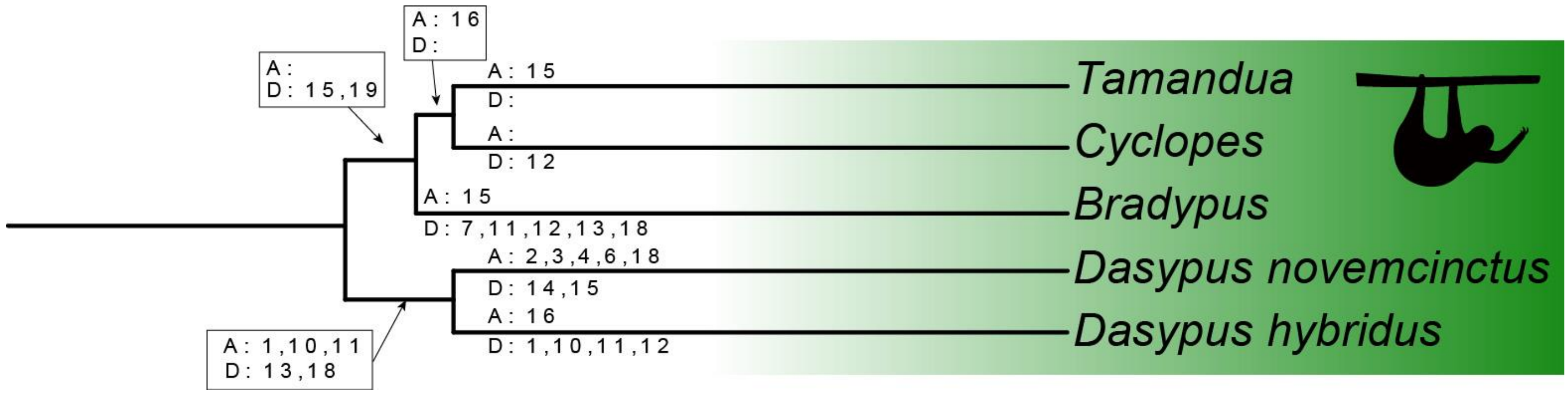
Supplementary Fig. 25. Sequence shifts recovered by the PGi analysis for inclusive clades (Lipotyphla). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.



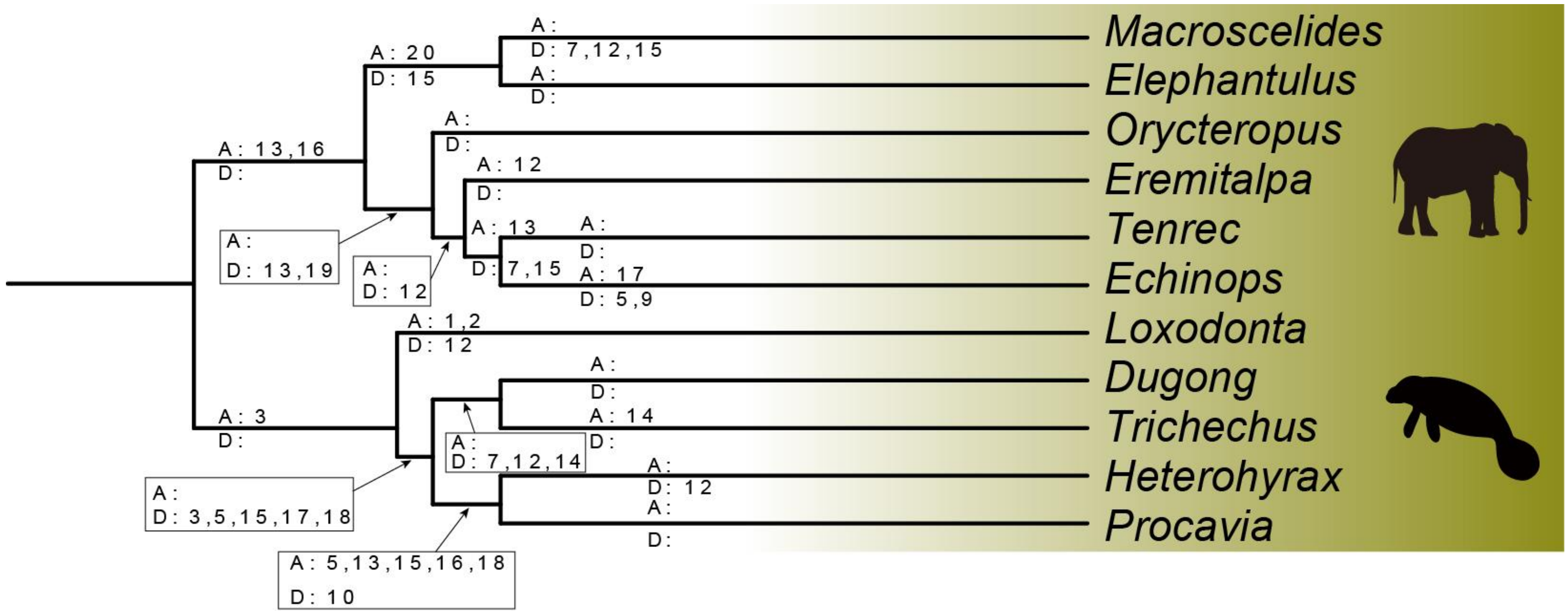
Supplementary Fig. 26. Sequence shifts recovered by the PGi analysis for inclusive clades (Glires). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.



Supplementary Fig. 27. Sequence shifts recovered by the PGi analysis for inclusive clades (Primates, Scandentia, and Dermoptera). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.



Supplementary Fig. 28. Sequence shifts recovered by the PGi analysis for inclusive clades (Xenarthra). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.



Supplementary Fig. 29. Sequence shifts recovered by the PGi analysis for inclusive clades (Afrotheria). Abbreviations: A, acceleration; D, delay. See Fig. 2 for element identities.

Supplementary Table 1. References and calculation of divergence time of each node of the composed topology. Reference 1 = chapters of the *Timetree of Life*". Age 1 = age as inferred in Reference 1; Reference 2 = literature reference for the age of a subclade; Age 2 = age as inferred in Reference 2; * = indicates the overlap of a major node of Reference 1 and the deepest node in Reference 2: for this overlap a Factor was calculated between Age 1 and Age 2, which was then used to calculate Age 3 in the related subclades of this clade in order to normalize Age 2 to the consistent, amniote wide age estimate of Reference 1 (Age 1). Age 3 = inferred divergence time of each node used to scale the composed topology. If no reference was available for the age of a particular node, the branch lengths of the containing subclades were evently distributed. If not the exact taxon composition was compared in Reference 1 and 2, a comment is made to Reference 2. Ages in million years, rounded to two decimal places. Node numbers of terminal taxa (species) are not listed and their age was set to 0.

