

# Phylogenetic biogeography inference using dynamic paleogeography models and explicit geographic ranges

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## Supplementary Information

**Supplementary table 1.** Dispersals into North America. The node column indicates the node that contains the youngest part of the credibility interval (of 50%); refer to supplementary figure 3 to get the node IDs. The time frame column reports an approximation of the 50% credibility interval for the dispersal (i.e., the oldest to youngest dispersal instances). Events indicated as ambiguous indicate that there are alternative dispersal routes for these nodes.

<b>Node</b>	<b>Time Frame 50% CI (Ma)</b>	<b>Source</b>	<b>Comments</b>
149	68.7 – 15.0	Eurasia	De Geer pass
18	68.1 – 15.0	Eurasia	De Geer pass
30	40.0 – 15.0	Eurasia	De Geer pass
129	33.1 – 20.0	Eurasia	De Geer pass
4	30.0 – 10.0	Eurasia	De Geer pass
63	30.0 – 5.0	Eurasia	De Geer pass
9	29.3 – 10.0	Eurasia	De Geer pass
51	28.1 – 10.0	Eurasia	De Geer pass
69	24.3 – 10.0	Eurasia	De Geer pass, or Bering pass
138	15.0 – 0.0	Eurasia	Bering pass, or De Geer pass
273	15.0 – 5.0	Eurasia	De Geer pass (ambiguous)
282	14.3 – 10.0	Eurasia	De Geer pass (ambiguous)
56	10.0 – 5.0	Eurasia	De Geer pass

**Supplementary table 2.** Dispersals into South America. See supp. table 1 for an explanation of the columns.

<b>Node</b>	<b>Time frame 50% CI (Ma)</b>	<b>Source</b>	<b>Comments</b>
162	40.0 - 21.1	North America	Throu Central America (ambiguous)
177	40.0 - 10.0	North America	Throu Central America
160	30.0 - 5.0	North America	Throu Central America (ambiguous)
167	30.0 - 5.0	North America	Throu Central America
20	25.0 - 5.0	North America	Throu Central America and Caribbean (ambiguous)
154	25.0 - 0.0	North America	Throu Central America and Caribbean
282	14.3 - 8.1	Africa	Throu Atlantic ocean (ambiguous)
20	15.0 - 0.0	Africa	Throu Atlantic ocean (ambiguous)
30	15.0 - 0.0	North America	Throu Central America and Caribbean
123	15.0 - 0.0	Africa	Throu Atlantic ocean
131	15.0 - 0.0	North America	Throu Central America and Caribbean
151	15.0 - 0.0	North America	Throu Central America

			and Caribbean
153	15.0 - 0.0	North America	Throu Central America and Caribbean
171	15.0 - 0.0	North America	Throu Central America and Caribbean
176	10.0 - 0.0	North America	Throu Central America and Caribbean
273	10.0 - 0.0	North America or Africa	Throu Atlantic ocean, or Caribbean
283	8.1 - 5.0	North America	Throu Central America and Caribbean (ambiguous)
286	7.7 - 2.3	North America	Throu Central America and Caribbean (ambiguous)

**Supplementary table 3.** Dispersals into Africa. See supp. table 1 for an explanation of the columns.

<b>Node</b>	<b>Time frame 50% CI (Ma)</b>	<b>Source</b>	<b>Comments</b>
144	50.0 - 30.6	Eurasia	Throu eastern Mediterranean (ambiguous)
172	35.0 - 10.0	Eurasia	Throu wastern Mediterranean, or eastern Mediterranean
191	35.0 - 18.1	Eurasia	Throu Anatolia, Iran, and Arabian peninsula
107	35.0 - 5.0	Eurasia	Throu eastern Mediterranean
121	34.3 - 5.0	Eurasia	Throu eastern Mediterranean
106	30.0 - 5.0	Eurasia	Throu Anatolia, Iran, and Arabian peninsula
145	30.0 - 5.0	Eurasia	Throu western Mediterranean (ambiguous)
146	30.0 - 5.0	Eurasia	Throu eastern Mediterranean (ambiguous)
10	29.3 - 15.0	Eurasia	Throu eastern Mediterranean (ambiguous)
20	25.0 - 10.0	Eurasia	Throu western Mediterranean (ambiguous)
25	25.0 - 5.0	Eurasia	Throu Anatolia, Iran, and Arabian peninsula
133	25.0 - 5.0	Eurasia	Throu Anatolia, Iran, and Arabian peninsula (ambiguous)
23	25.0 - 0.0	Eurasia	Throu Anatolia, Iran, and Arabian peninsula
100	20.0 - 3.1	Eurasia	Throu Anatolia and Arabian peninsula
26	20.0 - 0.0	Eurasia	Throu Anatolia, Iran, and Arabian peninsula
89	20.0 - 0.0	Eurasia	Throu Anatolia and Arabian peninsula
7	19.3 - 5.0	Eurasia	Throu Anatolia, Iran, and Arabian peninsula
272	18.1 - 6.9	Eurasia	Throu Anatolia, Iran, and Arabian peninsula

