

MATTERS OF THE RECORD

Measures of global biodiversity dynamics (past and present) are meaningless . . . or are they?

Introductory comments

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One can argue that the critical factors in evolution are competitive interaction, dispersal, and survival in that they determine the life and death of individuals and thus govern gene flow and the waxing and waning of populations; the byproduct of this cascade happens to be the origination and extinction of species and phylogenetic lineages. Perhaps evolutionary “truth” can be found only in petri dish experiments of lichens competing for space, through documentation of the wildly successful ecological invasion of purple loosestrife in ditches of northeastern North America, or by molecular phylogeographic analyses of the distribution of fruit fly lineages across the Hawaiian Islands. Nonetheless, there is something fundamentally intriguing in the fact that there are some 300,000 species of angiosperms currently distributed around the planet; an order of magnitude greater than other, far more ancient clades such as cycads, ferns, and horsetails and a discrepancy that has spurred centuries of evolutionary theorizing on the causes of their high relative diversity—Darwin’s “abominable mystery.” These sorts of macroevolutionary questions necessitate research agendas that target global distributions of taxa over long intervals of geological time. Did mammals stay low to the ground until the large-bodied herbivore niches were opened up when an asteroid knocked off the last of the non-avian dinosaurids at the end of the Cretaceous? Was the transition from the dazzling variety of trilobites that dominated Cambrian and Ordovician marine ecosystems to the diverse ammonoid fauna of the later Paleozoic associated with differing

intrinsic taxonomic turnover rates? Are species in tightly integrated communities such as reefs more vulnerable to extinction during intervals of climate change than species with lower levels of ecological connectivity?

These types of questions often prompt others of a different vein: Are such broad-scale questions interesting? What do the results mean? Can global patterns be measured accurately? Normally, *Paleobiology’s* Matters of the Record section is composed of a brief opinion article or, on occasion, a comment and reply. However, the issue of measuring and interpreting global diversity has such a variety of dimensions that I have invited ten authors to write 1500 words responding to the purposefully provocative statement “Measures of global biodiversity dynamics (past and present) are meaningless.” The authors represent different backgrounds, research agendas, and viewpoints, and the order of the articles was determined with a random-number generator. The evolution of this section benefited from my interaction with many people; I thank the contributors for their enthusiasm, John Pandolfi and Bill DiMichele for giving me the latitude to expand the MOR section, previous MOR editor Arnie Miller for advice, and Richard Bambach and Scott Wing for reviewing the manuscripts.

Although the resulting essays did not fall into clear factions, some consistencies recur through the series. Global biodiversity appears to be most interesting when compared with something else. For example, local extinctions at the Permian/Triassic boundary garner a great deal of attention when put in

the context of all the other local extinctions going on concurrently. The scale and complexity (and loss) of modern biodiversity is more striking when compared with that of 100 million years ago, or 10,000 years ago, or 100 years ago, rather as the first images of Earth from space affected our species' perspective (literally and philosophically) on our planet and our place in the universe. Also intriguing is how different authors focused on different aspects of the statement. Some responded that, although global temporal patterns are

present, they merely average out the key evolutionary processes occurring on local scales. Others focused on the word "measures"; if we have not managed to census the living species pool yet, can we claim to measure diversity patterns across all or portions of the Phanerozoic, given known and proposed nuisance factors such as heterogeneous preservation and sampling? However, as one of the key workers on global diversity, Jack Sepkoski, was fond of saying, the devil is in the details, and I leave further consideration of the essays and the issue to you.