Node	Taxon name	Reference 1 (*Timetree of Life*)	Age 1	Reference 2	Age 2	Factor	Age 3
2	Amniota	Shedlock and Edwards [1]	324.5	-	-	-	324.5
3	Sauropsida	Shedlock and Edwards [1]	274.9	-	-	-	274.9
4	Archosauria	Shedlock and Edwards [1]	219.2	-	-	-	219.2
5	Aves	van Tuinen [2]	119	-	-	-	119
6	Galloanserae	Pereia and Baker [3]	106.90*	Slack [4]	77.1	1.39	106.9
7	Anatidae	-	-	Slack [4]	29.6	1.39	41
11	Phasanidae (Galliformes)	-	-	Slack [4]	29.9	1.39	41.5
13	*Meleagris /Gallus*	-	-	-	-	-	20.75
16	Palaeognathae	Baker and Pereia [5]	96.7	-	-	-	96.7
18	*Dromaius +Rhea/Struthio*	-	-	-	-	-	88.65
19	*Rhea /Struthio*	Baker and Pereia [5]	80.6	-	-	-	80.6
23	Crocodylia	Brochu [6]	102.6	-	-	-	102.6
26	Testudines	Shaffer [7]	207	-	-	-	207
29	Unidentata (Scincidae+Lacertata)	Hedges and Vidal [8]	188.30*	Vidal and Hedges [9]	215	0.88	188.3
30	Scincidae	-	-	Vidal and Hedges [9]	min. 192	0.88	min. 168.20
32	NN	-	-	-	-	-	112.13
34	NN	-	-	-	-	-	56.07
37	Episquamata	Hedges and Vidal [8]	179.7	-	-	-	179.7
38	Lacertata	Hedges and Vidal [8]	169.30*	Vidal and Hedges [9]	177	0.96	169.3

39	Lacertiformes	-	-	Vidal and Hedges [9]	min. 152	0.96	min. 145.4
42	Teiioidea	Hedges and Vidal [8]	85.5	Vidal and Hedges [9]	min. 177	0.96	85.5
45	*Polychrus* +Serpentes	Hedges and Vidal [8]	166.4	-	-	-	166.4
47	Alethinophidia (Serpentes)	Vidal et al. [10]	105.80*	Burbik and Pyron [9]	93.5	1.13	105.8
49	Caenophidia	Vidal et al. [10]	103.7	-	-	-	103.7
51	Colubroidea	-	-	Burbik and Pyron [9]	37.2	1.13	42.1
52	Viperidae	-	-	Burbik and Pyron [9]	23.8	1.13	26.9
54	Crotlinae	-	-	-	-	-	13.45
57	NN	-	-	-	-	-	21.05
58	NN	-	-	-	-	-	10.05
61	Colubridae	-	-	-	-	-	5.38
64	Mammalia	Madsen [11]	220.2	-	-	-	220.2
65	Monotremata	Springer and Krajewski [12]	45.9	-	-	-	45.9
68	Theria	Madsen [11]	176.1	-	-	-	176.1
69	Marsupialia	Springer et al. [12]	78.1	-	-	-	78.1
70	Didelphimorphia	Springer et al. [12]	37.40*	Bininda-Emonds et al. [13]	56.1	0.67	37.4
71	Didelphidae	-	-	Bininda-Emonds et al. [13]	52.4	0.67	34.9
73	*Didelphis*	-	-	Bininda-Emonds et al. [13]	17.3	0.67	11.5
77	*Peramelis/Dasyurus*+Phalangeridae	Springer et al. [12]	63.90*	Bininda-Emonds et al. [13]	54.5	1.17	63.9
78	*Peramelis/Dasyurus*	Springer et al. [12]	60.7	Meredith (2008)	60	1.17	60.7
79	Perameliidae	-	-	Bininda-Emonds et al. [13]	12.2	1.17	14.3
82	Dasyuridae	-	-	Bininda-Emonds et al. [13]	27.4	1.17	32.1
85	Phalangeridae (Trichosurus)/Macropodidae (*Macropus*)	Springer et al. [12]	46.1	-	-	-	46.1
88	Placentalia	Murphy and Eizirik [14]	104.7	-	-	-	104.7
89	Atlantogenata	Murphy and Eizirik [14]	103.3	-	-	-	103.3
90	Afrotheria	Murphy and Eizirik [14]	77.8	-	-	-	77.8
91	Proboscidae/Hydacoidea	Murphy and Eizirik [14]	61.1	-	-	-	61.1
94	Macroscelidae/Afrosoricida	Murphy and Eizirik [14]	73.00*	Poux et al. [15]	71	1	73
95	Tenrecidae	-		Poux et al. [15]	21	1	21
98	Macroscelididae	-	-	-	-	-	36.5
101	Xenarthra	Dulcec et al. [16]	70.50*	Bininda-Emonds et al. [13]	72.5	0.97	70.5
102	*Dasypus*	-	-	Bininda-Emonds et al. [13]	11.1	0.97	10.8
105	Pilosa	Dulcec et al. [16]	60	-	-	-	60
108	Boreoeutheria	Murphy and Eizirik [14]	97.4	-	-	-	97.4
109	Euarchontoglires	Murphy and Eizirik [14]	91	-	-	-	91

110	Euarchonta	Murphy and Eizirik [14]	89.1	-	-	-	89.1
111	*Galeopterus* + Primates	Murphy and Eizirik [14]	86.2	-	-	-	86.2
112	Primates	Steiper and Young [17]	77.5	-	-	-	77.5
113	Haplorhini	Steiper and Young [17]	71.1	-	-	-	71.1
114	Catarrhini	Steiper and Young [17]	29.60*	Perelman et al. [18]	31.56	0.94	29.6
115	*Macaca nemestrina/M. fuscata/M. fascicularis)*	-		Perelman et al. [18]	4.13	0.94	4
117	*Macaca fuscata/M. fascicularis*	-		Perelman et al. [18]	2.77	0.94	2.7
122	Strepsirrhini	Steiper and Young [17]	61.90*	Perelman et al. [18]	40.34	1.53	61.9
124	Lorisinae	-	-	Perelman et al. [18]	21.14	1.53	32.4
129	Glires	Murphy and Eizirik [14]	86.4	-	-	-	86.4
131	Rodentia (*Cavia/Mus*)	Honeycutt [19]	82.8	-	-	-	82.8
132	Caviomorpha	Honeycutt [19]	35.3	-	-	-	35.3
133	*Cavia/Erethizon*	Honeycutt [19]	31.7	-	-	-	31.7
136	*Octodon/Myocastor*	Honeycutt [19]	32	-	-	-	32
139	*Jaculus/Mus*	Honeycutt [19]	66	-	-	-	66
140	Muridae+Cricetidae	Honeycutt [19]	24	-	-	-	24
141	NN	-	-	-	-	-	20
142	NN	-	-	-	-	-	16
143	*Mesocricetus/Microtus*	-	-	-	-	-	12
144	NN	-	-	-	-	-	8
145	NN	-	-	-	-	-	4
152	Muridae	-	-	-	-	-	20
153	*Mus/Rattus*	-	-	-	-	-	16
154	*Rattus*	-	-	-	-	-	8
157	NN	-	-	-	-	-	12
159	*Apodemus/Mus*	-	-	-	-	-	8
161	*Apodemus*	-	-	-	-	-	4
166	Laurasiatheria	Murphy and Eizirik [14]	87.2	-	-	-	87.2
167	Eulipothyphla	Douady and Douzery [20]	80.5	-	-	-	80.5
168	NN	-	-	-	-	-	67.1
169	NN	-	-	-	-	-	53.7
171	NN	-	-	-	-	-	40.25
173	NN	-	-	-	-	-	26.8
174	*Talpa occidentalis/europoaea*	-	-	-	-	-	13.4
177	NN	-	-	-	-	-	13.4
181	Erinaceidae/Soricidae	Douady and Douzery [20]	66.2	-	-	-	66.2