218	0.6 - 0.0	Kerguelen or Eurasia	Indian ocean
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**Supplementary table 4.** Dispersals into Madagascar. See supp. table 1 for an explanation of the columns.

<b>Node</b>	<b>Time frame 50% CI (Ma)</b>	<b>Source</b>	<b>Comments</b>
25	10.0 - 0.0	Africa	Throu Monzambique channel
193	10.0 - 0.0	Africa	Throu Monzambique channel
201	10.0 - 0.0	Africa	Throu Monzambique channel
202	10.0 - 0.0	Africa	Throu Monzambique channel
206	10.0 - 0.0	Africa	Throu Monzambique channel
207	10.0 - 0.0	Africa	Throu Monzambique channel
13	9.6 - 0.0	Africa	Throu Monzambique channel
15	5.0 - 0.0	Africa	Throu Monzambique channel
16	5.0 - 0.0	Africa	Throu Monzambique channel
28	5.0 - 0.0	Africa	Throu Monzambique channel
133	5.0 - 0.0	Africa or Inida	Throu Monzambique

			channel, or Indian ocean
173	5.0 - 0.0	Africa	Throu Monzambique channel
174	5.0 - 0.0	Africa	Throu Monzambique channel
195	5.0 - 0.0	Africa	Throu Monzambique channel
198	5.0 - 0.0	Africa	Throu Monzambique channel
204	5.0 - 0.0	Africa	Throu Monzambique channel
277	5.0 - 0.0	Africa	Throu Monzambique channel
278	5.0 - 0.0	Africa	Throu Monzambique channel
280	0.6 - 0.0	Eurasia	Indian ocean

**Supplementary table 5.** Dispersals into Australia and New Guinea. See supp. table 1 for an explanation of the columns.

<b>Node</b>	<b>Time frame 50% CI (Ma)</b>	<b>Source</b>	<b>Comments</b>
212	20.0 - 5.0	Eurasia	Throu Malesia
239	19.3 - 0.0	Eurasia	Throu Malesia
38	15.0 - 5.0	Eurasia	Throu Malesia
216	15.0 - 5.0	Eurasia	Throu Malesia
229	5.0 - 0.0	Eurasia	Throu Malesia
40	15.0 - 0.0	Eurasia	Throu Malesia
43	15.0 - 0.0	Eurasia	Throu Malesia
210	15.0 - 0.0	Eurasia	Throu Malesia
268	14.3 - 0.0	Eurasia	Throu Malesia
271	12.5 - 5.0	Eurasia	Throu Malesia
270	12.5 - 0.0	Eurasia	Throu Malesia
226	9.3 - 5.0	Eurasia	Throu Malesia
37	10.0 - 0.0	Eurasia	Throu Malesia
42	10.0 - 0.0	Eurasia	Throu Malesia, skip New Guinea
234	10.0 - 0.0	Eurasia	Throu Malesia
237	10.0 - 0.0	Eurasia	Throu Malesia

