Researchers suggest rate of evolution change can explain discrepancy between molecular clocks and fossil evidence

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A four-day-old mouse. Credit: Wikipedia/CC BY-SA 3.0

(Phys.org) —A pair of researchers affiliated with several institutions in Australia, believe they may have found a way to solve the discrepancy problem that exists between molecular biologists and paleontologists who disagree on the likely first appearance of placental mammals. They describe their new dating approach, which they call a "morphological clock" in their paper published in *Proceedings of the Royal Society B: Biological Sciences*.

To date the first appearance of a something in the biological record, modern scientists have two main tools—dating fossils and using what's known as a molecular clock, where DNA techniques are used to follow the evolution of species divergence. Problems come in when the two methods offer different results. That's been the case with researchers attempting to date the first arrival of placental mammals. The earliest fossils suggest they showed up on the scene approximately 66 million years ago. The molecular clock approach, however, suggests it happened long before that, approximately 90 to 100 million years ago. In this new effort, the research pair suggest a way to resolve the difference (without claiming that the difference is because older fossils have just not been found.) They call their approach a morphological clock, which is based on the progression of anatomical differences that arise in a species, rather than DNA tracing.

Using it, they suggest it's possible that placental mammals first arrived as early as 160 million years ago. But they have a caveat, they suggest, that the speed at which evolutionary changes took place could have changed, which if taken into account, would bring the time frame closer to 66 million years ago. As for why a change in speed of evolution might have taken place, the team notes that it might have occurred soon after the dinosaurs went extinct—which would have opened up a whole new niche that could have been filled very quickly by the advent of placental mammals.

If this new approach is to be taken seriously, it would cast doubts on the accuracy of molecular clocks in general—they're based on the assumption that evolution occurs at a fixed rate. It could also help explain the "sudden" appearance of a wide variety of species 540 million years ago—the Cambrian explosion—which many believe led to the appearance of all modern animal groups.

More information: Ancient dates or accelerated rates? Morphological clocks and the antiquity of placental mammals, *Proc. R. Soc. B* 22 October 2014 vol. 281 no. 1793 20141278. rspb.royalsocietypublishing.or … nt/281/1793/20141278

Abstract
Analyses of a comprehensive morphological character matrix of mammals using 'relaxed' clock models (which simultaneously estimate topology, divergence dates and evolutionary rates), either alone or in combination with an 8.5 kb nuclear sequence dataset, retrieve implausibly ancient, Late Jurassic–Early Cretaceous estimates for the initial diversification of Placentalia (crown-group Eutheria). These dates are much older than all recent molecular and palaeontological estimates. They are recovered using two very different clock models, and regardless of whether the tree topology is freely estimated or constrained using scaffolds to match the current consensus placental phylogeny. This raises the possibility that divergence dates have been overestimated in previous analyses that have applied such clock models to morphological and total evidence datasets. Enforcing additional age constraints on selected internal divergences results in only a slight reduction of the age of Placentalia. Constraining Placentalia to less than 93.8 Ma, congruent with recent molecular estimates, does not require major changes in morphological or molecular evolutionary rates. Even constraining Placentalia to less than 66 Ma to match the 'explosive' palaeontological model results in only a 10- to 20-fold increase in maximum evolutionary rate for morphology, and fivefold for molecules. The large discrepancies between clock- and fossil-based estimates for divergence dates might therefore be attributable to relatively small changes in evolutionary rates through time, although other explanations (such as overly simplistic models of morphological evolution) need to be investigated. Conversely, dates inferred using relaxed clock models (especially with discrete

morphological data and MRBAYES) should be treated cautiously, as relatively minor deviations in rate patterns can generate large effects on estimated divergence dates.

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