182	Erinaceus	-	-	-	-	-	33.1
185	*Crocidura+Suncus/Sorex*	-	-	-	-	-	52.96
186	*Crocidura/Suncus*	-	-	-	-	-	39.72
188	*Crocidura*	-	-	-	-	-	26.48
189	NN	-	-	-	-	-	13.24
193	*Sorex/Cryptotis/Chimarrogale*	-	-	-	-	-	39.72
194	NN	-	-	-	-	-	26.8
195	*Sorex*	-	-	-	-	-	13.4
199	*Chimarrogale/Neomys*	-	-	-	-	-	13.24
202	Pegasoferae/Cetartiodactyla	Murphy and Eizirik [14]	84.6	-	-	-	84.6
203	Pegasoferae (Chiroptera/Ferae)	Murphy and Eizirik [14]	84.2	-	-	-	84.2
204	Chiroptera	Teeling [21]	62.00*	Bininda-Emonds et al. [13]	74.9	0.83	62
205	Pteropodidae+Rhinolophidae	Teeling [21]	57.5	-	-	-	57.5
207	Pteropodidae	-	-	Bininda-Emonds et al. [13]	27.3	0.83	22.6
210	Vespertilionidae	-	-	Bininda-Emonds et al. [13]	56	0.83	46.4
212	NN	-	-	Bininda-Emonds et al. [13]	15.8	0.83	13.1
214	*Myotis*	-	-	Bininda-Emonds et al. [13]	12.9	0.83	10.7
217	Ferae (Carnivora/Pholidota(*Manis*))	Murphy and Eizirik [14]	79.8	-	-	-	79.8
218	Carnivora	Eizirik and Murphy [22]	52.9	-	-	-	52.9
220	Caniformia	Eizirik and Murphy [22]	44	-	-	-	44
222	*Phoca/Mustella*	Eizirik and Murphy [22]	38	-	-	-	38
225	*Manis*	-	-	-	-	-	19
228	Cetartiodactyla	Gatesy [23]	67.30*	Bininda-Emonds et al. [13]	74.1	0.91	67.3
230	*Sus*+Cetacea/Ruminantia	Gatesy [23]	63.5	-	-	-	63.5
232	Cetacea/Ruminantia	Gatesy [23]	59.1	-	-	-	59.1
234	Ruminantia (Capreolus/Bovidae)	Gatesy [23]	27.8	-	-	-	27.8
236	Bovidae	-	-	Bininda-Emonds et al. [13]	29.9	0.91	27.2
237	Caprinae	-	-	Bininda-Emonds et al. [13]	19.6	0.91	17.8

Supplementary Table 2. Reconstructed ossification sequence of the hypothetical common ancestor of Mammalia and Sauropsida (non-mammalian amniotes) using squared-change parsimony. Exact reconstructed value and 78% confidence interval (CI) values are given. Ossification sequence is scaled from 0 to 1. Values for orbitosphenoid and alisphenoid of sauropsid common ancestor are not available because of uncertain homologies of these bones.

		Mammalian last common ancestor			Sauropsid last common ancestor		
Number code	**Bone**	**Reconstructed value**	**Lower 78% CI**	**Upper 78% CI**	**Reconstructed value**	**Lower 78% CI**	**Upper 78% CI**
1	Premaxilla	0.27	-0.02	0.56	0.37	0.12	0.63
2	Maxilla	0.27	0.05	0.48	0.30	0.12	0.49
3	Dentary	0.28	0.10	0.45	0.29	0.14	0.45
4	Frontal	0.41	0.10	0.72	0.49	0.22	0.77
5	Nasal	0.49	0.22	0.75	0.52	0.27	0.76
6	Jugal	0.43	0.13	0.74	0.38	0.09	0.65
7	Lacrimal	0.67	0.29	1.05	0.65	0.27	1.04
8	Parietal	0.45	0.16	0.76	0.48	0.22	0.83
9	Squamosal	0.41	0.11	0.76	0.38	0.11	0.65
10	Vomer	0.51	0.14	0.89	0.54	0.21	0.87
11	Palatine	0.38	-infinity	infinity	0.40	-infinity	infinity
12	Orbitosphenoid	0.86	-infinity	infinity	-	-	-
13	Basisphenoid	0.73	0.38	1.07	0.68	0.38	0.99
14	Pterygoid	0.42	0.11	0.73	0.29	0.02	0.56
15	Alisphenoid	0.67	0.31	1.04	-	-	-
16	Basioccipital	0.66	0.30	1.01	0.76	0.29	1.16
17	Supraoccipital	0.67	0.33	1.01	0.83	0.53	1.13
18	Exoccipital	0.57	0.22	0.93	0.69	0.38	1.00
19	Ectotympanic	0.49	0.21	0.81	0.40	0.16	0.76
20	Goniale	0.57	0.25	0.91	0.53	0.22	0.88
21	Petrosal	0.98	0.80	1.14	0.94	0.78	1.09

Supplementary Table 3. List of life history variables.

