SUPPLEMENTARY INFORMATION

Assessment of the influence of phylogenetic uncertainty

As noted in the main text, the exact phylogenetic positions of all of the species considered in this analysis are not known with certainty. I conducted a simulation analysis to assess whether uncertainty in the evolutionary relationships of the plant species could have affected the conclusions of the paper. This was based on the Simulation with Uncertainty for Phylogenetic Investigations (SUNPLIN) approach of Martins et al. (1), and consisted of generating numerous phylogenetic trees, where each was created by random, sequential additions of the phylogenetically uncertain taxa. Species were added to the phylogeny in the same genus as their congeners that were already in the phylogeny. If there was more than one species in the genus, the most derived consensus clade (MDCC) was the most recent derived ancestor of all of them. If there was only one species in the genus, the MDCC was the closest node. I generated 1000 random phylogenetic trees using the branch-based approach to inserting phylogenetically uncertain taxa (1), whereby the likelihood of species insertions to the phylogeny is proportional to branch length.

I then ran phylogenetic generalized least-squares regression models on each phylogenetic tree individually, and assessed the distribution of model coefficients across all model runs. The regression coefficients were positive in 91.8% of model runs for the *Sunda* parameter, 47.3% for the *Sulawesi* parameter, 62.9% for the *Moluccas* parameter, and 91.0% for the *New Guinea* parameter (Figure S12).

TABLE S1: Similarity of the sub-regions of the Indo-Malay Archipelago in composition of plant, bird, and mammal genera.

	Sunda Region	Sulawesi	Moluccas	New Guinea
Percent of genera that occur in the Sunda Region				
Plants[a]	100.0	94.3	90.4	79.0
Birds[b]	100.0	42.5	37.2	45.6
Mammals[b]	100.0	21.6	15.6	24.6
Percent of families that occur in New Guinea				
Plants[a]	60.4	84.9	89.4	100.0
Birds[b]	53.1	54.3	69.6	100.0
Mammals[b]	34.2	48.3	43.3	100.0

[a]All families (not just those in Sapindales) covered by the Flora Malesiana Project (2-6) that contain at least one fleshy-fruited species native to Malesiana.

[b]Based on distributions in Olson et al. (7).

TABLE S2: Qualitative fruit descriptions from Flora Malesiana and the 7 different binary categorization schemes assessed here.

Qualitative fruit color description	Binary categorization scheme						
	Fruit_color1	Fruit_color2	Fruit_color3	Fruit_color4	Fruit_color5	Fruit_color6	Fruit_color7
black	0	1	1	1	1	1	1
black-blue	0	0	1	1	0	1	1
black-orange	0	0	1	1	0	1	1
brown	0	0	0	0	0	0	0
brown-black	0	0	0	1	0	0	1
brown-green	0	0	0	0	0	0	0
brown-orange	0	0	0	0	0	0	0
brown-red	0	0	0	1	0	0	1
brown-white	0	0	0	0	0	0	0
brown-yellow	0	0	0	0	0	0	0

green	0	0	0	0	0	0	0
green-orange	0	0	0	0	0	0	0
green-red	0	0	0	1	0	0	1
grey	0	0	0	0	0	0	0
grey-green	0	0	0	0	0	0	0
orange	1	0	0	0	0	0	0
orange-purple	1	0	0	0	0	0	0
orange-red	1	0	0	1	0	0	1
red	1	1	1	1	1	1	1
red-purple	1	0	1	1	0	1	1
white	1	0	0	0	0	0	0
white-green	1	0	0	0	0	0	0
white-yellow	1	0	0	0	0	0	0
yellow	1	0	0	0	0	0	0
yellow-green	1	0	0	0	0	0	0
yellow-orange	1	0	0	0	0	0	0
yellow-red	1	0	0	1	0	0	1

TABLE S3: Model selection results for the different binary fruit categorization schemes, based on phylogenetic generalized linear models using maximum penalized likelihood estimators.

Model	Penalized log likelihood	ΔAIC	AIC weight
Fruit_color2	-75.37	0	1
Fruit_color3	-81.97	12.93	0
Fruit_color6	-81.97	12.93	0
Fruit_color4	-128	103.25	0
Fruit_color7	-128	103.25	0
Fruit_color1	-151.3	149.05	0
Fruit_color5	na	na	na

TABLE S4: Model selection results for analysis of fruit traits. A total of 442 species were included in the analysis, but not all species had both fruit length and fruit color information available.

Model	Log likelihood or Penalized Log Likelihood	AIC	Δ AIC	AIC weight	Transformation parameters		
					alpha	lambda	rho
Fruit length (N = 385 species) -Ultrametric phylogeny							
Ornstein-Uhlenbeck	-1827.09	3668.2	0	1.0	219.45	na	na
Brownian motion	-1915.15	3842.3	174.1	0.0	na	na	na
Fruit length (N = 385 species) -Non-ultrametric phylogeny							
Ornstein-Uhlenbeck	-1825.66	3665.3	0	1.0	290757.9	na	na
Brownian motion	-2117.5	4247	581.69	0.0	na	na	na
Fruit color (N = 265 species) -Ultrametric phylogeny							
Logistic (MPLE)[a]	-75.37	178.9	na	na	15.96	na	na
Logistic (GEE)[b]	[Did not converge]		na	na	na	na	na
Fruit color (N = 265 species) -Non-ultrametric phylogeny							
Logistic (MPLE)[a]	[Did not converge]		na	na	na	na	na

Logistic (GEE)[b]	[Did not converge]	na	na	na	na	na

[a]MPLE = Maximum Penalized Likelihood Estimator

[b]GEE = Generalized Estimating Equations approximation to the penalized likelihood

TABLE S5: Model coefficients and regression statistics from phylogenetically explicit analysis. A total of 442 species were included in the analysis, but not all species had both fruit length and fruit color information available.

Model	Intercept				Sundaland			
	β	SE	t	*P*	β	SE	t	*P*
Fruit length (N = 385 species) -Ultrametric phylogeny								
Brownian motion	17.66	89	0.2	0.84	14.68	3.16	4.65	0
Ornstein-Uhlenbeck	21.29	3.91	5.45	0	13.61	3.44	3.96	0
Pagel's lambda	19.21	26.25	0.73	0.46	10.13	3.63	2.79	0.01
Grafen's rho	24.2	9.81	2.47	0.01	9.35	3.79	2.47	0.01
Fruit length (N = 385 species) -Non-ultrametric phylogeny								
Brownian motion	12.61	16636.51	0	1	13.49	3.84	3.52	0
Ornstein-Uhlenbeck	22.93	4.44	5.16	0	11.47	3.81	3.01	0
Pagel's lambda	21.04	17.37	1.21	0.23	9.66	3.66	2.64	0.01
Grafen's rho	24.1	9.8	2.46	0.01	9.41	3.79	2.48	0.01

Fruit color (N = 265 species) -Ultrametric phylogeny								
Logistic (MPLE)	-0.11	277.19	0	1	-0.01	0.16	-0.03	0.97
Logistic (GEE)	na	na	na	na		na	na	na
Fruit color (N = 265 species) -Non-ultrametric phylogeny								
Logistic (MPLE)	na	na	na	na		na	na	na
Logistic (GEE)	na	na	na	na		na	na	na

TABLE S5 (continued):

Model	Sulawesi				Moluccas				New Guinea			
	β	SE	t	*P*	β	SE	t	*P*	β	SE	t	*P*
Fruit length (N = 385 species) -Ultrametric phylogeny												
Brownian motion	-2	3.82	-0.52	0.6	-3.91	3.44	-1.14	0.26	3.28	3.27	1	0.32
Ornstein-Uhlenbeck	-0.42	4.32	-0.1	0.92	-2.61	4	-0.65	0.52	5.3	3.48	1.52	0.13
Pagel's lambda	-1.23	4.31	-0.29	0.78	-0.39	4.32	-0.09	0.93	7.42	3.48	2.13	0.03
Grafen's rho	-0.18	4.55	-0.04	0.97	0.82	4.49	0.18	0.86	7.2	3.57	2.02	0.04
Fruit length (N = 385 species) -Non-ultrametric phylogeny												
Brownian motion	-2.04	4.56	-0.45	0.65	-1.5	4.29	-0.35	0.73	10	3.57	2.8	0.01
Ornstein-Uhlenbeck	-0.03	4.73	-0.01	1	-0.88	4.56	-0.19	0.85	7.89	3.62	2.18	0.03
Pagel's lambda	-1.14	4.26	-0.27	0.79	-0.15	4.24	-0.04	0.97	7.82	3.42	2.29	0.02
Grafen's rho	-0.19	4.55	-0.04	0.97	0.87	4.49	0.19	0.85	7.15	3.57	2	0.05

Fruit color (N = 265 species) -Ultrametric phylogeny												
Logistic (MPLE)	-0.14	0.16	-0.88	0.38	0.07	0.17	0.43	0.66	-0.27	0.17	-1.62	0.11
Logistic (GEE)	na		na	na	na	na		na	na	na	na	na
Fruit color (N = 265 species) -Non-ultrametric phylogeny												
Logistic (MPLE)	na		na	na	na	na		na	na	na	na	na
Logistic (GEE)	na		na	na	na	na		na	na	na	na	na

TABLE S6: Extinct Pleistocene megafauna (8, 9) and extant species of mammal frugivore in the Indo-Malay Archipelago.

