Dinosaurs in Decline Tens of Millions of Years Before their Final Extinction

This paper is a brief statistical analysis of dinosaur diversity in the Cretaceous, accompanied by some speculation on possible causes for the decline in diversity. The paper used a modeling technique known as “phylogenetic generalized linear mixed model” to examine origination and extinction rates in three dinosaur phylogenies. They found that for the three clades studied, all saw a tailing off of speciation during the End Cretaceous; the authors stress that their findings do not conflict with the consensus on an impact kill mechanism, but rather help explain why the dinosaurs went extinct rather than recovering. The

I appreciated the qualitative analysis of the statistical results, as I’m usually adrift in model-based papers that don’t connect their findings to the actual rock record. I liked that they broke their analysis down by subclade, and discussed the significance of their findings as they related to therapods, sauropods and ornithischians. Their discussion of anomalously high speciation among hadrosaurs and ceratopsians was especially interesting, and I was also glad to see the first birds included as a sort of “control” on the other taxa. The statistical methods and modeling seemed solid; I don’t know how commonly used the technique of node counting is used, nor any of the problems inherent in it, but it seems like an ingenious way to pinpoint origination rates for a modeled study.

I am not sure if I agree with the emphasis on diversity as the prime metric of robustness. The paper’s modeling results are compelling, but I feel that they would be more accurate in a hypothetical sense, asking whether a the dinosaurs were on an extinction trajectory at the time of impact. The dinosaurs’ low origination rates probably were not the damning factor; as we have discussed in class, large range sizes, large populations and a host of other factors are the most distinct buffers against background extinction within a species or genus. On a higher taxonomic level, I am not sure how efficacious these characteristics are, but I saw no mention in the paper that speciation and survival of a higher-up taxon are related. Put shortly, I think the authors are jumping to conclusions about how their results intersect with the larger picture. On a related note, I was confused by the authors’ reasoning on supercontinent breakup; by the Late Cretaceous, Pangaea was already largely rifted, and such an event might spur origination rather than suppressing it.

Since I found the text descriptions of the model’s results a bit tough to follow, the figures were much appreciated. Figure 1 was a succinct presentation of the model’s starting assumptions, so I was glad to have it “spelled out” for me in a series of curves. This helped me to contextualize (if that’s the right term) Figures 2 and 3. Figure 2 is compellingly simple, and is a perfect summary of the study’s findings. Figure 3 was my favorite, though, because it follows a traditional cladistic arrangement and makes the origination results more intuitive. The second part of Figure 3 did seem a bit too simplified, though, as it merely repeated the paper results rather than summarizing or elaborating on the text.