Species name	Body wight	Neonatal weight	Gestation length	Brain wieght	EQ	Reference
Tarsius tarsier	125	28.5	191	3.6	0.2450	Gursky [24], Ross [25]
Nycticebus coucang	885	51.24	192	13.6	0.1881	Izard, et al. [26]
Loris tardigradus	322			5.9	0.1530	Silcox, et al. [27], Hansen [28]
Otolemur crassicaudatus	850	52	133	10.3	0.0805	Newman and Hendrickx [29]
Macaca nemestrina	8660	472	175	122	0.4020	Marino [30], Tokuda, et al. [31], Ross [25]
Macaca fuscata	9506	496	173	90.99	0.2444	Barton [32], Fooden and Aimi [33], Ross [25]
Macaca fascicularis	5060	345	164	70	0.3348	Marino [30], Jewett and Dukelow [34], Ross [25]
Homo sapiens	75000	3375	266	1460	0.7806	Hall [35], Ross [25]
Galeopterus variegatus	1300	35	60	7	-0.2249	Pirlot and Kamiya [36], Macdonald [37]
Tupaia belangeri	170	18	45	3.2	0.0942	Tsang and Collins [38], Ferner, et al. [39]
Oryctolagus cuniculus	1411	34	29	8.98	-0.1433	Gibb, et al. [40], Swihart [41]
Lepus sp.	1954	110	42	14.35	-0.0452	Swihart [41]
Abrothrix longipilis	66	3.5	23			Merani and Lizarralde [42], Antinuchi and Busch [43]
Mesocricetus auratus	94	2.5	16	1.12	-0.1684	Barton [32], Labov, et al. [44]
Rattus norvegicus (albino)	184			1.8	-0.1818	West and Kemper [45]
Rattus norvegicus (long-evans)	345	7.5	22	2.15	-0.3078	Troy-Harker and Whishaw [46], Wisniewski, et al. [47], Kalinichev, et al. [48],
Peromyscus melanophrys	45	1.9	23	0.94	-0.0072	Kiltie [49], Svihla [50]
Mus musculus	21	1.3	20	0.43	-0.0976	Laurie [51], Meikle and Westberg [52]
Cavia porcellus	415	94	68	4.6	-0.0373	Laurien-Kehnen and Trillmich [53]
Erethizon dorsatum	5397	504	213	24.6	-0.1403	Shadle [54]
Octodon degu	140	14	90			Mahoney, et al. [55], Long and Ebensperger [56]
Myocastor coypus	7052	207	133			Gosling [57]
Meriones unguiculatus	57	2.8	25.6	1.13	-0.0061	Lesku, et al. [58], McManus [59]
Rhabdomys pumilio	40	2.5	23	0.69	-0.1009	Brooks [60]
Myodes glareolus	18	1.8	18.5	0.52	0.0344	Vihervaara, et al. [61], Mappes, et al. [62]
Myodes rex	38		18.5			Kaneko, et al. [63]
Apodemus speciosus	48	2.4	20	0.54	-0.2681	Fujimaki [64], Oh and Mori [65]
Apodemus argenteus	15	1.7	20	0.312	-0.1302	Koyama [66,]Koyama [67], Fujimaki [64]
Microtus montebelli	35	2.9	21.1			Yoshinaga, et al. [68]
Jaculus jaculus	55	2	25	1.8	0.2100	McNab and Eisenberg [69], Jordan, et al. [70], Happold [71]
Arvicola amphibius	168	5	21	1.64	-0.1928	Bazhan, et al. [72]
Xerus sp.	640	20	48	10.74	0.1908	Skurski and Waterman [73]
Erinaceus europaea	697	16	37	3.77	-0.2917	Symonds [74]
Erinaceus amurensis	600					Japanese Ministry of the Environment [75]
Mogera wogura	129		40			De Magalhaes and Costa [76]
Mogera insularis	57					Lin and Motokawa [77]
Condylura cristata	50	1.5	45	1.37	0.1223	Lesku, et al. [58], Eadie and Hamilton [78]
Scapanus orarius	70	5	35	2.02	0.1819	Carraway, et al. [79]

Talpa europaea	81	3.5	31.5	1.69	0.0592	Symonds [74]
Talpa occidentalis	45	3	28			Barrionuevo, et al. [80]
Urotrichus talpoides	19					Ishii [81]
Cryptotis parva	5	0.34	21.5			Mock [82], De Magalhaes and Costa [76]
Suncus murinus	36	2.7	30			Dryden, et al. [83], Lesku, et al. [58]
Chimarrogale platycephala	45	1	22	0.9	-0.0261	This study, Furuta [84]
Neomys fodiens	14	1	22			McNab and Eisenberg [69], Stephenson and Racey [85]
Sorex araneus	8	0.45	22	0.25	-0.0019	Symonds [74]
Sorex unguiculatus	10	0.6	24			Inoue [86], Nesterenko and Ohdachi [87]
Crocidura russula	10	0.88	29.6	0.19	-0.2110	Symonds [74]
Crocidura attenuata	10	1.5	29			This study, Fang, et al. [88]
Crocidura dsinezumi	10		29	0.19	-0.1908	Ohno, et al. [89]
Crocidura watasei	6		29			This study
Rousettus aegyptiacus	130	12	120	2.6	0.0910	Giannini, et al. [90], Kurta and Kunz [91]
Myotis myotis	25	5.9	65	0.48	-0.1086	Lesku, et al. [58], De Magalhaes and Costa [76]
Kerivoula sp.	4					This study
Myotis sp.	7	2	60	0.23	-0.0157	De Magalhaes and Costa [76], Eisenberg and Wilson [92]
Rhinolophus thomasi						
Cynopterus sphinx		11	120			De Magalhaes and Costa [76]
Hesperoptenus blanfordi	7					This study
Hipposideros larvatus	14	2.34	158	0.32	-0.0948	De Magalhaes and Costa [76]
Canis familaris	22680	450	63	119	0.0792	De Magalhaes and Costa [76]
Felis catus	5400	97.5	65	30	-0.0542	Burton [93], De Magalhaes and Costa [76]
Mustela sp.	179	2.6	36	4.6	0.2351	De Magalhaes and Costa [76]
Eumetopias jubatus	181000	5900	237	367	-0.1046	York and Scheffer [94], Trites [95]
Phoca sp.						
Sus scrofa	84528	960	115	185.35	-0.1545	Burton [93], De Magalhaes and Costa [76]
Ovis aries	32950	2370	146	125.90	-0.0173	De Magalhaes and Costa [76]
Bos taurus	591562	26000	280	456.04	-0.3939	Camargo, et al. [96], De Magalhaes and Costa [76]
Capra hircus	37068	2250	155	102.57	-0.1445	Burton [93], De Magalhaes and Costa [76]
Dama dama	56234	4500	233	220.80	0.0535	Burton [93], De Magalhaes and Costa [76]
Capreolus capreolus	25119	1010	153	64.42	-0.2204	Burton [93], De Magalhaes and Costa [76]
Camelus dromedarius	400000	760			-0.0453	McNab and Eisenberg [69]
Manis javanica	3500	87	60	11	-0.3495	McNab and Eisenberg [69], Lim and Ng [97]
Manis crassicaudata	15910	235	67			Heusner [98], De Magalhaes and Costa [76], Lim and Ng [97]
Stenella attenuata	65615	10000	345	779.83	0.5515	Burton [93], De Magalhaes and Costa [76]
Dasypus novemcinctus	3401	66	133	7.5	-0.5065	De Magalhaes and Costa [76]
Dasypus hybridus	1900	30	120			Galíndez, et al. [99], Superina, et al. [100]
Bradypus variegatus		340	180			Taube, et al. [101], Hayssen [102]
Cyclopes didactylus	400		135	4.29	-0.0557	McNab and Eisenberg [69], De Magalhaes and Costa [76]
Tamandua tetradactyla	3692	380	160	25	-0.0102	De Magalhaes and Costa [76], San Diego Zoo [103]