Species	Extant	Mass (g)	Sunda	Sulawesi	Moluccas	New Guinea
Acerodon celebensis	1	384.84	0	1	0	1
Acerodon humilis	1	unknown	0	1	0	1
Acerodon jubatus	1	1087.04	0	0	0	0
Acerodon leucotis	1	unknown	1	0	0	0
Acerodon mackloti	1	467.93	0	0	0	0
Aethalops aequalis	1	unknown	1	0	0	0
Aethalops alecto	1	15.00	1	0	0	0
Aproteles bulmerae	1	623.91	0	0	0	1
Arctictis binturong	1	12999.99	1	0	0	0
Arctogalidia trivirgata	1	2323.79	1	0	0	0
Balionycteris maculata	1	14.43	1	0	0	0
Celebochoerus sp.	0	unknown	0	1	0	0
Chironax melanocephalus	1	17.70	1	1	0	1
Cynopterus brachyotis	1	33.87	1	0	0	0
Cynopterus horsfieldi	1	unknown	1	0	0	0
Cynopterus luzoniensis	1	unknown	0	1	0	1
Cynopterus minutus	1	26.45	1	1	0	1
Cynopterus nusatenggara	1	unknown	0	0	0	0
Cynopterus sphinx	1	44.71	1	0	0	0

Cynopterus titthaecheileus	1	unknown	1	0	0	0
Dobsonia anderseni	1	233.99	0	0	0	1
Dobsonia beauforti	1	165.35	0	0	1	1
Dobsonia crenulata	1	218.21	0	0	1	0
Dobsonia emersa	1	201.06	0	0	0	1
Dobsonia exoleta	1	302.03	0	1	0	1
Dobsonia magna	1	465.00	0	0	1	1
Dobsonia minor	1	85.95	0	1	0	1
Dobsonia moluccensis	1	447.64	0	0	1	0
Dobsonia pannietensis	1	239.19	0	0	0	1
Dobsonia peronii	1	226.51	1	0	1	0
Dobsonia praedatrix	1	178.74	0	0	0	1
Dobsonia viridis	1	240.66	0	1	1	1
Dorcopsis atrata	1	6198.87	0	0	0	1
Dorcopsis hageni	1	5499.99	0	0	0	1
Dorcopsis luctuosa	1	4939.56	0	0	0	1
Dorcopsis muelleri	1	5370.79	0	0	1	1
Dyacopterus brooksi	1	unknown	1	0	0	0
Dyacopterus spadiceus	1	81.10	1	0	0	0
Eonycteris major	1	70.70	1	0	0	0
Eonycteris robusta	1	78.36	0	0	0	0
Eonycteris spelaea	1	58.70	1	1	1	1
Harpiocephalus harpia	1	13.65	1	0	1	0

Harpiocephalus mordax	1	unknown	1	0	0	0
Harpyionycteris celebensis	1	116.77	0	1	0	1
Harpyionycteris whiteheadi	1	135.48	0	0	0	0
Helarctos malayanus	1	57075.78	1	0	0	0
Hulitherium spp.	0	~150000	0	0	0	1
Hylobates agilis	1	5829.08	1	0	0	0
Hylobates albibarbis	1	unknown	1	0	0	0
Hylobates klossii	1	5822.29	1	0	0	0
Hylobates lar	1	5578.61	1	0	0	0
Hylobates moloch	1	5860.81	1	0	0	0
Hylobates muelleri	1	5909.81	1	0	0	0
Hylobates pileatus	1	5542.37	1	0	0	0
Macaca arctoides	1	9358.04	1	0	0	0
Macaca assamensis	1	8546.89	1	0	0	0
Macaca fascicularis	1	4569.32	1	0	0	0
Macaca hecki	1	unknown	0	1	0	1
Macaca leonina	1	unknown	1	0	0	0
Macaca maura	1	7290.30	0	1	0	1
Macaca mulatta	1	6455.19	1	0	0	0
Macaca nemestrina	1	7820.78	1	0	0	0
Macaca nigra	1	7359.39	0	1	0	1
Macaca nigrescens	1	unknown	0	1	0	1
Macaca ochreata	1	2745.50	0	1	0	1

Macaca pagensis	1	4534.66	1	0	0	0
Macaca siberu	1	unknown	1	0	0	0
Macaca tonkeana	1	10035.53	0	1	0	1
Macroglossus minimus	1	16.30	1	1	1	1
Macroglossus sobrinus	1	21.80	1	0	0	0
Maokopia spp.	0	~100000	0	0	0	1
Megaerops ecaudatus	1	26.29	1	0	0	0
Megaerops kusnotoi	1	unknown	1	0	0	0
Megaerops niphanae	1	32.59	1	0	0	0
Megaerops wetmorei	1	18.70	1	0	0	0
Neopteryx frosti	1	unknown	0	1	0	1
Nomascus concolor	1	6410.47	1	0	0	0
Nomascus gabriellae	1	unknown	1	0	0	0
Nomascus hainanus	1	unknown	1	0	0	0
Nyctimene aello	1	85.26	0	0	1	1
Nyctimene albiventer	1	29.95	0	0	1	1
Nyctimene celaeno	1	unknown	0	0	1	1
Nyctimene cephalotes	1	44.92	0	1	1	1
Nyctimene certans	1	43.24	0	0	0	1
Nyctimene cyclotis	1	48.83	0	0	0	1
Nyctimene draconilla	1	30.15	0	0	0	1
Nyctimene keasti	1	unknown	0	0	1	0
Nyctimene major	1	107.06	0	0	0	1

Nyctimene masalai	1	53.20	0	0	0	1
Nyctimene minutus	1	unknown	0	1	1	1
Nyctimene rabori	1	68.25	0	0	0	0
Nyctimene vizcaccia	1	41.96	0	0	0	1
Otopteropus cartilagonodus	1	16.92	0	0	0	0
Paguma larvata	1	4300.00	1	0	0	0
Penthetor lucasi	1	35.39	1	0	0	0
Phalanger alexandrae	1	unknown	0	0	1	0
Phalanger carmelitae	1	1820.88	0	0	0	1
Phalanger gymnotis	1	2597.89	0	0	1	1
Phalanger intercastellanus	1	1747.50	0	0	0	1
Phalanger lullulae	1	1632.50	0	0	0	1
Phalanger matabiru	1	unknown	0	0	1	0
Phalanger matanim	1	1442.38	0	0	0	1
Phalanger mimicus	1	unknown	0	0	0	1
Phalanger orientalis	1	2487.50	0	0	1	1
Phalanger ornatus	1	1787.50	0	0	1	0
Phalanger rothschildi	1	1365.00	0	0	1	0
Phalanger sericeus	1	2003.00	0	0	0	1
Phalanger vestitus	1	1850.00	0	0	0	1
Pongo abelii	1	39696.12	1	0	0	0
Pongo pygmaeus	1	53408.29	1	0	0	0
Ptenochirus jagori	1	79.18	1	0	0	0

Ptenochirus minor	1	47.02	0	0	0	0
Pteropus admiralitatum	1	306.46	0	0	0	1
Pteropus alecto	1	610.13	1	0	0	1
Pteropus argentatus	1	unknown	0	0	1	0
Pteropus aruensis	1	unknown	0	0	1	1
Pteropus caniceps	1	525.12	0	1	1	1
Pteropus capistratus	1	unknown	0	0	0	1
Pteropus chrysoproctus	1	730.19	0	0	1	0
Pteropus conspicillatus	1	760.71	0	0	1	1
Pteropus dasymallus	1	491.86	0	0	0	0
Pteropus giganteus	1	824.85	1	0	0	0
Pteropus gilliardorum	1	406.94	0	0	0	1
Pteropus griseus	1	unknown	1	1	1	1
Pteropus hypomelanus	1	435.61	1	1	1	1
Pteropus keyensis	1	unknown	0	0	1	0
Pteropus leucopterus	1	343.81	0	0	0	0
Pteropus lombocensis	1	256.15	0	0	0	0
Pteropus lylei	1	319.75	1	0	0	0
Pteropus macrotis	1	365.99	0	0	1	1
Pteropus melanopogon	1	874.94	0	0	1	0
Pteropus melanotus	1	unknown	1	0	0	0
Pteropus neohibernicus	1	1017.37	0	0	1	1
Pteropus ocularis	1	228.76	0	0	1	0

Pteropus personatus	1	130.84	0	0	1	0
Pteropus pohlei	1	352.75	0	0	0	1
Pteropus pumilus	1	184.05	1	0	0	0
Pteropus speciosus	1	unknown	1	0	0	0
Pteropus temminckii	1	unknown	0	0	1	0
Pteropus tonganus	1	561.51	0	0	0	1
Pteropus vampyrus	1	1027.54	1	0	0	0
Rousettus amplexicaudatus	1	74.37	1	1	1	1
Rousettus bidens	1	unknown	0	1	0	1
Rousettus celebensis	1	63.07	0	1	0	1
Rousettus leschenaultii	1	84.88	1	0	0	0
Rousettus spinalatus	1	92.32	1	0	0	0
Stegodon spp.	0	unknown	1	1	1	0
Strigocuscus celebensis	1	unknown	0	1	1	1
Strigocuscus pelengensis	1	unknown	0	1	0	1
Styloctenium wallacei	1	172.42	0	1	0	1
Symphalangus syndactylus	1	10839.00	1	0	0	0
Thoopterus nigrescens	1	66.12	0	1	1	1
Tragulus javanicus	1	1889.93	1	1	0	1
Tragulus napu	1	5273.67	1	0	0	0
Ursus thibetanus	1	99714.19	1	0	0	0
Zygomaturus spp.	0	~300000	0	0	0	1

FIGURE S1: Average temperatures across the Indo-Malay Archipelago from WorldClim (10), with the delineation of the four geographic sub-regions.