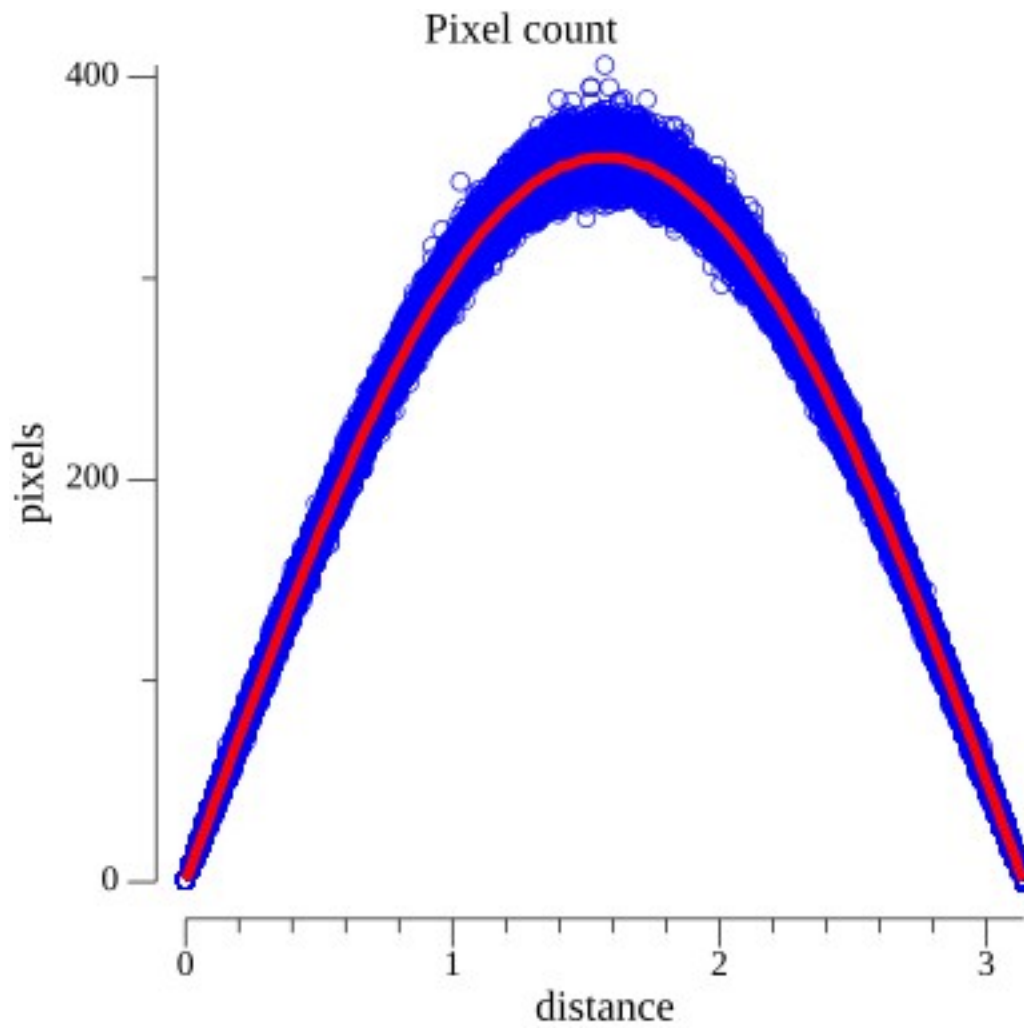


265	10.0 - 0.0	Eurasia	Throu Malesia
266	10.0 - 0.0	Eurasia	Throu Malesia
6	5.0 - 0.0	Eurasia	Throu Malesia
222	5.0 - 0.0	Eurasia	Throu Malesia
232	5.0 - 0.0	Eurasia	Throu Malesia
281	0.6 - 0.0	Eurasia	Throu Malesia