Trichechus manatus	**322000**	**32000**	**335**			De Magalhaes and Costa [76]
Dugong dugong	**360000**	**27500**	**374**			De Magalhaes and Costa [76]
Loxodonta africana	3505000	105000	670	4420	0.0161	De Magalhaes and Costa [76]
Echinops telfairi		50	55			De Magalhaes and Costa [76]
Tenrec ecaudatus		25	59.3			Lesku, et al. [58], Stephenson and Racey [85]
Procavia capensis	**2275**					Welker and Carlson [104]
Heterohyrax brucei	**2457**	**225**	**229**			De Magalhaes and Costa [76]
Elephantulus rozeti		10	55			Tripp [105]
Macroscelides proboscideus	**40**	**7**	**19**			De Magalhaes and Costa [76]
Eremitalpa granti	**22.7**		**35**			Stuart and Stuart [106]
Orycteropus afer	**60000**	**1800**	**225**			De Magalhaes and Costa [76]
Monodelphis domestica	103	0.1	15	1	-0.2486	Watson, et al. [107], De Magalhaes and Costa [76]
Caluromys philander	277	0.2	24	3.626	-0.0097	De Magalhaes and Costa [76]
Didelphis albiventris	1500	0.12	12			Nogueira 1988. Tyndale-Biscoe and Mackenzie 1976 Santos et al. 2003
Didelphis virginiana		0.147	12.6			De Magalhaes and Costa [76], Lesku, et al. [58]
Perameles nasuta		0.245	12			De Magalhaes and Costa [76]
Dasyurus viverrnus	813	0.013	19	5.52	-0.1760	Smith [108]
Macropus eugenii	4425	0.37	11	24.55	-0.0768	Gemmell and Selwood [109], Smith [108]
Sminthopsis macroura	17	0.01	12	0.41	-0.0475	De Magalhaes and Costa [76]
Trichosurus vulpecula	1620	0.2	18	11.4	-0.0844	Smith [108]
Isoodon macrourus	822	0.188	12	4.42	-0.2761	De Magalhaes and Costa [76], Weisbecker and Goswami [110]
Ornithorhynchus anatinus	1200	0.5	37	10	-0.0441	Grant and Temple–Smith [111], McNab and Eisenberg [69] *gestation + incubation.
Tachyglossus aculeatus	2544	0.303	34	19	-0.0088	McNab and Eisenberg [69], Rismiller and McKelvey [112-140] *gestation + incubation.
Dromaius novaehollandiae	38000			28.09	-1.0858	Corfield, et al. [114], Blakers, et al. [115]
Rhea americana	20000			22.5	-1.0289	Mlikovsky [116]
Struthio camelus	80000			41.9	-1.0900	Mlikovsky [116]
Eudromia elegans						
Meleagris gallopavo						
Gallus gallus	2580	46.1	21	3.6	-1.3356	Burton [93], Uni, et al. [117], University of Michigan, Museum of Zoology [118]
Coturnix coturnix	186	8.2	18	0.49	-1.5732	Bashir and Javed [119], Tserveni-Gousi [120], Woodard, et al. [121]
Anas platyrhynchos	1100			6.2	-0.8959	Mlikovsky [116]
Cairina moschata						
Somateria mollissima						
Liopholis whitii						
Lerista bougainvillii						
Hemiergis peronii						
Saiphos equalis						
Lacerta agilis	10	5.13	53	0.076	-1.6913	Jensen [122], Amat, et al. [123], Ekner, et al. [124]
Ptychoglossus bicolor						
Tupinambis merianae	97	15				
Zootoca vivipara						

Polychrus acutirostris	20	1.3				Vitt and Lacher [125]
Caiman yacare						
Alligator mississippiensis	67131	67.6	64	6.58	-1.8521	Ferguson [126], Ross [127]
Python sebae		105	87			Branch and Patterson [128], Branch and Erasmus [129], Ott and Secor [130]
Pantherophis alleghaniensis						
Acrochordus granulatus						
Vipera aspis						
Agkistrodon piscivorus						
Bothropoides jararaca						
Naja kaouthia						
Boaedon fuliginosus	202	5.5	60			Boback, et al. [131]
Natrix taxispilota	336					Mills [132]
Emydura subglobosa	500					University of Michigan, Museum of Zoology [118]
Chelydra serpentina	4000	10.8	60	0.98	-2.0054	Yntema [133], Burghardt and Hess [134], University of Michigan, Museum of Zoology [118]

Supplementary Table 4. Standard deviations and coefficients of variation of ossification timing of cranial elements in mammals. Species with more than three ranks were included in the analysis.

Number Code	Bone	Standard deviation	CV
1	Premaxilla	0.16	1.79
2	Maxilla	0.09	1.98
3	Dentary	0.06	3.44
4	Frontal	0.16	1.04
5	Nasal	0.26	0.64
6	Jugal	0.24	0.86
7	Lacrimal	0.30	0.62
8	Parietal	0.23	0.97
9	Squamosal	0.21	0.78
10	Vomer	0.27	0.89
11	Palatine	0.17	0.84
12	Orbitosphenoid	0.17	0.20
13	Basisphenoid	0.23	0.37
14	Pterygoid	0.21	0.83
15	Alisphenoid	0.27	0.43
16	Basioccipital	0.25	0.59
17	Supraoccipital	0.29	0.61
18	Exoccipital	0.25	0.60
19	Ectotympanic	0.25	0.53
20	Goniale	0.28	0.45
21	Petrosal	0.08	0.08

Supplementary references

1. Shedlock, A. M. & Edwards, S. V. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 375-379 (Oxford University Press, 2009).
2. van Tuinen, M. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 409-411 (Oxford University Press, 2009).
3. Pereia, S. L. & Baker, A. J. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 415-418 (Oxford University Press, 2009).
4. Slack, K. E. *Avian phylogeny and divergence times based on mitogenomic sequence* PhD thesis. Massey University (2012).
5. Baker, A. J. & Pereia, S. L. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 412-414 (Oxford University Press, 2009).
6. Brochu, C. A. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 402-406 (Oxford University Press, 2009).
7. Shaffer, H. B. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 398-401 (Oxford University Press, 2009).
8. Hedges, S. B. & Vidal, N. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 383-389 (Oxford University Press, 2009).
9. Vidal, N. & Hedges, S. B. The phylogeny of squamate reptiles (lizards, snakes, and amphisbaenians) inferred from nine nuclear protein-coding genes. *C. R. Biol.* **328**, 1000-1008 (2005).
10. Vidal, N., Rage, J.-C., Couloux, A. & Hedges, S. B. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 390-397 (Oxford University Press, 2009).
11. Madsen, O. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 459-461 (Oxford University Press, 2009).
12. Springer, M. S., Krajewski, C. W. & Meredith, R. W. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 466-470 (Oxford University Press, 2009).
13. Bininda-Emonds, O. R. P. *et al.* The delayed rise of present-day mammals. *Nature* **446**, 507-512 (2007).
14. Murphy, W. J. & Eizirik, E. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 471-474 (Oxford University Press, 2009).
15. Poux, C., Madsen, O., Glos, J., de Jong, W. W. & Vences, M. Molecular phylogeny and divergence times of Malagasy tenrecs: influence of data partitioning and taxon sampling on dating analyses. *BMC Evol. Biol.* **8**, 102 (2008).
16. Dulcec, F. & P, D. E. J. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 475-478 (Oxford University Press, 2009).
17. Steiper, M. E. & Young, N. M. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 482-486 (Oxford University Press, 2009).
18. Perelman, P. *et al.* A molecular phylogeny of living primates. *PLoS Genet.* **7**, e1001342 (2011).
19. Honeycutt, R. L. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 490-494 (Oxford University Press, 2009).
20. Douady, C. J. & Douzery, E. J. P. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 495-498 (Oxford University Press, 2009).
21. Teeling, E. C. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 499-503 (Oxford University Press, 2009).
22. Eizirik, E. & Murphy, W. J. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 504-507 (Oxford University Press, 2009).
23. Gatesy, J. in *The TimeTree of Life* (eds Hedges, S. B. & Kumar, S.) 511-515 (Oxford University Press, 2009).
24. Gursky, S. Allocare in a nocturnal primate: Data on the spectral tarsier, *Tarsius spectrum*. *Folia Primatol.* **71**, 39-54 (2000).
25. Ross, C. Life history patterns of New World monkeys. *Int. J. Primatol.* **12**, 481-502 (1991).
26. Izard, M. K., Weisenseel, K. & Ange, R. Reproduction in the slow loris (*Nycticebus coucang*). *Am. J. Primatol.* **16**, 331-339 (2005).
27. Silcox, M. T., Benham, A. E. & Bloch, J. I. Endocasts of *Microsyops* (Microsyopidae, Primates) and the evolution of the brain in primitive primates. *J. Hum. Evol.* **58**, 505-521 (2010).
28. Hansen, T. F. The Evolution of Genetic Architecture. *Annu. Rev. Ecol. Evol. Syst* **37** (2006).