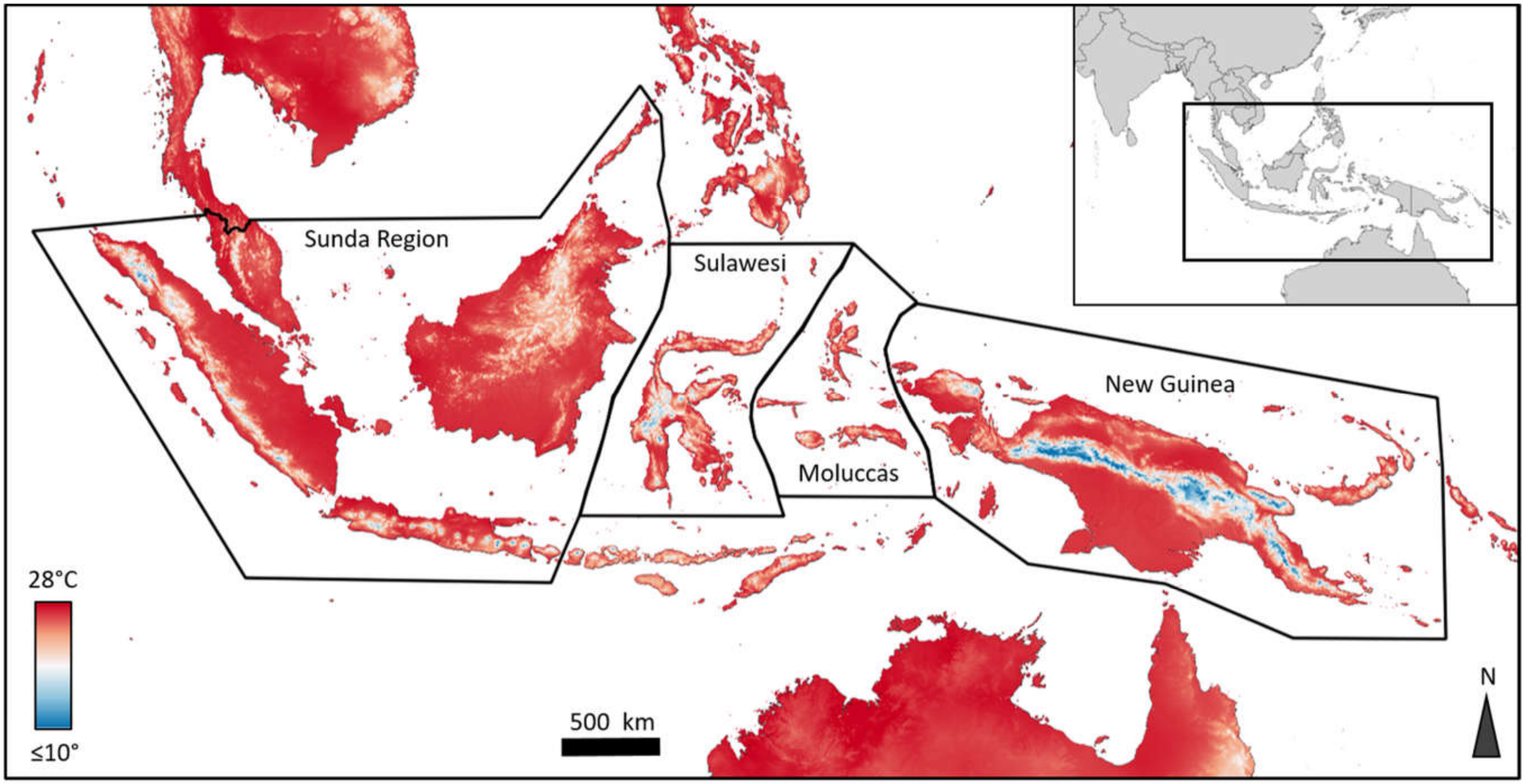


FIGURE S2: Average annual precipitation across the Indo-Malay Archipelago from WorldClim (10), with the delineation of the four geographic sub-regions.

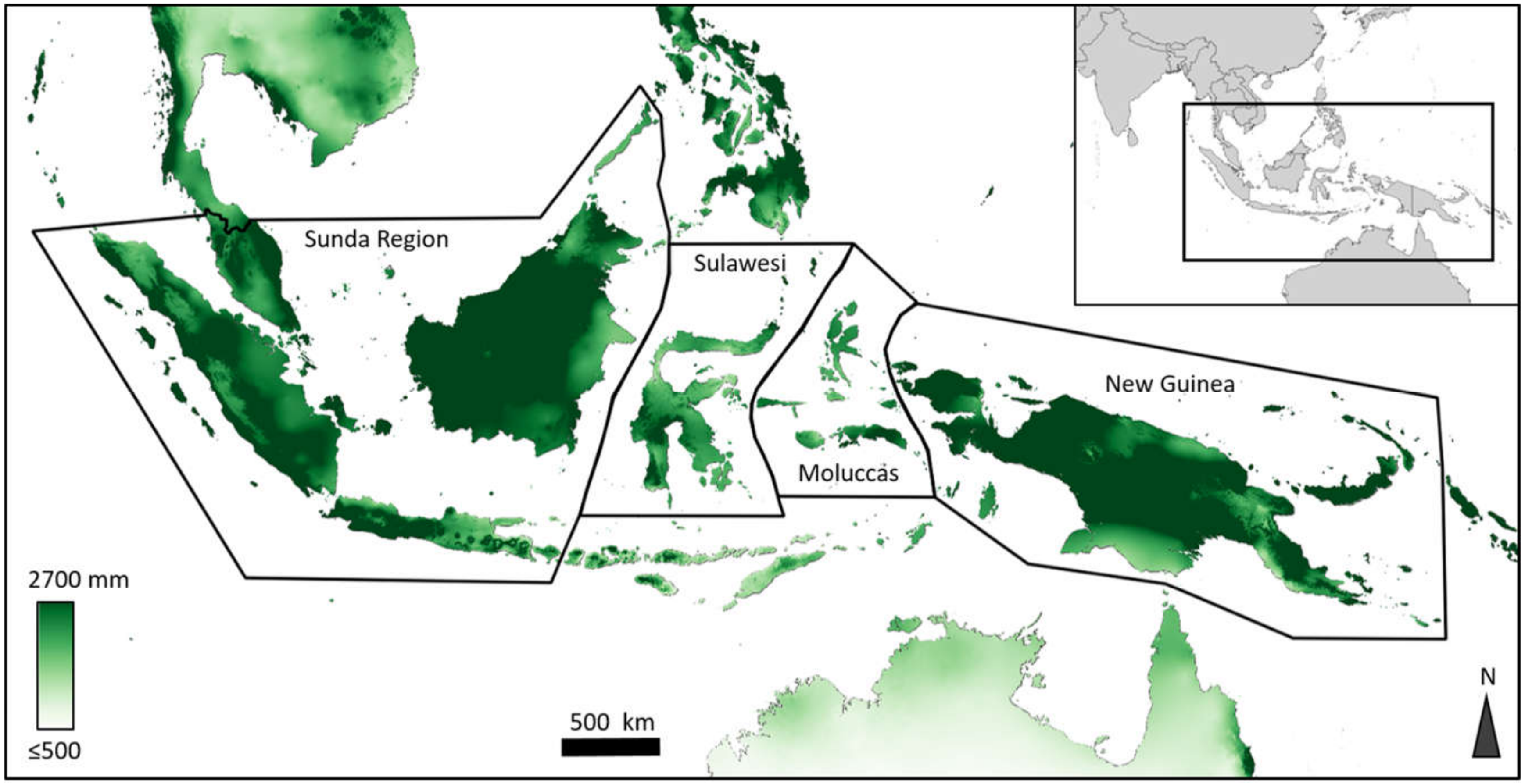


FIGURE S3: Average annual precipitation seasonality (coefficient of variation among monthly precipitation totals) across the Indo-Malay Archipelago from WorldClim (10), with the delineation of the four geographic sub-regions.