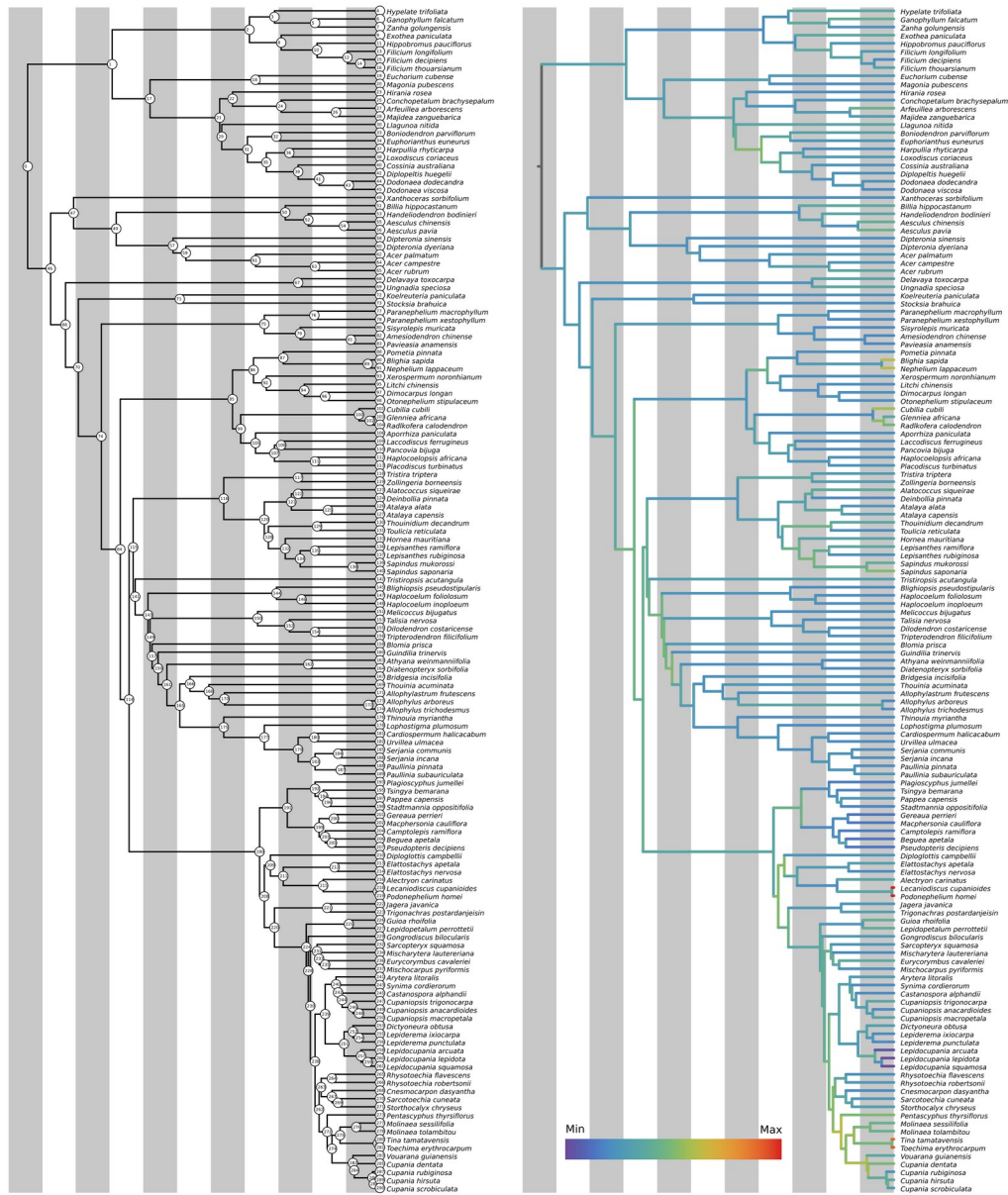
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**Supplementary table 6.** Dispersals into New Caledonia. See supp. table 1 for an explanation of the columns.

