

Resolution of the Early Placental Mammal Radiation Using Bayesian Phylogenetics

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Molecular phylogenetic studies have resolved placental mammals into four major groups, but have not established the full hierarchy of interordinal relationships, including the position of the root. The latter is critical for understanding the early biogeographic history of placentals. We investigated placental phylogeny using Bayesian and maximum-likelihood methods and a 16.4-kilobase molecular data set. Interordinal relationships are almost entirely resolved. The basal split is between Afrotheria and other placentals, at about 103 million years, and may be accounted for by the separation of South America and Africa in the Cretaceous. Crown-group Eutheria may have their most recent common ancestry in the Southern Hemisphere (Gondwana).

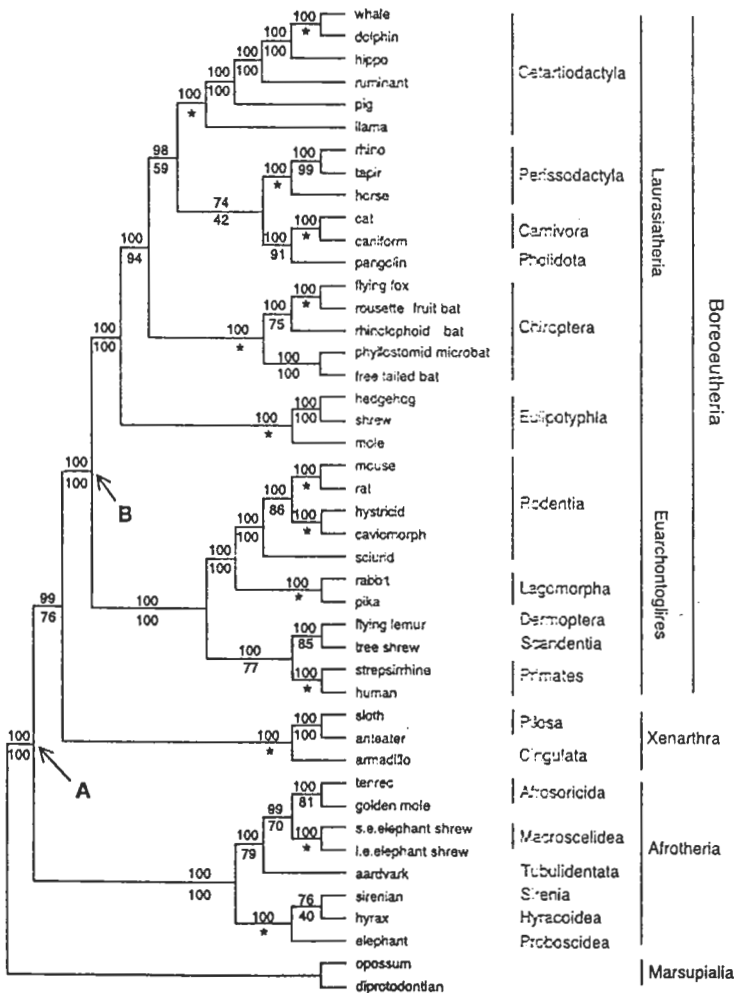


Fig. 1. Phylogeny of living placental mammals reconstructed using a Bayesian phylogenetic approach. An identical topology was obtained with maximum likelihood [$-\ln L = 211110.54$; see (15) for methodological details]. The number above each branch refers to the Bayesian posterior probability (shown as percentages; i.e., 95 represents a posterior probability of 0.95) of the node derived from 26,250 MCMC sampled trees on the basis of the complete 16.4-kb data. Additional analyses with the full data set and with data sets that varied taxon sampling (i.e., jackknifing single group taxa) and character sampling (nuclear only and nuclear coding loci only) produced similarly high posterior probabilities (15). Values below branches represent percent support in maximum likelihood (GTR + Γ + I) nonparametric bootstrap. An asterisk indicates nodes constrained in the ML nonparametric bootstrap analysis. (A) Bifurcation between Afrotheria and Xenarthra + Boreoeutheria at approximately 103 million years, which corresponds to the vicariant event that separated Africa and South America (Fig. 2B). (B) Branch where dispersal from South America to Laurasia is hypothesized to have occurred (15). Blue, monophyletic Northern Hemisphere group (i.e., Boreoeutheria); red, paraphyletic Southern Hemisphere group (i.e., Xenarthra + Afrotheria); black, outgroups.

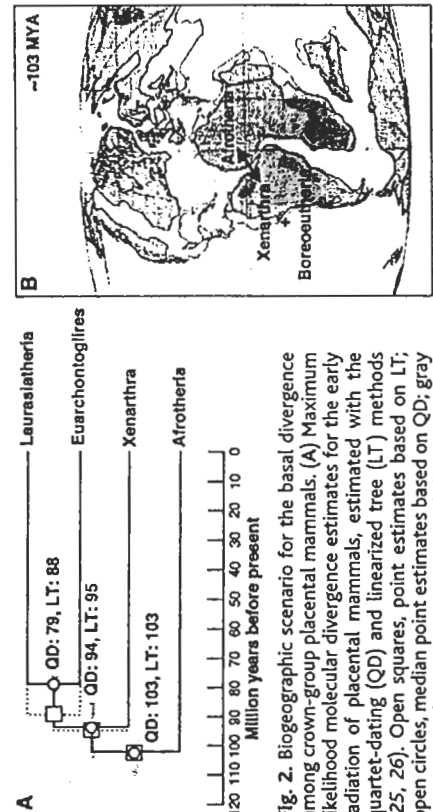


Fig. 2. Biogeographic scenario for the basal divergence among crown-group placental mammals. (A) Maximum likelihood molecular divergence estimates for the early radiation of placental mammals, estimated with the quartet-dating (QD) and linearized tree (LT) methods (25, 26). Open squares, point estimates based on LT; open circles, median point estimates based on QD; gray bars, range of 95% confidence intervals based on QD. A summary of QD and LT methods and results can be found in supplemental material (15). (B) Final vicariant separation of Africa and South America, approximately 100 to 120 Mya (28, 29), isolates Afrotheria in Africa and the common ancestor of Xenarthra and Boreoeutheria in South America. Reprinted with permission from Cambridge University Press (28).