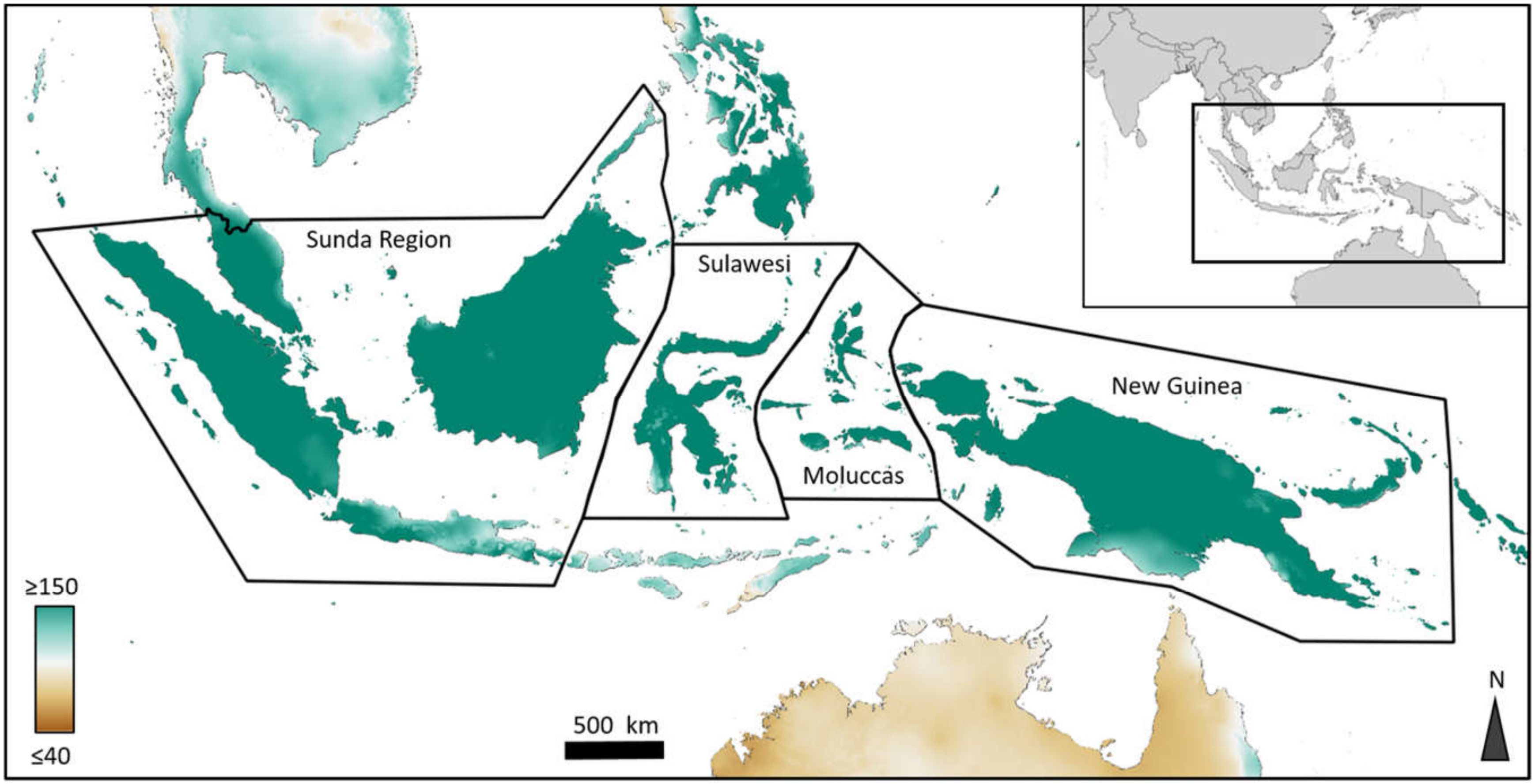


FIGURE S4: Likelihood of different values of the rate-smoothing parameter (11) in the transformation of the Sapindales phylogeny to an ultrametric state. The maximum penalized likelihood was at λ = 0.

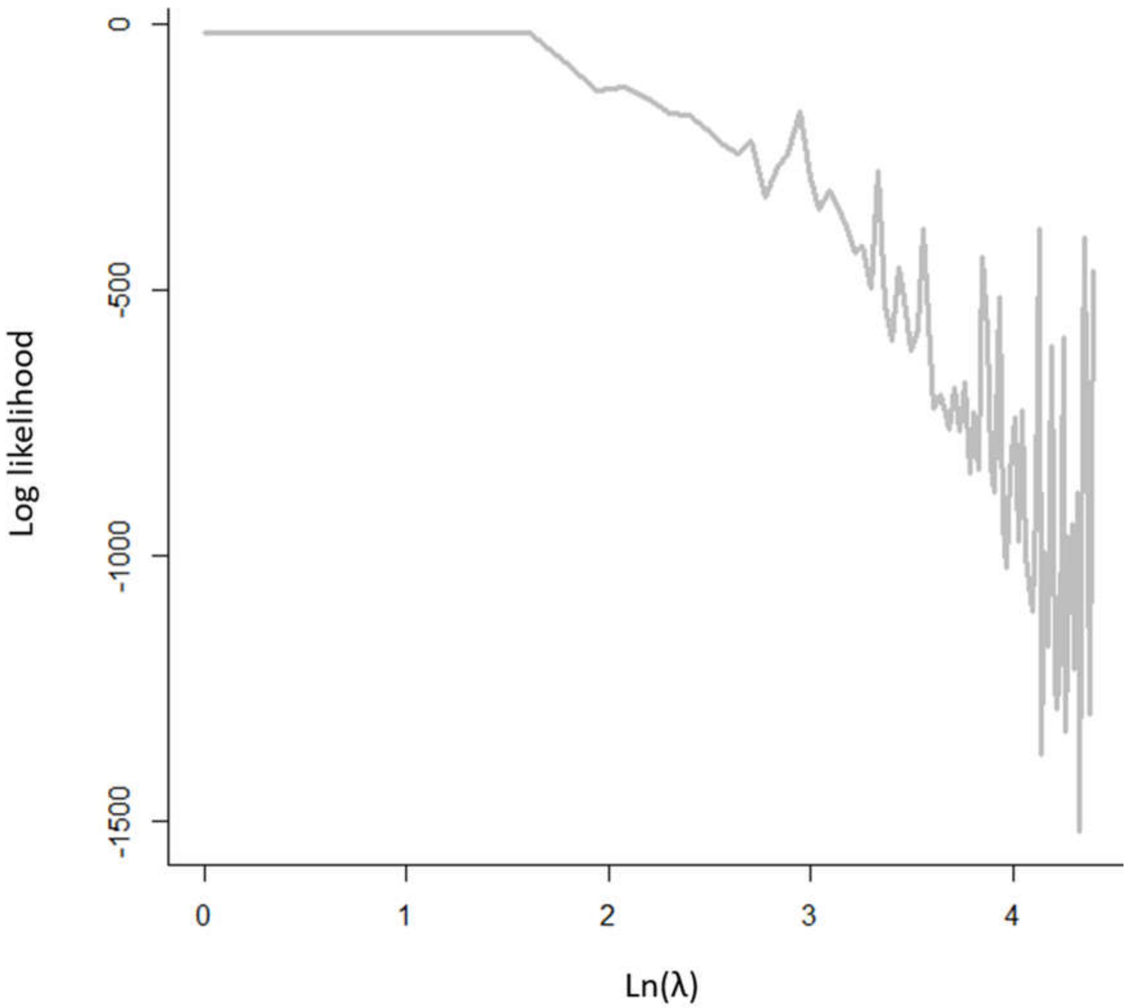


FIGURE S5: Null model randomization test of geographic sub-region as a possible ecological mechanism explaining variation in phylogenetically controlled mean fruit length. The observed coefficient (β_{obs}) from phylogenetic generalized least-squares (PGLS) regression is compared against the 95% confidence intervals of coefficients (β_{null} CI) from 1000 PGLS iterations where trait values were randomized across the phylogeny.

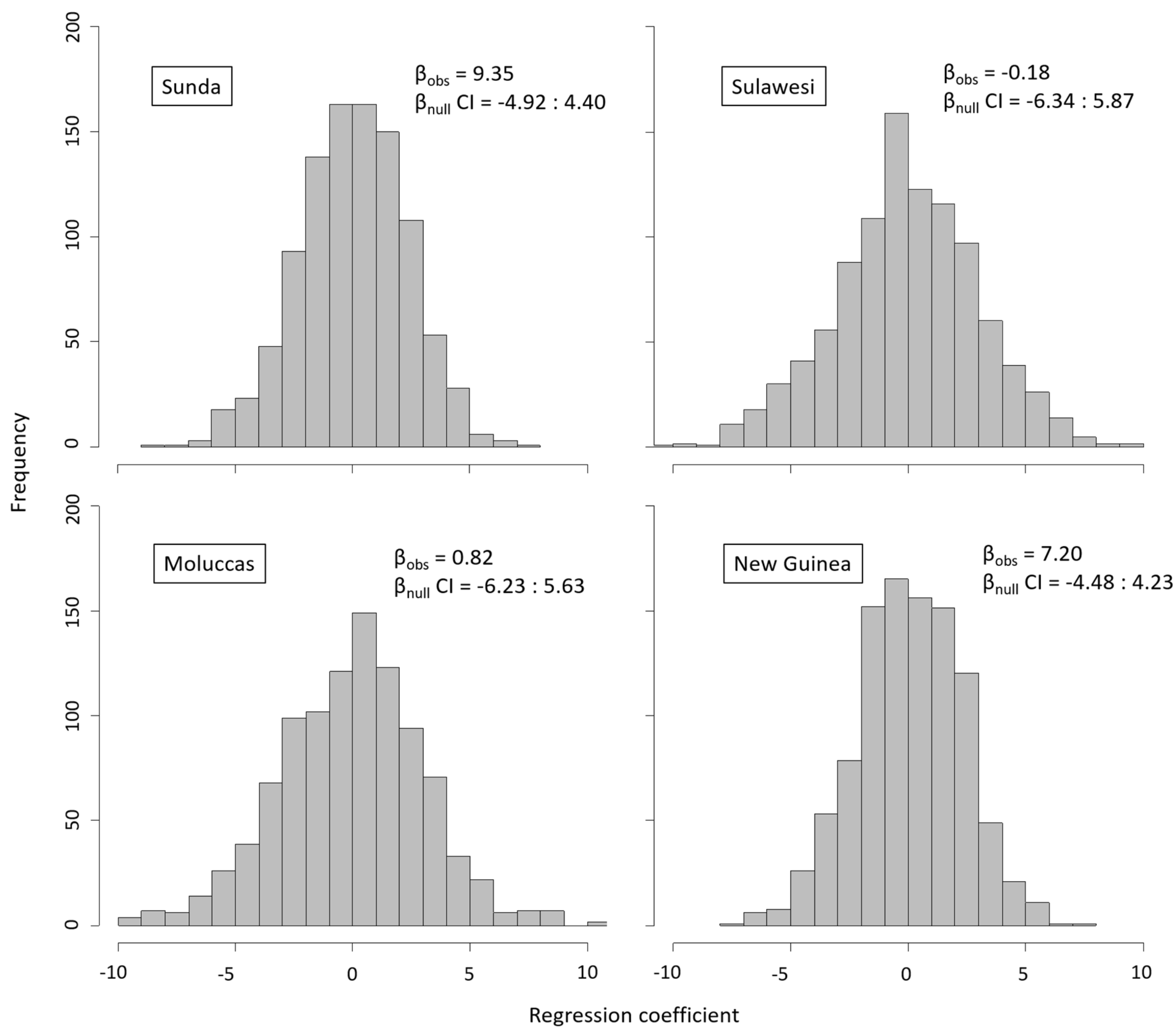


FIGURE S6: Size distributions of granivorous mammals in the Indo-Malay Archipelago.