29. Newman, L. & Hendrickx, A. Fetal development in the normal thick-tailed bushbaby (*Galago crassicaudatus panganiensis*). *Am. J. Primatol.* **6**, 337-355 (1984).
30. Marino, L. A comparison of encephalization between odontocete cetaceans and anthropoid primates. *Brain Behav. Evol.* **51**, 230-238 (1998).
31. Tokuda, K., Simons, R. C. & Jensen, G. D. Sexual behavior in a captive group of pigtailed monkeys (*Macaca nemestrina*). *Primates* **9**, 283-294 (1968).
32. Barton, R. A. Binocularity and brain evolution in primates. *Proc. Nat. Acad. Sci. U.S.A.* **101**, 10113-10115 (2004).
33. Fooden, J. & Aimi, M. Birth-season variation in Japanese macaques, *Macaca fuscata*. *Primates* **44**, 109-117 (2003).
34. Jewett, D. & Dukelow, W. R. Cyclicity and gestation length of *Macaca fascicularis*. *Primates* **13**, 327-332 (1972).
35. Hall, M. H. Definitions used in relation to gestational age. *Paediatr. Perinat. Epidemiol.* **4**, 123-128 (1990).
36. Pirlot, P. & Kamiya, T. Relative size of brain and brain components in three gliding placentals (Dermoptera: Rodentia). *Can. J. Zool.* **60**, 565-572 (1982).
37. Macdonald, D. W. *The Encyclopedia of Mammals* (Oxford University Press, 2009).
38. Tsang, W. & Collins, P. Techniques for hand-rearing tree-shrews (*Tupaia belangeri*) from birth. *Zoo Biol.* **4**, 23-31 (1985).
39. Ferner, K., Zeller, U., Schmelting, B. & Fuchs, E. Ontogenetic and lung development in *Tupaia belangeri* during the early postnatal period. *Mamm. Biol.* **75**, 95-105 (2010).
40. Gibb, J. A., Chapman, J. & Flux, J. in *Rabbits, Hares, and Pikas: Status Survey and Conservation Action Plans* (eds Chapman, J. A. & Flux, J. E. C.) 116-120 (IUCN, 1990).
41. Swihart, R. K. Body size, breeding season length, and life history tactics of lagomorphs. *Oikos* **43**, 282-290 (1984).
42. Merani, M. S. & Lizarralde, M. S. *Akodon molinae* (Rodentia Cricetidae), a new laboratory animal: breeding, management and reproductive performance. *Lab. Anim.* **14**, 129-131 (1980).
43. Antinuchi, C. D. & Busch, C. Reproductive energetics and thermoregulatory status of nestlings in pampas mice *Akodon azarae* (Rodentia: Sigmodontinae). *Physiol. Biochem. Zool.* **74**, 319-324 (2001).
44. Labov, J. B., William Huck, U., Vaswani, P. & Lisk, R. D. Sex ratio manipulation and decreased growth of male offspring of undernourished golden hamsters (*Mesocricetus auratus*). *Behav. Ecol. Sociobiol.* **18**, 241-249 (1986).
45. West, C. D. & Kemper, T. L. The effect of a low protein diet on the anatomical development of the rat brain. *Brain Res.* **107**, 221-237 (1976).
46. Troy-Harker, K. & Whishaw, I. Q. Place and matching-to-place spatial learning affected by rat inbreeding (Dark–Agouti, Fischer 344) and albinism (Wistar, Sprague–Dawley) but not domestication (wild rat vs. Long–Evans, Fischer–Norway). *Behav. Brain Res.* **134**, 467-477 (2002).
47. Wisniewski, A. B., Klein, S. L., Lakshmanan, Y. & Gearhart, J. P. Exposure to genistein during gestation and lactation demasculinizes the reproductive system in rats. *J. Urol.* **169**, 1582-1586 (2003).
48. Kalinichev, M., Easterling, K. W., Plotsky, P. M. & Holtzman, S. G. Long-lasting changes in stress-induced corticosterone response and anxiety-like behaviors as a consequence of neonatal maternal separation in Long–Evans rats. *Pharmacol. Biochem. Behav.* **73**, 131-140 (2002).
49. Kiltie, R. A. Intraspecific variation in the mammalian gestation period. *J. Mammal.* **63**, 646-652 (1982).
50. Svihla, A. *A comparative life history study of the mice of the genus Peromyscus* (University of Michigan Press, 1932).
51. Laurie, E. The reproduction of the house-mouse (*Mus musculus*) living in different environments. *Proc. R. Soc. Lond., B, Biol. Sci.* **133**, 248-281 (1946).
52. Meikle, D. & Westberg, M. Maternal nutrition and reproduction of daughters in wild house mice (*Mus musculus*). *Reproduction* **122**, 437-442 (2001).
53. Laurien-Kehnen, C. & Trillmich, F. Maternal food restriction delays weaning in the guinea pig, *Cavia porcellus*. *Anim. Behav.* **68**, 303-312 (2004).
54. Shadle, A. R. Gestation period in the porcupine, *Erethizon dorsatum dorsatum*. *J. Mammal.* **29**, 162-164 (1948).
55. Mahoney, M. M., Rossi, B. V., Hagenauer, M. H. & Lee, T. M. Characterization of the estrous cycle in *Octodon degus*. *Biol. Reprod.* **84**, 664-671 (2011).

