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Reading#10

Origination, extinction and mass depletions of marine diversity.

Authors: Bambach et al., 2004

Summary: This paper investigates whether the five traditional mass extinctions can be really considered “mass extinctions” and it calls into question previous techniques that have been used in such estimates because these techniques did not take into account several sources of error, as, for example, the incomplete nature of the rock record and the fact that some background extinction data became indistinct from actual mass extinctions when statistical analysis was performed. However, when all these have been corrected, it is still clear that the diversity signal is stronger than the background noise. They also present the idea that a mass extinction may grade continuously into a background extinction and list three concepts that explain this: (i) continuity of cause, where a mass extinction is driven by the same process that causes the background extinction, (ii) Continuity of effect, where background and mass extinctions show similar losses based on similar ecology or morphology, and (iii) continuity of magnitude, if the intensity of the mass extinction grades smoothly and continuously into the background. To test their ideas they used previously compiled data and boundary-crossing standing diversity to test diversity change through time. They use plots of proportion of gain or loss to study genera data from Sepkoski (1981) and find that three of the “big five” mass extinctions may have simply been a stronger effect from the background extinction, based on the diversity losses and gains that they saw. They also strongly consider “origination” and “origination failure”, which led to depletions in biodiversity. The authors conclude that the five major mass extinctions have such different features that they could not possibly all share the same cause, and neither did they have the same effects. Instead of considering the big five extinctions as “extinctions” we might want to think of them instead as “mass depletions” or failures in origination. Two of the BIg Five extinctions could have been because origination failure simply exacerbated the effect of the background extinction (late Frasnian and end-Triassic) but the results show other three mass extinctions were the result of “genuine” elevated levels of extinction (end-Ordovician, end-Permian and end-Cretaceous).

What I liked: I really enjoyed reading this paper because it presents a very critical analysis of what has always been accepted to have been the five major extinctions in earth history. I liked that it called into question the “sixth mass extinction” which is said to be occurring today. I also like that they were critical of some of their techniques, and that they looked at the data in a very critical and (I think) unconventional way. For example when they were talking about their preferred methods of testing, like using boundary-crossing standing diversity, they also said why they preferred it as opposed to total diversity. This paper makes me curious about extinction (??) that we see occurring today. What does the diversity loss look like today and is it comparable to the background extinction? Is it a “true” global mass extinction? (Maybe not, because of the short timescale? It could be that humans are just driving up the background extinction?)

What I disliked: This paper was very long and I got lost sometimes. I really disliked that there was no clearly defined “methods” section because I wanted to find out easily which datasets they used and what statistical tests they were going to apply without reading the entire paper. Having no methods section was made worse because the paper was so long and I kept having to return to previous earlier sections to find out what they were referencing. I also think that some terms could have been more well-defined, or maybe a glossary presented (unless there is supplementary material to this paper that I haven’t seen as yet). This is not related to this paper (or the fault of the authors) but I wonder why no one talks about the results in this paper as normally as they talk about the five big mass extinctions? For example, nothing I have read in previous geology textbooks or seen on websites or even documentaries (I watched a lot) talked about origination failure as a way to increase the effects of an extinction.

Diagrams: There were lots of diagrams in this paper and I liked that because it was much easier to visualise the authors’ results. In one way I do appreciate the length of this paper because it allowed for adequate spacing and explanation between diagrams and I liked that they were not all clustered together. Another thing I liked about the diagrams was that they were very systematic. For example, the authors start out with Figure 1 which shows diversity and diversity turnover for the entire Phanerozoic, with the five major extinctions highlighted. This just gives an overall view of the current understanding of the levels of extinction. They then move to the second step, which is to show their plot of proportion of gain or loss of genus diversity, again numbering the mass extinctions. They then move on to figures plotting ranking by magnitude and then go on to show figures of statistical analyses for individual epochs. I think this is a great way to present diagrams because it’s like the inverted triangle presentation where you start with a large overall idea and then progress to more detailed and specific ideas.