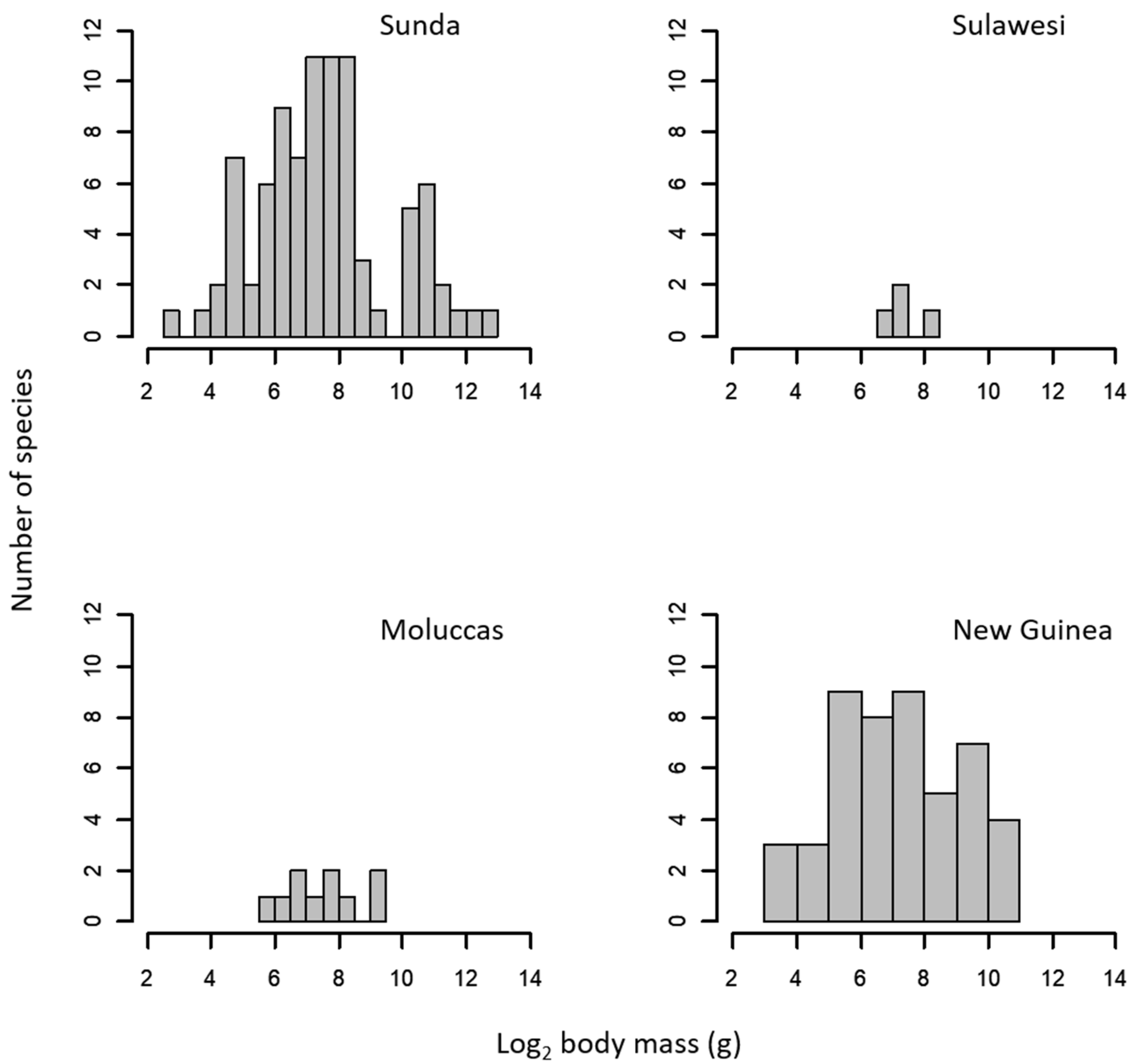


FIGURE S7: Size distributions of carnivorous mammals in the Indo-Malay Archipelago.

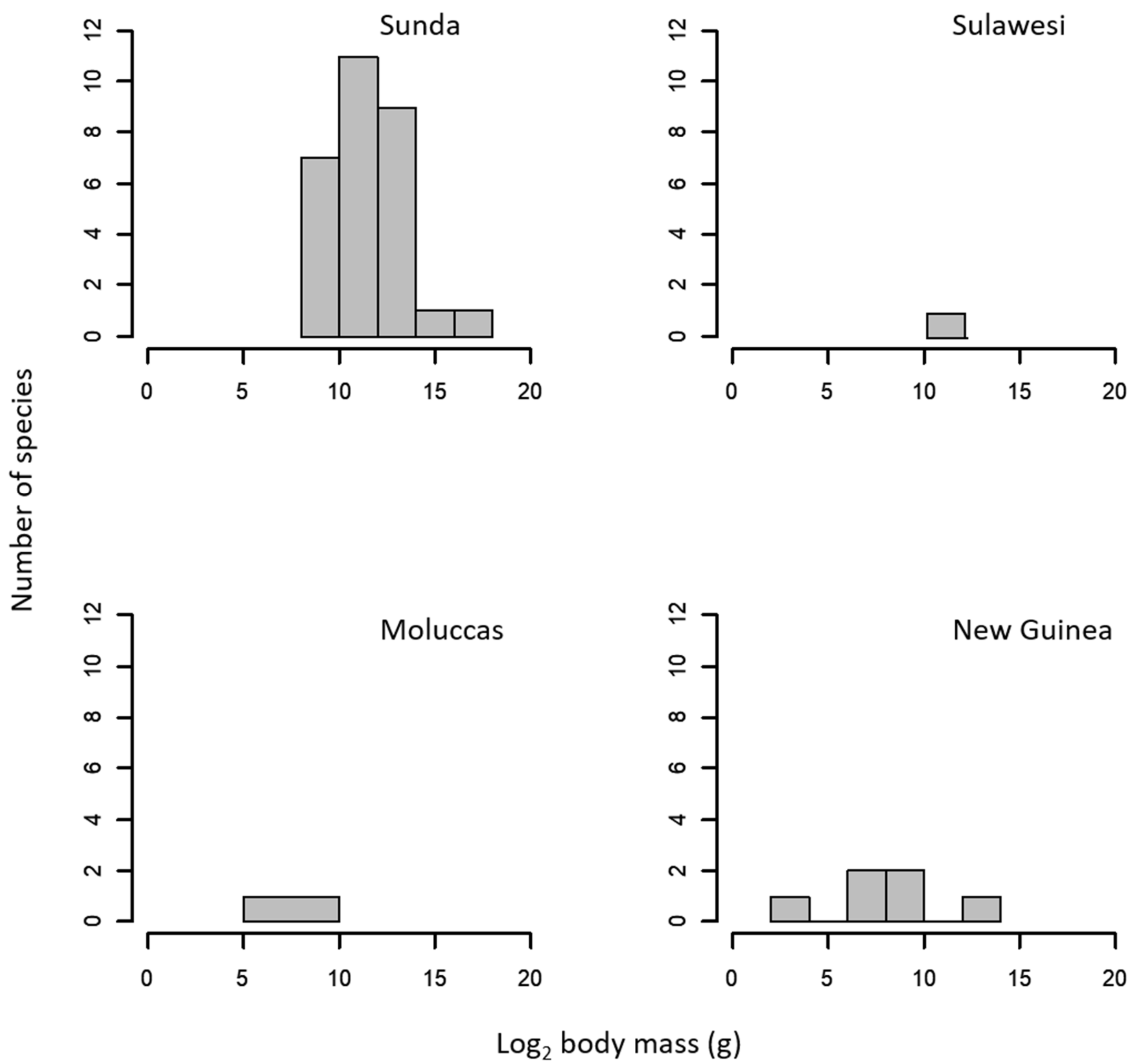


FIGURE S8: Size distributions of non-volant insectivorous mammals in the Indo-Malay Archipelago.