56. Long, C. & Ebensperger, L. Pup growth rates and breeding female weight changes in two populations of captive bred degus (Octodon degus), a precocial caviomorph rodent. *Reprod. Domest. Anim.* **45**, 975-982 (2010).
57. Gosling, L. Selective abortion of entire litters in the coypu: adaptive control of offspring production in relation to quality and sex. *Am. Nat.* **127**, 772-795 (1986).
58. Lesku, J. A., Roth, T. C., Rattenborg, N. C., Amlaner, C. J. & Lima, S. L. Phylogenetics and the correlates of mammalian sleep: a reappraisal. *Sleep Med. Rev.* **12**, 229-244 (2008).
59. McManus, J. J. Early postnatal growth and the development of temperature regulation in the Mongolian gerbil, *Meriones unguiculatus*. *J. Mammal.* **52**, 782-792 (1971).
60. Brooks, P. Aspects of the reproduction, growth and development of the four-striped field mouse, *Rhabdomys pumilio* (Sparrman, 1784). *Mammalia* **46**, 53-64 (1982).
61. Vihervaara, H., Sundell, J. & Ylönen, H. Is mating alone enough to inhibit infanticide in male bank voles? *Ethology* **116**, 888-894 (2010).
62. Mappes, T. *et al.* Island selection on mammalian life-histories: genetic differentiation in offspring size. *BMC Evol. Biol.* **8**, 296 (2008).
63. Kaneko, Y., Nakata, K., Saitoh, T., Stenseth, N. C. & Bjørnstad, O. N. The biology of the vole *Clethrionomys rufocanus*: a review. *Res. Popul. Ecol.* **40**, 21-37 (1998).
64. Fujimaki, Y. Japanese Mammals (9) Rodentia, *Apodemus*. *Mammalian Science (Honyurui Kagaku)* **10**, 1-11 (1970).
65. Oh, H. S. & Mori, T. Growth, development and reproduction in captive of the large Japanese field mouse, *Apodemus speciosus* (Rodentia, Muridae). *Journal of the Faculty of Agriculture, Kyushu University* **42**, 397-408 (1998).
66. Koyama, S. On the growth and development of *Apodemus argenteus* under laboratory conditions. *Mammalian Science (Honyurui Kagaku)* **33**, 109-122 (1994).
67. Koyama, S. Reproductive activity of the japanese long-tailed field mouse *Apodemus argenteus* under laboratory conditions. *J. Mammal. Soc. Jp.* **20**, 117-124 (1995).
68. Yoshinaga, Y., Okayama, T., Ohno, W. & Shiraishi, S. Growth, development, and reproductive patterns in the Japanese field vole, *Microtus montebelli*. *J. Mammal.* **78**, 830-838 (1997).
69. McNab, B. K. & Eisenberg, J. F. Brain size and its relation to the rate of metabolism in mammals. *Am. Nat.* **133**, 157-167 (1989).
70. Jordan, B., Vercammen, P. & Cooper, K. L. Husbandry and breeding of the lesser Egyptian Jerboa, *Jaculus jaculus*. *Cold Spring Harb. Protoc.* **2011**, 1457-1461 (2011).
71. Happold, D. Reproduction and development of the Sudanese jerboa, *Jaculus jaculus butleri* (Rodentia, Dipodidae). *J. Zool.* **162**, 505-515 (1970).
72. Bazhan, N. M., Makarova, E. N. & Yakovleva, T. V. Deprivation of food during pregnancy and reproduction in the water vole (*Arvicola terrestris*). *J. Mammal.* **77**, 1078-1084 (1996).
73. Skurski, D. A. & Waterman, J. M. *Xerus inauris*. *Mammalian Species* **781**, 1-4 (2005).
74. Symonds, M. R. E. Life histories of the Insectivora: the role of phylogeny, metabolism and sex differences. *J. Zool.* **249**, 315-337 (2006).
75. Eble, G. J. in *Phenotypic Integration Studying the Ecology and Evolution of Complex Phenotypes* (eds Pigliucci, M. & Preston, K.) 253-273 (Oxford University Press, 2003).
76. De Magalhaes, J. & Costa, J. A database of vertebrate longevity records and their relation to other life-history traits. *J Evol. Biol.* **22**, 1770-1774 (2009).
77. Lin, L. K. & Motokawa, M. *Mammals of Taiwan. Vol. 1. Soricomorpha* (Tsunghai University Press, 2010).
78. Eadie, W. R. & Hamilton, W. Notes on reproduction in the star-nosed mole. *J. Mammal.* **37**, 223-231 (1956).
79. Carraway, L. N., Alexander, L. F. & Verts, B. *Scapanus townsendii*. *Mammalian Species* **434**, 1-7 (1993).
80. Barrionuevo, F. J., Zurita, F., Burgos, M. & Jiménez, R. Developmental stages and growth rate of the mole *Talpa occidentalis* (Insectivora, Mammalia). *J. Mammal.* **85**, 120-125 (2004).
81. Ishii, N. Reproductive activity of the Japanese shrew-mole, *Urotrichus talpoides* Temminck. *J. Mammal. Soc. Jp.* **9**, 25-36 (1982).
82. Mock, O. The least shrew (*Cryptotis parva*) as a laboratory animal. *Lab. Anim. Sci.* **32**, 177 (1982).
83. Dryden, G. L., Gebczynski, M. & Douglas, E. Oxygen consumption by nursling and adult musk shrews. *Acta theriol* **19**, 453-461 (1974).

84. Furuta, Y. Reproduction and measurements of *Chimarrogale platycephala* from western Hyogo (Ichinomiya-cho and Ooya-cho). *Kagawa Biology (Kagawa Seibutsu)* **31**, 45-58 (2004).
85. Stephenson, P. & Racey, P. Resting metabolic rate and reproduction in the Insectivora. *Comp. Biochem. Physiol. A Physiol.* **112**, 215-223 (1995).
86. Inoue, T. Sex difference in spatial distribution of the big-clawed shrew *Sorex unguiculatus*. *Acta Thcriologica* **36**, 229-237 (1991).
87. Nesterenko, V. & Ohdachi, S. D. Postnatal growth and development in *Sorex unguiculatus*. *Mammal Study* **26**, 145-148 (2001).
88. Fang, Y. P., Lee, L. L., Yew, F. H. & Yu, H. T. Systematics of white-toothed shrews (*Crocidura*)(Mammalia: Insectivora: Soricidae) of Taiwan: Karyological and morphological studies. *J. Zool.* **242**, 151-166 (1997).
89. Ohno, K. *et al.* The domestication of *Crocidura dsinezumi* as a new laboratory animal. *Experimental Animal (Jikken Dobutsu)* **41**, 449-454 (1992).
90. Giannini, N., Goswami, A. & Sánchez-Villagra, M. R. Development of integumentary structures in *Rousettus amplexicaudatus* (Mammalia: Chiroptera: Pteropodidae) during late-embryonic and fetal stages. *J. Mammal.* **87**, 993-1001 (2006).
91. Kurta, A. & Kunz, T. H. Size of bats at birth and maternal investment during pregnancy. *Symp. Zool. Soc. Lond.* **57**, 79-106 (1987).
92. Eisenberg, J. F. & Wilson, D. E. Relative brain size and feeding strategies in the Chiroptera. *Evolution* **32**, 740-751 (1978).
93. Burton, R. F. The scaling of eye size in adult birds: relationship to brain, head and body sizes. *Vis. Res.* **48**, 2345-2351 (2008).
94. York, A. E. & Scheffer, V. B. Timing of implantation in the northern fur seal, *Callorhinus ursinus*. *J. Mammal.* **78**, 675-683 (1997).
95. Trites, A. W. Fetal growth of northern fur seals: life-history strategy and sources of variation. *Can. J. Zool.* **69**, 2608-2617 (1991).
96. Camargo, L. S. A. *et al.* Gestation length, birth weight and offspring gender ratio of *in vitro*-produced Gyr (*Bos indicus*) cattle embryos. *Anim. Reprod. Sci.* **120**, 10-15 (2010).
97. Lim, N. T. L. & Ng, P. K. L. Home range, activity cycle and natal den usage of a female Sunda pangolin *Manis javanica* (Mammalia: Pholidota) in Singapore. *Endangered Species Research* **3**, 1-8 (2007).
98. Heusner, A. A. Size and power in mammals. *J. Exp. Biol.* **160**, 25-54 (1991).
99. Galíndez, E. J., Codón, S. M. & Casanave, E. B. Spleen of *Dasypus hybridus* (Mammalia, Dasypodidae): A light and electron microscopic study. *Anat. Rec.* **258**, 286-291 (2000).
100. Superina, M., Miranda, F. R. & Abba, A. A. The 2009/2010 Armadillo red list assessment. *Edentata* **11**, 135-184 (2010).
101. Taube, E., Keravec, J., Vié, J. C. & Duplantier, J. M. Reproductive biology and postnatal development in sloths, *Bradypus* and *Choloepus*: review with original data from the field (French Guiana) and from captivity. *Mamm. Rev.* **31**, 173-188 (2001).
102. Hayssen, V. *Bradypus variegatus* (Pilosa: Bradypodidae). *Mammalian Species* **42**, 19-32 (2010).
103. Emerson, S. B. & Hastings, P. A. Morphological correlations in evolution: consequences for phylogenetic analysis. *Quart. Rev. Biol.* **73**, 141-162 (1998).
104. Welker, W. & Carlson, M. Somatic sensory cortex of hyrax (*Procavia*). *Brain Behav. Evol.* **13**, 294-301 (2008).
105. Tripp, H. Capture, laboratory care and breeding of elephant-shrews (Macroscelididae). *Lab. Anim.* **6**, 213-224 (1972).
106. Stuart, C. & Stuart, T. *Field Guide to Mammals of Southern Africa* (Struik Publishers, 2001).
107. Watson, C., Provis, J. & Herculano-Houzel, S. What determines motor neuron number? Slow scaling of facial motor neuron numbers with body mass in marsupials and primates. *Anat. Rec.* **295**, 1683-1691 (2012).
108. Smith, K. K. Craniofacial development in marsupial mammals: developmental origins of evolutionary change. *Dev. Dyn.* **235**, 1181-1193 (2006).
109. Gemmell, R. & Selwood, L. Structural development in the newborn marsupial, the stripe-faced dunnart, *Sminthopsis macroura*. *Cells Tissues Organs* **149**, 1-12 (1994).
110. Weisbecker, V. & Goswami, A. Brain size, life history, and metabolism at the marsupial/placental dichotomy. *Proc. Nat. Acad. Sci. U.S.A.* **107**, 16216-16221 (2010).

