

## **Biodiversity in Space and Time**

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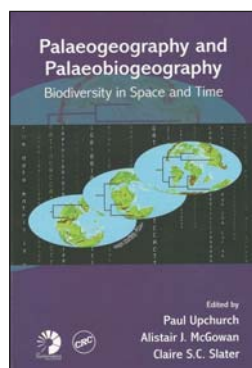
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## Biodiversity in space and time

Paul Upchurch, Alistair J. McGowan, and Claire S.C. Slater (eds.) 2011. *Palaeogeography and Palaeobiogeography: Biodiversity in Space and Time*. xv + 223 pp. CRC Press [Systematics Association Special Volume Series 77]. Hardcover. ISBN: 978-1-4200-4551-2. Price: £76.99.

This volume presents seven papers as separate chapters. A preface contains brief summaries of each chapter, followed by information about the editors and a list of contributors.

Chapter 1 (Biogeographical Convergence and Time Slicing by Cecca, Morone and Ebach) defines biogeographical terms such as diachronic theory, synchronic theory, geographic paralogy, biogeographic convergence, etc., but the main thrust is how patterns of endemism can become erased due to historical successions of vicariant and convergent events, leading to “overprinting” of past patterns by subsequent patterns. The authors advocate the use of a time-slicing approach and discuss the pros and cons of the methods available for such analyses, e.g., parsimony analysis of endemism, area cladistics and temporary partitioned component analysis.

Chapter 2 (Phylogenetic Methods in Palaeobiogeography by Brooks and Folinsbee) begins with a philosophical insight into our ability to interpret simple and complex systems, and that despite 700 years of endeavour no link between parsimony and truth has been established. Biology and historical biogeography are complex sciences, where reticulated area relationships (rather than simple linear ones) are the rule because life has overrun the planet multiple times. Methods for analyzing data that do not allow for complex reticulated area relations must be considered oversimplified and obsolete and a new generation of methods is required. The authors explain phylogenetic analysis for comparing trees (PACT) with an example incorporating hominoids, hyaenids and proboscideans and how it reconstructs historical patterns that are more complex than any of the individual clades. Such studies yield more information than data-deficient studies of a single clade, which is the norm, mainly through researcher choice rather than methodological constraints. This approach permits complex patterns to be found in complex data including the integration of fossil and recent taxa.

Chapter 3 (Uncertainties in Phanerozoic Global Continental Reconstructions and Their Biogeographical Implications by Smith) reviews our knowledge of tectonics, including the uncertainties of palaeomaps. Whereas major steps can be made in reconstructing ocean floor bathymetry, continental topography is more poorly understood. The further one goes back in time, the greater are the uncertainties regarding the palaeocontinental positions. Other than for Western Europe and North America the sparse data available means that palaeocoastlines must be considered speculative.

In Chapter 4 (Boundaries and Barriers of North American Warm Deserts) Hafner and Riddle review and update their earlier findings on North American deserts as a case study illustrating the predictive powers of the comparative phylogeographic approach, identifying

congruent phylogeographic patterns across co-distributed taxa. Despite the ability of this method to resolve differences between regions previously considered indistinct based on a rather static physiognomic botanical viewpoint, there is a reluctance of some workers to reject the latter in favour of this powerful multifaceted approach.

Chapter 5 (Integrating GIS and Phylogenetic Biogeography to Assess Species-Level Biogeographic Patterns by Stigall) introduces GIS in palaeobiogeography, with a case study of Middle to Late Devonian brachiopods and bivalves. Although in its infancy in palaeobiogeographical research, there is no doubt that GIS (where data permit) can be a powerful tool for investigating the spatial dynamics of fossil species, providing a framework in which geographic changes can be compared with environmental, climatic or tectonic events.

Chapter 6 (A Case Study of the Palaeobiogeography of Early Mesozoic Actinopterygians by Mutter) differs in having less of a general interest in terms of theoretical methodology, focusing mainly on fish taxonomy and systematics. However, there is a biogeographic analysis using Brooks' Parsimony Analysis, so it fits within the remit of the volume. The use of authorship, date information and parentheses for taxonomic notation does not follow standard practices. However, these may have resulted from editorial “corrections”.

Chapter 7 (Disparity as a Complement to Taxonomy and Phylogeny in Biogeographic Studies by McGowan and Neige) investigates whether morphological disparity between taxonomic units can provide additional insight in palaeo/biogeographic research, using case studies of cuttlefish and ammonoids. While the analysis of the extant taxa provided some interesting results that may complement taxonomic and phylogenetic data, the palaeostudy was less convincing, particularly with regard to sample sizes in addition to the taxonomic uncertainty of much of the sample (322 genera). Although these issues were discussed under “caveats”, I was still left doubting any conclusions drawn from these data. Nonetheless, the chapter creates an awareness of disparity analyses as a potential research tool.

The volume concludes with an index. It would have been useful to include a summary of ideas regarding future research (particularly as suggestions are made throughout the volume). Having read this volume there is no doubt that understanding the multifaceted complexities of the palaeobiogeography of the multitude of extant and extinct clades and its bearing on the present biota will be no easy feat and that the analytical methods available are still in their infancy. A notable feature is that it considers methods widely used by biologists and ecologists for extant taxa, but in a palaeobiogeographic context, which will stimulate future interaction of neo- and palaeobiogeographers within a framework for comparing the dynamics of extinct and extant taxa across multiple timescales. Unfortunately the paper quality and image reproduction are poor for such an expensive book.

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