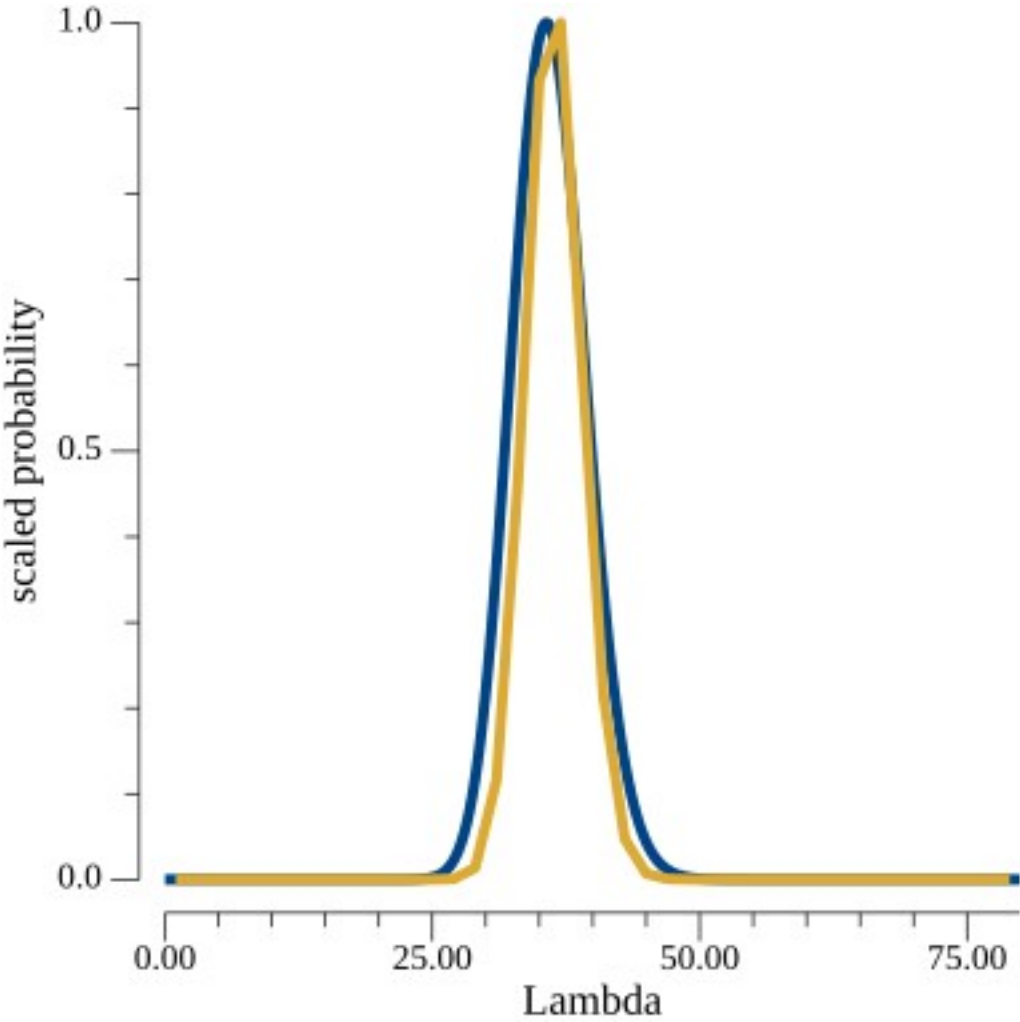
<b>Node</b>	<b>Time frame 50% CI (Ma)</b>	<b>Source</b>	<b>Comments</b>
38	5.0 - 0.0	Australia or New Guinea	
213	5.0 - 0.0	Australia or New Guinea	
216	5.0 - 0.0	Australia or New Guinea	
229	5.0 - 0.0	Australia or New Guinea	
247	5.0 - 0.0	Australia	
258	5.0 - 0.0	Australia	
271	5.0 - 0.0	Australia or New Guinea	
260	3.7 - 0.0	Australia	
261	3.7 - 0.0	Australia	
219	0.6 - 0.0	Kerguelen or Eurasia	Throu Malesia