111. Grant, T. & Temple–Smith, P. Field biology of the platypus (*Ornithorhynchus anatinus*): historical and current perspectives. *Philos. Trans. R. Soc. Lond., B, Biol. Sci.* **353**, 1081-1091 (1998).
112. Rismiller, P. D. & McKelvey, M. W. Body mass, age and sexual maturity in short-beaked echidnas, *Tachyglossus aculeatus*. *Comp. Biochem. Physiol., Part A Mol. Integr. Physiol.* **136**, 851-865 (2003).
113. Rismiller, P. D. & McKelvey, M. W. Frequency of breeding and recruitment in the short-beaked echidna, *Tachyglossus aculeatus*. *J. Mammal.* **81**, 1-17 (2000).
114. Corfield, J. R., Wild, J. M., Hauber, M. E., Parsons, S. & Kubke, M. F. Evolution of brain size in the Palaeognath lineage, with an emphasis on New Zealand ratites. *Brain Behav. Evol.* **71**, 87-99 (2008).
115. Blakers, M., Davies, S., Reilly, P. N. & Union, R. A. O. *The atlas of Australian birds* (Melbourne University Press, 1984).
116. Mlikovsky, J. Brain size in birds: 1. Tinamiformes through Ciconiiformes. *Vest. Cs. Spolec. Zool.* **53**, 33-47 (1989).
117. Uni, Z., Ferket, P., Tako, E. & Kedar, O. In ovo feeding improves energy status of late-term chicken embryos. *Poul. Sci.* **84**, 764-770 (2005).
118. Flint, J. & Mott, R. Finding the molecular basis of quantitative traits: successes and pitfalls. *Nat. Rev. Genet.* **2**, 437-445 (2001).
119. Bashir, M. & Javed, M. T. Effects of ethanol on brain and pancreas weights, serum sodium and potassium, and haematological parameters in quail (*Coturnix coturnix japonica*). *Avian Pathol.* **34**, 96-100 (2005).
120. Tserveni-Gousi, A. S. Relationship between parental age, egg weight and hatching weight of Japanese quail. *Br. Poult. Sci.* **28**, 749-752 (1987).
121. Woodard, A. E., Abplanalp, H. & Wilson, W. O. *Japanese Quail Husbandry in the Laboratory (Coturnix coturnix japonica)* (Department of Avian Sciences, University of California, Davis, 1973).
122. Jensen, J. K. Sand lizard (*Lacerta agilis* L.) with a second clutch in Denmark. *Amphibia-Reptilia* **2**, 267 (1981).
123. Amat, F., Llorente, G. & Carretero, M. Reproductive cycle of the sand lizard (*Lacerta agilis*) in its southwestern range. *Amphibia-Reptilia* **21**, 463-476 (2000).
124. Ekner, A. *et al.* Densities and morphology of two co-existing lizard species (*Lacerta agilis* and *Zootoca vivipara*) in extensively used farmland in Poland. *Folia Biol.* **56**, 3-4 (2008).
125. Vitt, L. J. & Lacher, T. E. Behavior, habitat, diet, and reproduction of the iguanid lizard *Polychrus acutirostris* in the caatinga of northeastern Brazil. *Herpetologica* **37**, 53-63 (1981).
126. Ferguson, M. W. J. in *Biology of the Reptilia* (eds Gans, G., Billett, F., & Maderson, P. F. A.) 329-491 (Academic Press, 1985).
127. Ross, J. P. *Continuing Studies of Mortality of Alligators on Central Florida Lakes: Pathology and Nutrition: Final Report to St. Johns River Water Management District, Contract #SE122AA* (St. Johns River Water Management District, 2002).
128. Branch, W. R. & Patterson, R. W. Notes on the development of embryos of the African rock python, *Python sebae* (Serpentes: Boidae). *J. Herpetol.* **9**, 243-248 (1975).
129. Branch, B. & Erasmus, H. Captive breeding of pythons in south africa, including details of an interspecific hybrid (*Python sebae natalensis* x *Python molurusbiviitatus*). *Afr. J. Herpetol.* **30**, 1-10 (1984).
130. Ott, B. D. & Secor, S. M. Adaptive regulation of digestive performance in the genus *Python*. *J. Exp. Biol.* **210**, 340-356 (2007).
131. Boback, S. M., Dichter, E. K. & Mistry, H. L. A developmental staging series for the African house snake, *Boaedon* (*Lamprophis*) *fuliginosus*. *Zoology* **115**, 38-46 (2012).
132. Mills, M. S. *Ecology and life history of the brown water snake (Nerodia taxispilota)* Ph.D. thesis. University of Georgia (2002).
133. Yntema, C. Procurement and use of turtle embryos for experimental procedures. *Anat. Rec.* **149**, 577-585 (1964).
134. Burghardt, G. M. & Hess, E. H. Food imprinting in the snapping turtle, *Chelydra serpentina*. *Science* **151**, 108-109 (1965).