This paper examines the relationship of geographic range size and likelihood of extinction throughout the Phanerozoic. They performed a logistic regression on occurrence data of genera of benthic marine invertebrates in the Paleobiology Database in a series of 10-million year intervals, the authors found a weak negative correlation between large range size and chance of extinction; however, that correlation was weakest during intervals containing mass extinctions. They concluded that a large geographic range size was a reliable buffer against background extinction, but that mass extinctions disrupt that paradigm and cause similar mortality rates among genera with broader ranges and smaller ones. From this, the researchers concluded that background extinctions are generally caused by local environmental perturbances, which have a disproportionate effect on genera with small ranges centered on that locale; genera with larger range sizes may be affected locally, but their prospects of survival are better. Mass extinctions, being global in scale, are less selective in terms of range size.

As Basil Tikoff likes to say, any good paper is one that preemptively addresses possible flaws. I liked that this paper discussed potential concerns about biases and distortions, and explained how they had worked to minimize those effects or had structured their research to avoid them. The nature of their research objective meant they had fewer such biases to contend with, as they were looking at relative effects rather than absolute data. However, they still took steps to quantify any distortions present, and reported them to strengthen their claim. While this isn’t always possible especially in shorter papers with more specific aims, I appreciated that they included their exploration of errors here. I also found their discussion and conclusion to be thoughtful and thorough, and I liked that they specifically discussed intervals containing mass extinctions or other examples of global environmental perturbance; they linked their statistical results back to the rock record in a way that I realy appreciate as a geology student, as it helped me to situate my understanding firmly in a familiar context.

I would have liked to have seen some companion research on planktic invertebrates as well, despite the scientists’ discussion of why they chose to exlude them. Although the data would be much harder to control for, they could have yielded some fascinating results. Additionally, I would have liked to have seen a discussion of how ontogeny affects the results; free-swimming larva that mature into benthic organisms may have a shot at larger range sizes, but could their unprotected nature also make them more vulnerable to background extinction? How does water depth play into these findings? A crab and a foram can both be benthic, but the former will prefer a shallower environment to the latter’s deeper one. Perhaps by examining their data on these bases as well as in aggregate, some new trends may have emerged.

The figures were all appropriately linked to the text, as will be the case with most statistically-based papers; given that they were the results themselves, I’m not sure how they would be poorly incorporated! Figure 1 plotted the results of their logistic regression on the Phanerozoic timescale, showing how geographic range selectivity (great or small) had changed over time. The researchers included both a plain selectivity graph and one incorporating possible confounding variables, which showed the same shape and general magnitude (though the second one had less certainty). This figure was a strong summary of their findings, showing how selectivity declined during times of mass extinction. Figure 2 was simpler, plotting geographic range selectivity against extinction intensity and exhibiting a weak negative correlation between the two. The graph is plain, and there is little to say about it besides the general trend. I was puzzled as to why they did not include an even simpler graph—that of geographic range size (not selectivity) against selectivity. Since these were the two variables at play, why not include the most basic possible result? Figure 3 was quite compelling, as it illustrated a large part of the researchers’ discussion of expected selectivity. The scientists created a null model across plates based around selectivity as the only factor affecting marine invertebrates’ chances of survival. They graphed the resulting expected selectivity against that observed from the database data; the graph shows that expected selectivity consistently exceeds actual selectivity across time intervals. This indicates that geographic range size is not the only effect on extinction risk; other factors separate from this exert a control as well.