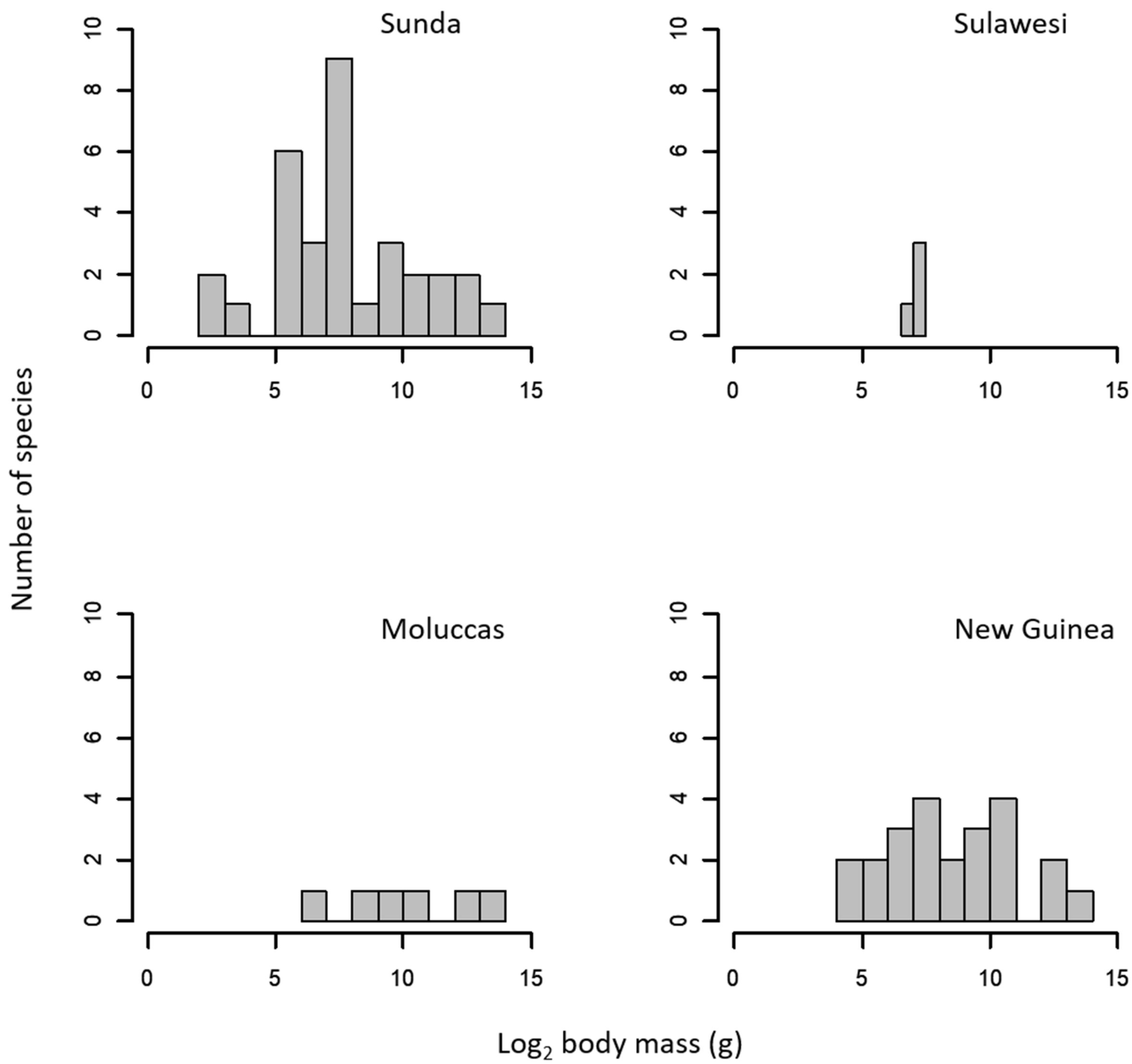


FIGURE S9: Size distributions of volant insectivorous mammals in the Indo-Malay Archipelago.

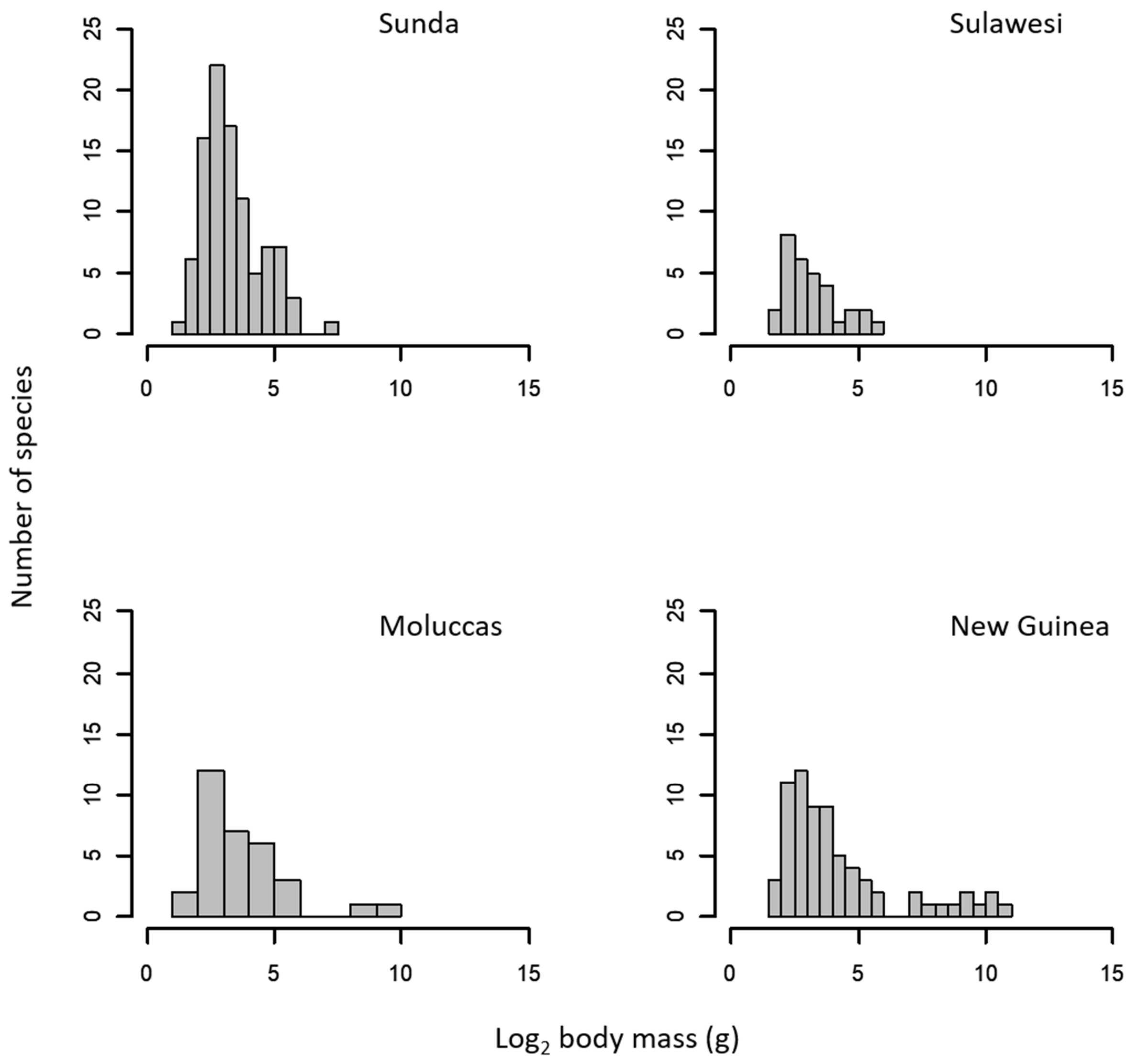


FIGURE S10: Size distributions of volant frugivorous mammals in the Indo-Malay Archipelago.

