MATTERS OF THE RECORD

Incumbency, diversity, and latitudinal gradients

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Accepted: 5 November 2007

Physical environmental factors have been seen as paramount in determining many large-scale biodistributional patterns in time and space. Although this is probably correct for many situations, this view has become so pervasive that it has led to the neglect of the role of biotic interactions in setting large-scale diversity patterns. (In this paper diversity denotes taxonomic richness.) New approaches to this perennial debate on the roles of physical and biotic forces in paleoecology and macro-evolution are needed, and here we explore an argument for the role of incumbency or priority effects in the dynamics behind the most dramatic spatial pattern in biodiversity, the latitudinal diversity gradient.

A global analysis of the fossil record of living marine bivalve genera and subgenera (hereafter simply genera) of the continental shelves provides perhaps the strongest evidence for the Out of the Tropics (OTT) dynamic associated with the formation of the present marine latitudinal diversity gradient (LDG) (Jablonski et al. 2006). The marine LDG appears to be driven primarily by the origin of novel lineages in the Tropics, some of which then expand their ranges into higher, extratropical latitudes (see Jablonski 1993, 2005; Clark and Crame 2003; Goldberg et al. 2005; Jablonski et al. 2006; Martin et al. 2007). Support for this pattern comes from the overwhelmingly tropical first fossil occurrences of living bivalve genera and their subsequent appearances in higher latitudes. Some genera are first found in the extratropical fossil record, but these never match, at any latitude, the number or proportion of genera that have expanded from the Tropics (the ratio is generally ~3:1), and even this smaller number is probably an overestimate, because the extratropical post-Paleozoic fossil record is so much better sampled than that of the Tropics (Allison and Briggs 1993; Jablonski 1993; Jackson and Johnson 2001; Jablonski et al. 2006; Valentine et al. 2006). The result is a gradient wherein the majority of taxa in each latitudinal bin is shared with the Tropics. For genera that originate extratropically, expansion into the Tropics is virtually unknown, at least at shelf depths, and given the anti-tropical bias in the evidence of first occurrences, most apparent instances may be artifacts (Jablonski et al. 2006; see also Vermeij 2005a). Over the past few centuries, successful species invasions have been less frequent in tropical than extratropical regions, at least for mainland terrestrial communities, even though several studies have shown a positive relationship between the number of exotic and native species within climatic zones (Rejmánek 1996; Sax 2001; Fine 2002; Sax and Gaines 2006; Fridley et al. 2007). Fewer data are available for marine tropical settings, but success rates of invasions from the temperate zones also appear to be low, outside of severely disturbed or novel habitats (e.g., Hewitt 2002; Paulay et al. 2002; Fridley et al. 2007). Here we explore some features that may regulate this evolutionary and biogeographic dynamic, and advance a counterintuitive hypothesis in hopes of stimulating research into the neglected role of biotic factors in shaping the LDG.