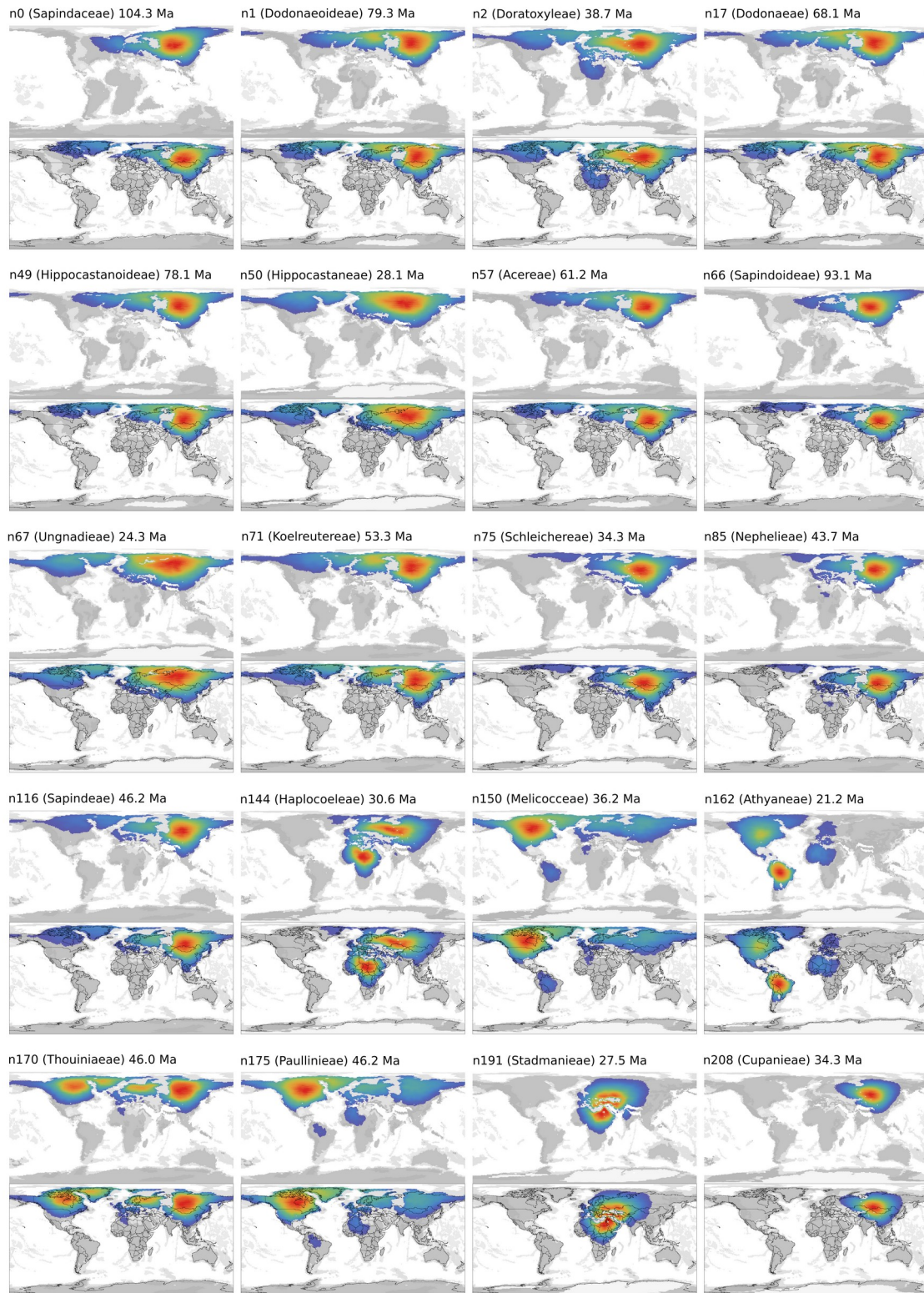
**Supplementary figure 1.** Plot of the number of pixels at a given distance (in radians) from 20 random pixels in each ring of an e360 pixelation used in this paper; the pixelation has 180 rings (for a total of 3600 sampled pixels). In red is the number of pixels at a given distance from the North Pole, which is used for quick approximations of the spherical normal in the likelihood calculations.



**Supplementary figure 2.** Phylogenetic relationships of Sapindaceae used in this work. On the left, the tree with the node numbers indicated; on the right, the same tree with the branches colored by its average speed (in Km/My) log10 scaled.



**Supplementary figure 3.** In yellow, the estimated posterior distribution of the  $\lambda$  parameter (using a flat uniform prior) for the Sapindaceae data set; in blue, the gamma distribution ( $\alpha = 108.0$  and  $\beta = 3.0$ ) used to approximate the posterior distribution.



**Supplementary figure 4.** *Pixel posterior probabilities for the nodes assigned to the family, subfamily, and tribal ranks. Monogeneric groups are not displayed. For the node IDs, see supplementary figure 3.*