

The Past and Future of Biogeography

**Mark V. Lomolino, Dov F. Sax and James H. Brown (editors),
Foundation of Biogeography: Classic Papers with Commentaries
University of Chicago Press, Chicago, 2004, 1291 pp, \$45.00 (paper),
ISBN 0-226-49236-2**

**Mark V. Lomolino and Lawrence R. Heaney (editors), Frontiers of
Biogeography: New Directions in the Geography of Nature Sinauer
Associates, Inc., Sunderland, Massachusetts, 2004. 436 pp, \$49.95
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The past and future of the field of biogeography are on display in the *Foundations of Biogeography* and the *Frontiers of Biogeography*. The former is a collection of classic papers focusing on the history of the field, whereas the latter is an edited volume resulting from the first meeting of the International Biogeography Society. Reading the two books in sequence allows for a more complete understanding of the trajectory of the field and why the current state of some aspects of the field stand where they do.

The purpose of the *Foundations* series is to bring together and reprint classic papers from a field in one place and create a volume for students of the field to use as a reference. In this aim, the *Foundations of Biogeography* succeeds admirably. The book is divided into eight sections and seminal papers for each field have been included. One of the editors notes in the introduction that many will likely quibble with the particular papers that have been included or left out. However, the structure of this volume illustrates the breadth of topics that needed to be covered and the editors did a reasonable job of including important papers for each one. Moreover, the length of the book certainly indicates their attempts to be inclusive.

I found part one of *Foundations* to be the most interesting section of the book for two reasons. First, it was fascinating to observe the differences in how science was conducted and presented in the 1700s and 1800s as compared to today. References to god, religion, and theology were common. One paper uses biogeographic principles to argue against Noah's flood as an explanation for the distribution of organisms. Another refers to the natives of a region as savages and theorizes that the mild climate must make them indolent and lazy. Second, despite the differences in approach and tone, it was eye-opening to see that many of the patterns we are trying to explain today were identified very early in the history of biogeography. Even some of

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the proposed causes are the same. It seems a little as though we are just arguing over the same points using ever more sophisticated methods.

Each of the other sections tackles a particular topic and the selection of papers in each is well chosen. In particular, I was pleased to see that geology and paleontology papers were included where appropriate. My problems with the book are common to the *Foundations* series and not unique to this volume. Although I understand the reasons why one might want to present classic papers in exactly the form they were first presented, very early papers whose type-setting was difficult to read in the original form would be better if they were re-set here (e.g., paper 7 by James Dwight Dana, p. 88). In particular, ones that have to be reduced to fit within the page size of the book should be re-set if the original font was difficult to read. Even recent papers that are readable in their original form are rendered less so when reduced to fit within the volume. Papers from the journal *Science* provide a typical example (e.g., David Raup's paper on Phanerozoic diversity patterns, p. 901). Once reduced, the font is so small that they are difficult to read even by those with good vision.

Overall, the *Foundations of Biogeography* book should make a worthy addition to the library of a biogeographer at any stage. Students just beginning their study will find it an easy and useful way to learn the history of the field. More established researchers will find it to be a handy reference. Finally, this book would make an excellent text for use in an introduction to biogeography seminar or in a history of biogeography course.

Frontiers of Biogeography is an edited volume resulting from the first meeting of the International Biogeography Society. Although *Frontiers* is ultimately an interesting collection of papers, people should not be misled by the title. This book is more of a summary of the state of biogeography at present, than a compilation of papers that push the envelope. Many, but not all, of the chapters are review papers that reiterate ideas the authors have published elsewhere. I do not mean to say that the ideas are not worthy of repeating, only that much of what is found in this book can be found elsewhere, albeit piecemeal.

Frontiers is divided into five sections that each tackle a particular area of biogeography. However, the demarcations are not clear-cut and some chapters could have been placed in multiple sections. For example, the Crame chapter on marine diversity gradients could have been placed in the section on diversity gradients rather than marine biogeography. Similarly, the Roy et al. chapter on gradients in other metrics of diversity using marine invertebrates would have worked equally well in the marine section. Overall, the book is well organized and my only quibble is with the placement of the Humphries and Ebach chapter. A naïve reader would be better served to read the section on phylogeny and diversification prior to tackling the Humphries and Ebach chapter on cladistic biogeography.

