

Rooting the family tree of placental mammals

February 15 2016



Elephant. Credit: Picture by Yathin S Krishnappa. Licensed under CCBY-SA3.0

Placental mammals consist of three main groups that diverged rapidly, evolving in wildly different directions: Afrotheria (for example, elephants and tenrecs), Xenarthra (such as armadillos and sloths) and

Boreoeutheria (all other placental mammals). The relationships between them have been a subject of fierce controversy with multiple studies coming to incompatible conclusions over the last decade leading some researchers to suggest that these relationships might be impossible to resolve.

There are thus many outstanding questions such as which is the oldest sibling of the three? Did the mammals go their separate ways due to South America and Africa breaking apart? And if not, when did placentals split up?

"This has been one of the areas of greatest debate in evolutionary biology, with many researchers considering it impossible to resolve," said lead author Dr Tarver of Bristol's School of Earth Sciences. "Now we've proven these problems can be solved - you just need to analyse genome-scale datasets using models that accurately reflect genomic evolution."

The researchers assembled the largest mammalian phylogenomic dataset ever collected before testing it with a variety of models of molecular evolution, choosing the most robust model and then analysing the data using several supercomputer clusters at the University of Bristol and the University of Texas Advanced Computing Centre. "We tested it to destruction," said Dr Tarver. "We threw the kitchen sink at it."

"A complication in reconstructing evolutionary histories from [genomic data](#) is that different parts of genomes can and often do give conflicting accounts of the history," said Dr Siavash Mirarab at the University of California San Diego, USA. "Individual genes within the same species can have different histories. This is one reason why the controversy has stood so long - many thought the relationships couldn't be resolved."

To address the complexities of analysing large numbers of genes shared

among many species, the researchers paired two fundamentally different approaches - concatenated and coalescent-based analyses - to confirm the findings. When the dust settled, the team had a specific family tree showing that Atlantogenata (containing the sibling groups of African Afrotheria and the South American Xenarthra) is the sister group to all other placentals.

Because many conflicting family trees have already been published, the team then gathered three of the most influential rivals and tested them against each other with the same model. All of the previous studies suddenly fell into line, their data agreeing with Tarver and colleagues.

With the origins of the family tree resolved, what does this mean for [placental mammals](#)? The researchers folded in another layer - a molecular clock analysis. "The molecular clock analysis uses a combination of fossils and genomic data to estimate when these lineages diverged from each other," said author Dr Mario Dos-Reis of Queen Mary London, UK. "The results show that the afrotherians and xenarthrens diverged from one another around 90 million years ago."

Previously, scientists thought that when Africa and South America separated from each other over 100 million years ago, they broke up the family of placental mammals, who went their separate evolutionary ways divided by geography. But the researchers found that placental mammals didn't split up until after Africa and South America had already separated.

"We propose that South America's living endemic Xenarthra (for example, sloths, anteaters, and armadillos) colonized the island-continent via overwater dispersal," said study author Dr Rob Asher of the University of Cambridge, UK.

Dr Asher suggests that this isn't as difficult as you might think.

Mammals are among the great adventurers of the animal kingdom, and at the time the proto-Atlantic was only a few hundred miles wide. We already know that New World monkeys crossed the Atlantic later, when it was much bigger, probably on rafts formed from storm debris. And, of course, mammals repeatedly colonised remote islands like Madagascar.

"You don't always need to overturn the status quo to make a big impact," said Dr Tarver. "All of the competing hypotheses had some evidence to support them - that's precisely why it was the source of such controversy. Proving the roots of the placental [family tree](#) with hard empirical evidence is a massive accomplishment."

More information: 'The Interrelationships of Placental Mammals and the Limits of Phylogenetic Inference' by James E. Tarver, Mario dos Reis, Siavash Mirarab, Raymond J. Moran, Sean Parker, Joseph E. O'Reilly, Benjamin L. King, Mary J. O'Connell, Robert J. Asher, Tandy Warnow, Kevin J. Peterson, Philip C.J. Donoghue and Davide Pisani in *Genome Biology and Evolution*

Provided by University of Bristol

Citation: Rooting the family tree of placental mammals (2016, February 15) retrieved 25 April 2024 from <https://phys.org/news/2016-02-rooting-family-tree-placental-mammals.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.