NOTHING NEW UNDER THE SUN? TROPICAL VS TEMPERATE PATTERNS IN THE BIOGEOGRAPHY OF EVOLUTIONARY INNOVATION

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Evolutionary novelties do not originate randomly in time and space, but geographic patterns have not been investigated systematically. The present-day latitudinal diversity gradient, manifest at many taxonomic levels, has been taken to suggest that most evolutionary novelties originate in the tropics, but differential extinction could have been as important as differential origination in the accumulation of taxa at low latitudes. Further, a clade's Recent diversity pattern need not reflect its initial geographic distribution. For example, several marine genera that are widespread or mainly tropical today have their oldest representatives recorded as fossils in high paleolatitudes. Are the tropics, in Stenseth's words, a cradle or a museum?

The question requires an empirical analysis of the fossil record, but preservation and sampling are highly uneven across the globe over the Phanerozoic. As a first attempt to detect robust patterns, I compared the geographic distribution of the 26 post-Paleozoic marine invertebrate orders having high preservation potential to two datasets likely to reflect preservation and sampling bias (Jablonski and Bottjer 1991): (a) first occurrences of poorly preserved orders (having flimsy or easily disarticulated skeletons, e.g. notaspidean gastropods and comatulid crinoids, n = 16), and (b) all published records of Triassic-Bajocian echinoids (n = 887, first third of Paleozoic-time, with most ordinal originations). First occurrences of well-preserved orders were evenly distributed above and below 30° absolute paleolatitude, contrasting significantly with the poorly preserved orders, which are predominantly extratropical in first occurrences ($p < 0.001$, G test). Despite the much more intense collecting and description of fossils at higher paleolatitudes, the Triassic-Bajocian peak in the first occurrence of well-preserved orders falls below 30° paleolatitude, significantly different from the contemporaneous echinoid records, which do appear to reflect collecting intensity ($p < 0.005$, G test; $p < 0.05$ for frequency distributions using 10° blocks, Kolmogorov-Smirnov test). The difference increases if the echinoid superorder Microstomata (which contains primitive taxa bearing novelties related to an important shift to deposit-feeding, but not assignable to any presently recognized order) is used instead of its oldest named order, the Cassiduloida; and remains significant if the Lower Triassic is ignored owing to especially poor sampling ($p < 0.02$). Low paleolatitudes, then, contain significantly more first occurrences of marine invertebrate orders than would be expected from a null hypothesis of sampling and preservation: major novelties appear to have originated preferentially in the tropics. Still unknown is whether the tropics have a higher per-taxon rate of novelty production, but the apparent discordance between within-habitat diversity and ordinal origination along bathymetric gradients suggests that a simple probabilistic explanation may be inappropriate.