The first section is on paleobiogeography and starts with Scotese explaining the methods used in reconstructing Meso-Cenozoic paleobiogeography and continental positions. Those interested in understanding how the science of plate tectonics is conducted will find this a very useful chapter as will those interested in a recent, comprehensive reconstruction of continental positions from 240 Ma to the present. Scotese does a nice job presenting both the strengths and the weaknesses of his field, allowing the reader to have a better appreciation of the validity of the resulting maps. Next Betancourt presents a good summary and critique of using paleomidden data to reconstruct deserts in North and South America. He also makes a compelling case for using paleomidden data to help answer questions about the role of history in community assembly and species coexistence. Jackson's paper continues the discussion of Quaternary biogeography and reviews the literature on climate reconstruction using the plant record and ice cores. He presents his dynamic model of species co-occurrence under changing environments that will be familiar to those aware of his work. I find this to be a compelling model and I liked the way he used it to illustrate the role Quaternary biogeography can play in answering some basic ecological

questions. Finally, Humphries and Ebach give a discussion of the history and state of cladistic biogeography. Much of the paper is a philosophical discussion of why cladistic biogeography is the only reasonable way to reconstruct a taxon's history in a particular area using the area cladistics of the Hawaiian Islands to illustrate their points. Overall, I did not find the case for cladistic biogeography to be particularly compelling and I found some of their criticisms of other forms of phylogenetic biogeography rather bizarre. For example, on page 85 they criticize methods that take into account the fact that biotic areas evolve over time and that species may disperse into and out of those areas for *generating* “a result as opposed to discovering a pattern” [emphasis is theirs]. I do not normally consider getting a result a bad thing.

The next section focuses on phylogeography and diversification. Riddle and Hafner start out this section with a paper on the contributions of phylogeography to biogeography. I found this chapter to be extremely useful, in part because they did an excellent job explaining and clarifying the chapter by Humphries and Ebach. However, the section dealing with the growth of phylogeography in the literature could have been shortened. Lieberman explains how to apply the techniques of phylogenetic biogeography to uncover events of geo-dispersal and applies it to a clade of Devonian trilobites. Finally, Brooks gives an in-depth discussion of Brooks Parsimony Analysis (BPA) that will be very useful to those wanting to understand both the method and the history of the method.

The third section concerns diversity gradients. I found this section to be the most enjoyable of the *Frontiers* volume, in part because the majority of the chapters in this section present new analyses and ideas that would not be out of place in mainstream journals, but also because each chapter presents a unique perspective on the best way to tackle this topic. It starts with Roy et al. presenting a paper examining latitudinal gradients in metrics of diversity other than species richness using marine gastropods and bivalves. They document significant relationships between latitude and morphological or functional diversity. They test the model of Allen et al. (2002) that argues that temperature regulates species richness through the kinetics of metabolism, and find support for all their groups except non-carnivorous northeastern Pacific gastropods. Overall, they make a compelling case that testing theory using metrics other than species richness can provide insight into the ultimate causes of the latitudinal diversity gradient. This paper is followed by one by Turner and Hawkins that reviews some of the debate on diversity gradients and argues that species-energy theory is the best supported and that the framework of Hubbell's neutral theory (Hubbell, 2001) is likely to be the most fruitful. The Turner and Hawkins' chapter is thought provoking, but particularly so when read in sequence with the Marquet et al. chapter that follows it. Marquet et al. argue that different taxonomic groups are unique and that deconstructing diversity patterns into their component taxonomic groups and comparing the patterns provides interesting insights into the causes of the latitudinal gradient that are not apparent when only larger taxonomic groupings are considered. Because Hubbell's neutral theory (Hubbell, 2001) argues that species can be considered equivalent units, the framework advocated by Marquet et al. is wildly divergent from the approach recommended by Turner and Hawkins. The juxtaposition of these two chapters made for some very interesting reading. The final chapter in this section reviews island biogeography theory and builds conceptual models bracketed by the extreme types of species turnover on islands (e.g., dynamic equilibrium, dynamic non-equilibrium, static equilibrium, and static non-equilibrium). Whittaker then makes a case for extending this framework to studies of latitudinal gradients in diversity.