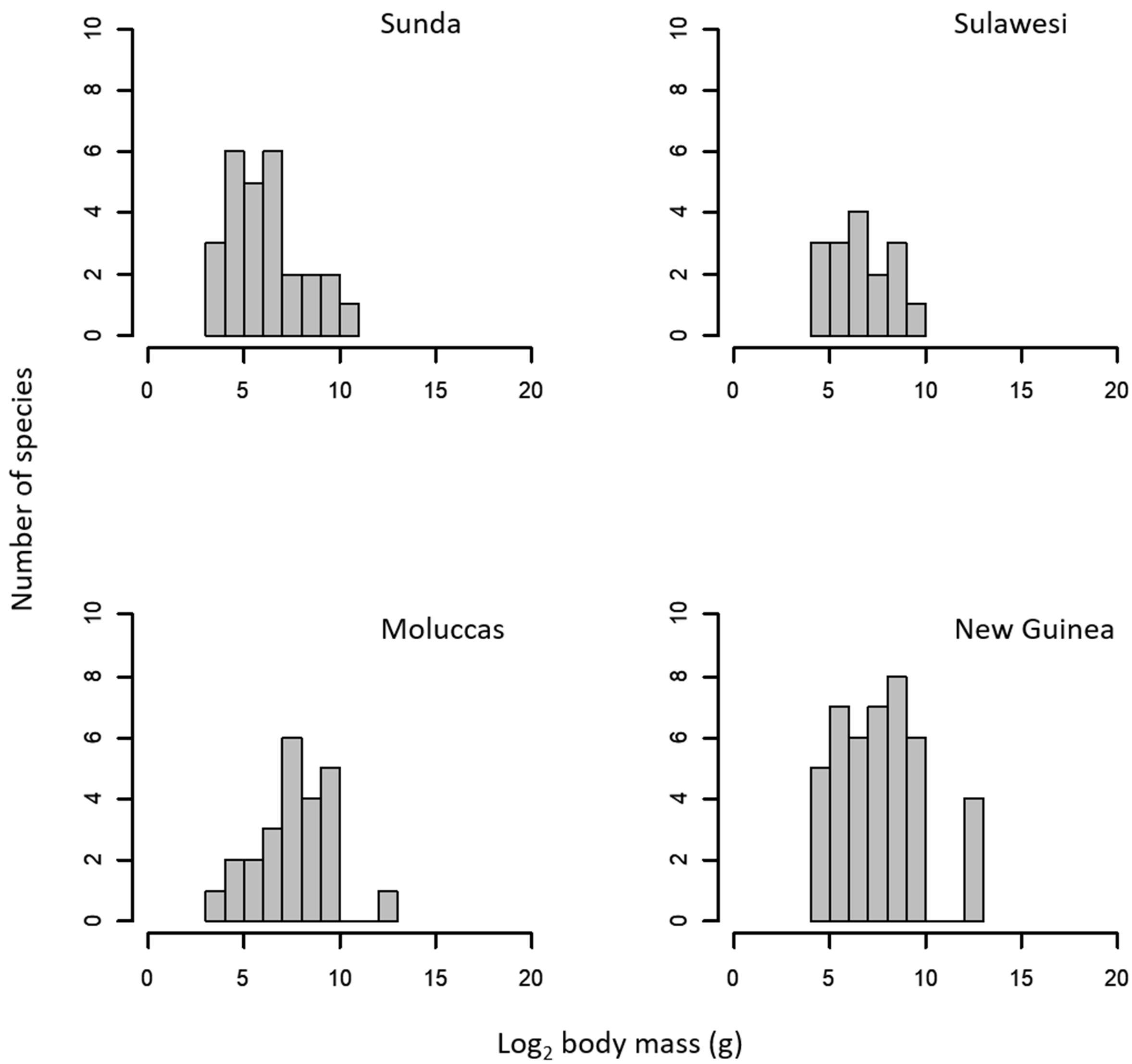


FIGURE S11: Size distributions of non-volant frugivorous mammals in the Indo-Malay Archipelago.

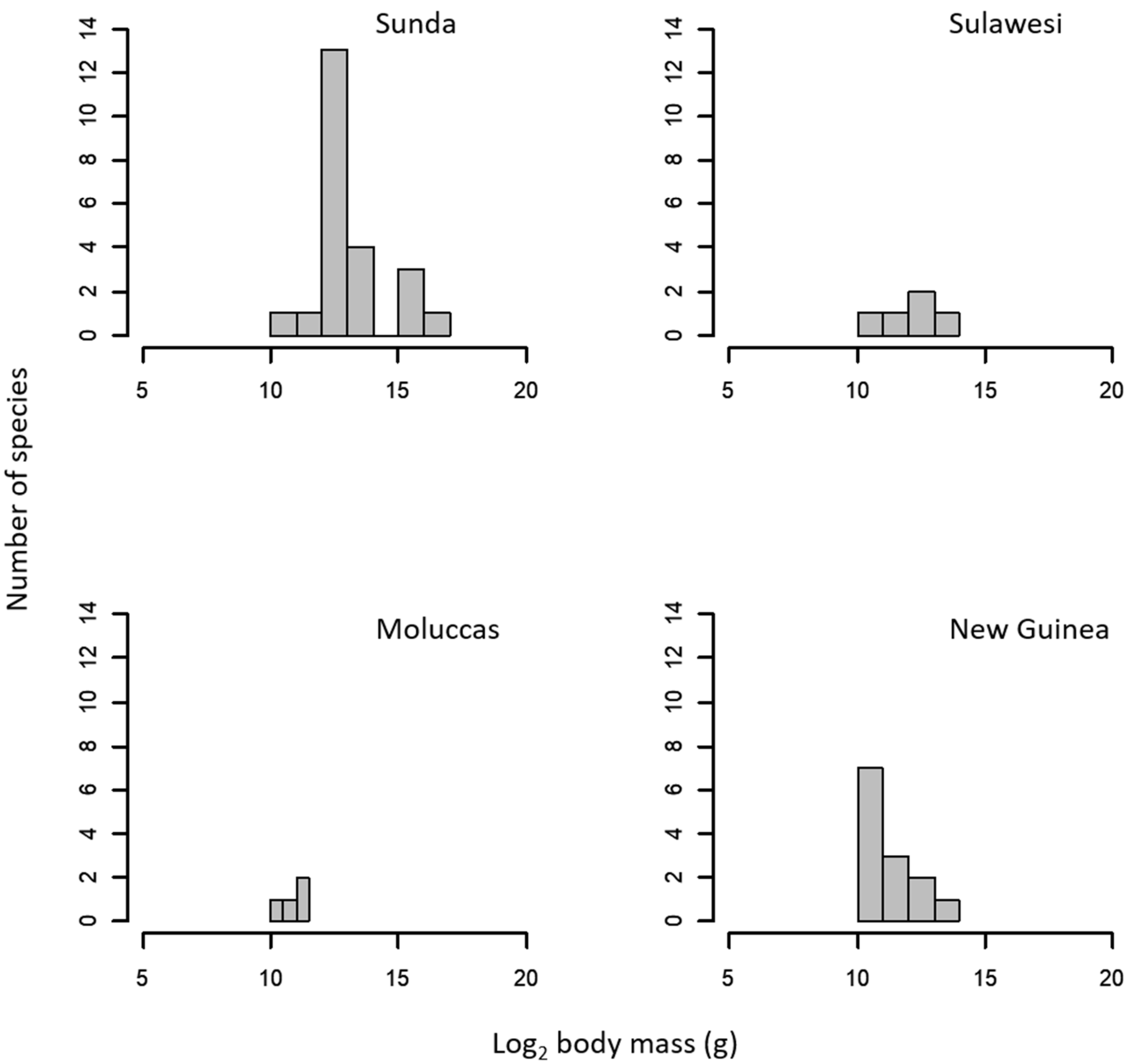


FIGURE S12: Histograms of phylogenetic generalized least-squares regression coefficients from 1000 model runs where the phylogenetic tree was generated by random draws of the phylogenetically uncertain taxa in each run.

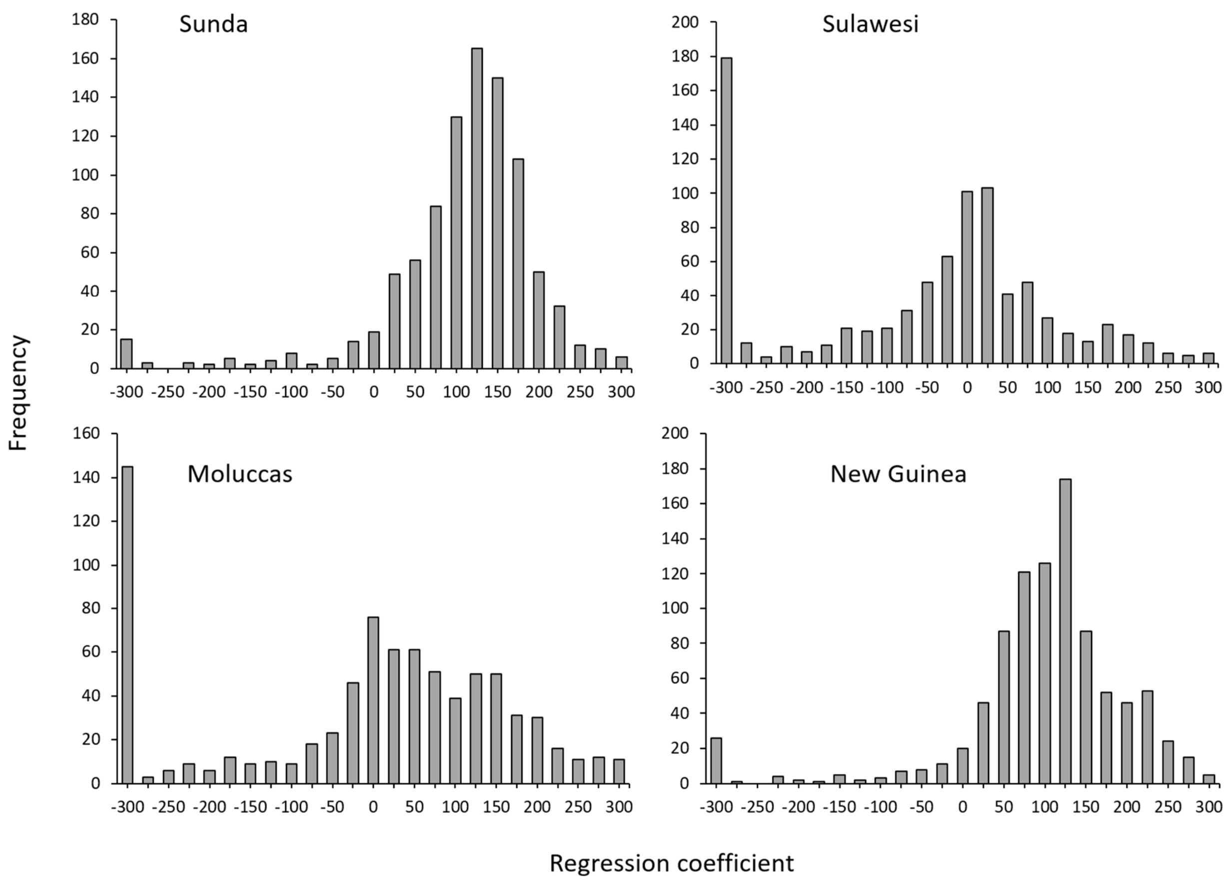


FIGURE S13: Phylogenetic relationships among Sapindales species, as used here.

