**Dinosaurs in decline tens of millions of years before their final extinction**

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This article aims to settle the debate between whether dinosaurs were on the decline in the time leading up to the K-Pg impact or whether they were wiped out in their prime about 66 Ma. Nonavian dinosaurs suddenly disappear from the fossil record at the K-Pg boundary, coinciding with the Chicxulub impact on the Yucatan peninsula, but, based on the approach used in this study, they may have already been on the way out. The statistical methods used were rather simple in principle. They tested for rates of speciation and rates of extinction in the three main dinosaur subclades: Ornithischia, Sauropodomorpha, and Theropoda. They used Bayesian methods and the slope of the graph was either positive, speciation rate > extinction rate, zero, sp. = ext., or negative, sp. < ext. Their findings indicate that these three subclades, with the exception of Hadrosauriformes and Ceratopsidae, were in decline for approximately 40 million years before the K-Pg impact. They did not infer a causal mechanism for the reduction in speciation but many hypotheses are offered in the discussion.

I think this is the first time I have seen a comprehensive phylogeny of dinosaurs in a paper, but I do not really read many papers about dinosaurs, so that was cool to see. I feel like the authors took a great deal of care in their statistical methods to try to have as much confidence as possible that the results reflect the actual events that may have conspired leading up to the K-Pg impact. I liked that the methods used were fairly easy to understand, but I am sure there is a lot more to it than they included in the paper. I liked seeing Bayesian methods used in this paper because, more often than not, I only see them used in biological studies with typically larger samples sizes, or molecular phylogenies. I also found it a little odd that there was no significant difference in the speciation rates of nonavian theropods and birds, but I am not quite sure what the implications of that result are. This paper was fun to read, and it was a manageable length.

I would have liked to see them explain the methods a little better in the body of the paper instead of in the very dense section at the end which I still feel could use some more explanation. I wish they would have offered an explanation as the difference between most dinosaurs and the hadrosaurs and ceratopsians. It seems like a very interesting point that they actually had fairly high speciation rates but still went extinct at 66 Ma. If the decline in speciation was a significant reason that dinosaurs went extinct, then ceratopsians and hadrosaurs may have had a chance to survive the K-Pg impact, but I know that the extinctions of this time are also correlated with body size. I would be very curious to see any papers that come out trying to explain this difference (or possibly be involved in the research!).

I liked the figures in this paper a lot. They were very well done and coincided well with the text. Figure 1 showed how the model would be interpreted. Figure 2A showed what the theoretical models should look like in the context of the Mesozoic, and Figure 2B showed the results for the three subclades and the two clades that were not included in the analysis with clear patterns of early rapid speciation followed by a slowdown. Figure 3A was very cool because one can see by the yellow-gray gradient when speciation rates slowdown and are exceeded by extinction rates. Figure 3B showed the log of the ratio of speciation to extinction rates, I think, and the results seem very clear for the three main subclades. In all of the figures they include Hadrosauriformes and Ceratopsidae, and the differences between these two groups and the rest of the dinosaurs is striking in terms of the rates of speciation to extinction.