The fourth section contains three papers that focus on marine biogeography and run the gamut from marine community ecology to the origins of the centers of marine diversity to dynamics of the marine diversity gradient through the Cenozoic. Vermeij's chapter is a comparison of the expectations for faunas of marine species on islands versus terrestrial species on islands. He argues that the main difference is in dispersal abilities, which are generally low for terrestrial

organisms and high for marine organisms. As a consequence, dominant terrestrial species on islands are likely to belong to clades that occupy subordinate roles on the mainland, whereas faunas on marine islands should not show this sort of turnover in clades. He ends by arguing that ecological information other than taxonomy, range size, and abundance are important in understanding the processes that govern the composition of island and marine biotas and that this information should not be ignored when trying to understand diversity. In the next chapter, Briggs turns his attention to the Indo-West Pacific (IWP) as a center of origin for marine diversity. He argues that there are six coincident patterns that are both ecological and evolutionary in nature that support the idea of the IWP as a dynamic evolutionary center of origin and reviews the literature for each one. The final paper in this section reviews the latitudinal gradient in diversity for marine organisms and discusses the dynamics of this pattern over the Cenozoic. Because the fossil evidence documents a steepening of the gradient over the last 65 million years, Crame argues that the gradient is driven by higher origination rates in the tropics. Although it may not ultimately affect his conclusions, the paper would have been strengthened if it had addressed the effect of sampling as it pertains to diversity estimates derived from the fossil record. Recent work suggests that estimates of diversity are heavily influenced by sampling (e.g., Alroy et al., 2001) and that estimates of Cenozoic diversity might be exaggerated by increasing outcrop area through time (e.g., Peters and Foote, 2001).

The final section concerns biogeography's contributions to conservation biology. It starts with a comparison of the effects of invasions in different taxonomic groups and a discussion of the resulting changes in diversity at local and regional scales. Lockwood argues that the data for many groups, particularly on continents, show an increase in local diversity and very little extinction, but predict a decrease in diversity at regional scales. Islands show similar patterns for poor dispersers (e.g., plants), but taxonomic groups that contain species with good dispersers (e.g., birds) have not shown increases in local diversity on islands. Lockwood argues that taxonomic groups such as birds are likely to be at their carrying capacity on islands and therefore show extinction and turnover in diversity rather than an increase. The next chapter explains GIS-based predictive modeling and its potential application to biogeography. Although Sánchez-Cordero et al. give an example of a predictive model for *Liomys spectabilis* (a rodent endemic to central Mexico) and create a map of potential and projected distributions, they do not really do anything with it. As a result, the chapter reads as though it is an advertisement for predictive modeling, but makes no concrete predictions or conclusions concerning the conservation status of *L. spectabilis*. In contrast, Rosenzweig's chapter is packed with ideas about how species-area relationships (SPARs) can be applied to conservation efforts. First, he uses SPARs to elegantly show that the SLOSS (single large or several small reserves) does not matter for the scale at which it was designed. Despite this, he concedes that it was a useful debate in that it focused attention on the application of SPARs to conservation biology. He then shows that SPARs predict the effects of invasive species shown by Lockwood. Next he makes a case that with a great deal more work, SPARs could be used as environmental indicators and ends by making a case for the importance of reconsiliation ecology. I found this chapter to be thought provoking and challenging and I liked the section on diversity gradients; I expect it to incite future research. The final paper is a case study using the Philippines about how biogeography can be used to create predictive models of centers of endemism and diversity that in turn can be used in conservation planning even if some of the biotas are not well characterized. The predictive model of endemism presented here is based on the extensive work in the Philippines done by Heaney and colleagues. As a result, the mechanics of how one uses biogeographic principles to create such a model are not well explained, making this paper less satisfying than it might have been. However, the paper represents a success story for the role of biogeography in helping to solve today's ecological

problems, and as a final chapter in a book on the frontiers of biogeography, it hits just the right note.

Together, these two books, *Foundations of Biogeography* and *Frontiers of Biogeography*, cover the high points of the science of biogeography with the past on display in *Foundations* and the present and future covered in *Frontiers*. *Foundations* is a handy reference collection for any student of biogeography, and *Frontiers* is an excellent review of the current state of the field with some of the brightest minds in biogeography illuminating a path into the future.

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