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Reading #13

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

Authors: Sakamoto et al., 2015.

Summary: This paper investigates the declining speciation of dinosaurs some 20 My before the Chixculub bolide impact which has traditionally been interpreted as main mechanism responsible for the end-Cretaceous mass extinction (~65 My). Noting that patterns of speciation and extinction are mostly understudied in paleontology, the authors apply a Bayesian phylogenetic approach in order to model and understand dinosaur speciation throughout the Mesozoic. They predict three possible results: (1) a linear increase with time in the logarithm of the number of speciation events along each path of a tree would indicate that speciation and extinction rate were constant; (2) a curvilinear relationship would show that speciation rate did decrease over time but remained above extinction rate and (3) an asymptote that then curves down as extinction rate surpasses speciation. The authors use a phylogenetic generalized linear mixed model (GLMM) in a Bayesian framework and three dinosaur phylogenies and find that the third option where extinction rate exceeds speciation best fits their data. They conclude that they agree with the hypothesis that increasing sea-levels caused land and habitat fragmentation affects speciation, and for this they find a positive correlation. They find that for dinosaur species, extinction rates exceeded speciation rates for about 40 My before the Chixculub impact.

What I liked: I didn’t like this paper as much as I liked others we’ve already read and I think they could have had a better organization of their content. I do think that they did a good job of presenting relevant historical background, for example about the phylogenies that they studied. I also think they did really well with their diagrams and they explained them in a way that an undergrad like me could understand (some papers have super confusing explanations for their diagrams). Lastly, I liked their recommendation to study longer time periods than just the last 10-20 My of the Cretaceous.

What I disliked: I disliked several things. Over the course of the semester we looked at how incomplete and unreliable fossil data is and we talked about several reasons for that. Many of the papers we’ve read also acknowledged that and we could see the authors taking steps to correct for the uncertainties in the fossil record. This paper seems like it does present important information but I somehow don’t feel as though they took the incompleteness of the fossil record into consideration very much. They do talk about how they made their models fit the data at the end of the paper but there are no techniques here that I recognize from previous papers that we’ve read. I also think that they made such a big deal about their new, never-before-done approach that it took away some of the credibility of the paper for me (unless their approach is really that important, I don’t know). We definitely talked about avoiding overblown language in class. Another thing I really don’t like about this paper is the format. The results and discussion together are very long and this makes it difficult to gather the important parts of the paper. For example, they talk about speciation of ornithischians in comparison to theropods. I think that there should have been sub-headings for these as well as for other main parts so that it would be easier to compare and place into context the new information that they give. One thing I would have liked to see in this paper is some reference to what climate was like over the time period they talked about so I could have a more overall view of what the dinosaur habitat may have been like.

Diagrams: Fig. 1 is very useful in showing the theoretical trends of speciation of dinosaurs through time. It shows speciation = extinction and decreasing speciation rate. Fig. 2 shows model predictions of speciation through time for Mesozoic dinosaurs. Fig. 2A shows both a linear and quadratic model. The quadratic model provides a better fit for the speciation that is seen in Fig. 2B. Fig. 3 shows the net speciation per 1 My through time in Mesozoic dinosaurs. Fig. 3A shows net speciation that was calculated and assigned to each dinosaur branch, while 3B shows speciation slow-down and gain for the three main groups.