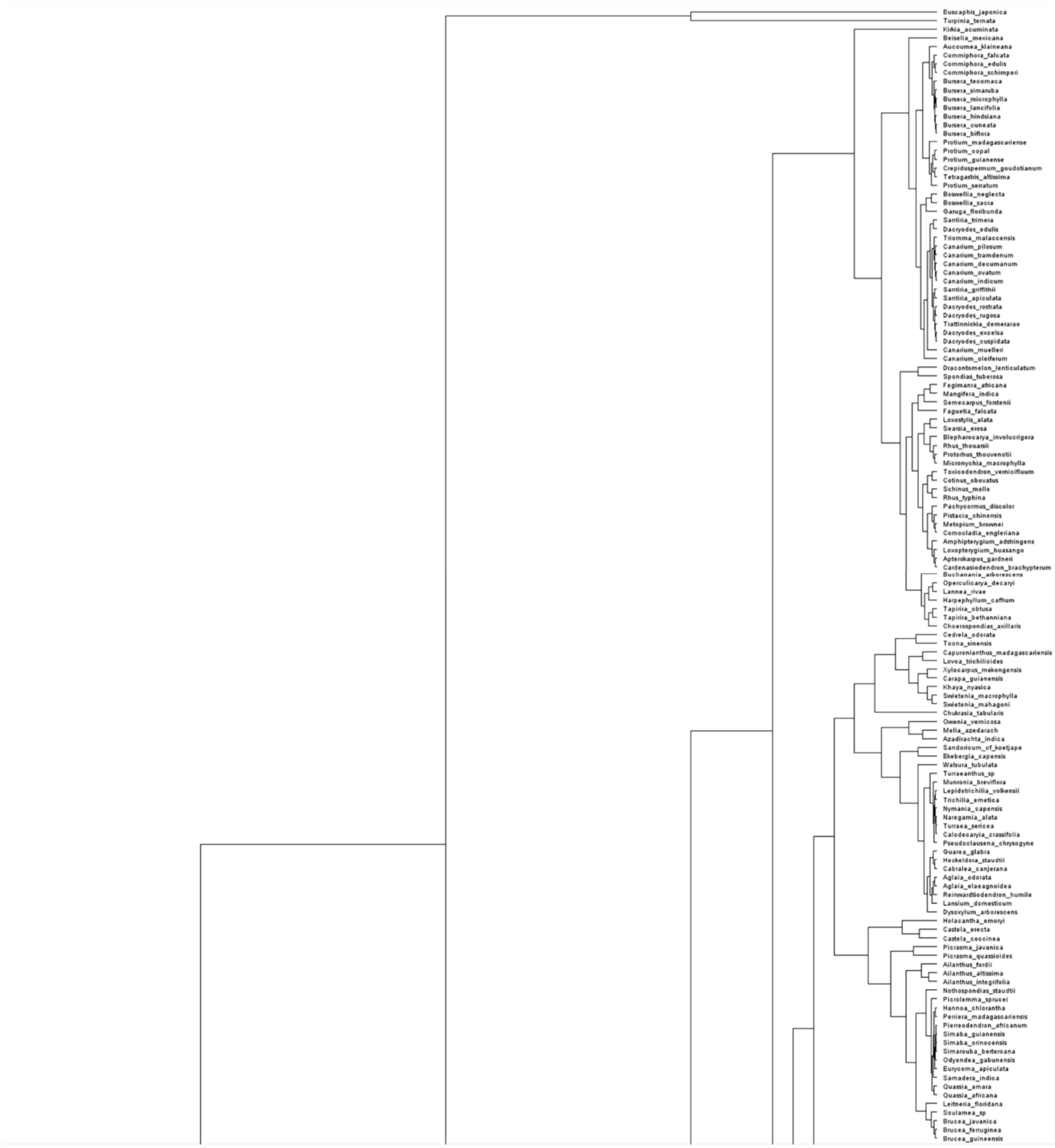
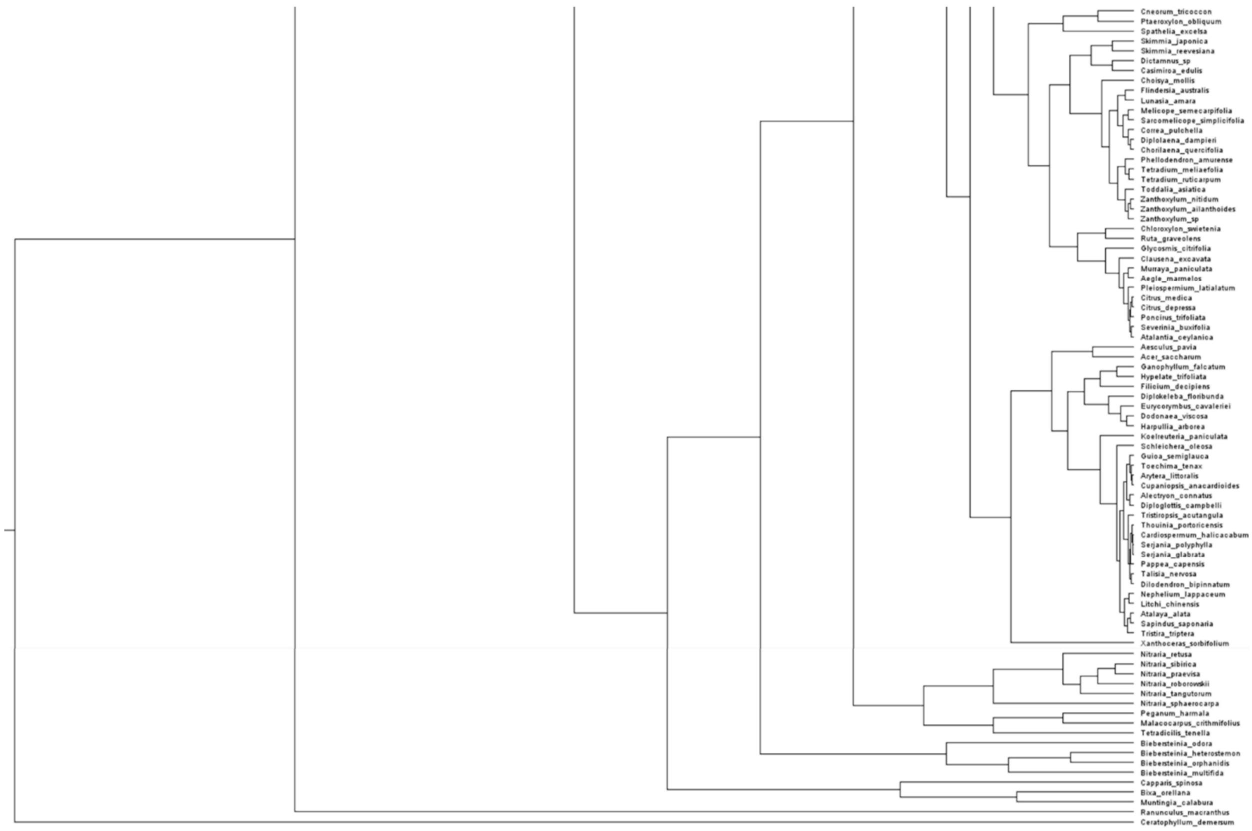


FIGURE S13 (Continued):



REFERENCES

1. Martins WS, Carmo WC, Longo HJ, Rosa TC, & Rangel TF (2013) SUNPLIN: simulation with uncertainty for phylogenetic investigations. *BMC bioinformatics* 14(1):324.
2. Leenhouts PW, Kalkman C, & Lam HJ (1958) Burseraceae. *Flora Malesiana, Series I, Spermatophyta: Flowering Plants*, ed Van Steenis C (Noordhoff-Kolff N.V., Jakarta, Indonesia), Vol 5, pp 209-296.
3. Nooteboom HP (1972) Simaroubaceae. *Flora Malesiana, Series I, Spermatophyta: Flowering Plants*, ed Van Steenis C (Wolters-Noordhoff Publishing, Groningen, The Netherlands), Vol 6, pp 193-226.
4. Hou D (1978) Anacardiaceae. *Flora Malesiana, Series I, Spermatophyta: Flowering Plants*, ed Van Steenis C (Sijthoff & Noordhoff International Publishers, Alphen Aan Den Rijn, The Netherlands), Vol 8, pp 395-548.
5. Adema F, Leenhouts PW, & van Welzen PC (1994) Sapindaceae. *Flora Malesiana, Series I, Spermatophyta: Flowering Plants*, ed Malesiana FF (Rijksherbarium/ Hortus Botanicus, Leiden University, Leiden, The Netherlands), Vol 11, pp 419-756.
6. Mabberley DJ, Pannell CM, & Sing AM (1995) Meliaceae. *Flora Malesiana, Series I, Spermatophyta: Flowering Plants*, ed Malesiana FF (Rijksherbarium/ Hortus Botanicus, Leiden University, Leiden, The Netherlands), Vol 12, pp 1-388.
7. Olson DM*, et al.* (2001) Terrestrial Ecoregions of the World: A New Map of Life on Earth: A new global map of terrestrial ecoregions provides an innovative tool for conserving biodiversity. *BioScience* 51(11):933-938.

8. Corlett RT (2010) Megafaunal extinctions and their consequences in the tropical Indo-Pacific. *Terra Australis* 32:117-131.

9. Corlett RT (2013) The shifted baseline: Prehistoric defaunation in the tropics and its consequences for biodiversity conservation. *Biological conservation* 163:13-21.

10. Hijmans RJ, Cameron SE, Parra JL, Jones PG, & Jarvis A (2005) Very high resolution interpolated climate surfaces for global land areas. *International journal of climatology* 25(15):1965-1978.

11. Sanderson MJ (2002) Estimating absolute rates of molecular evolution and divergence times: a penalized likelihood approach. *Molecular biology and evolution* 19(1):101-109.