

Book Review

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Biogeography in a Changing World.—Malte C. Ebach and Raymond S. Tangney (editors). 2006. The Systematics Association Special Volume Series 70. CRC Press, New York. 212 pp. ISBN 978-0-8493-8038-9 (ISBN-10 0-8493-8038-3). \$49.99 (hardcover).

Biogeography—the study of biology in a geographic context—has potential to be a key area of evolutionary and ecological research. Since the time of Darwin and Wallace, biogeography has evolved to incorporate a diverse range of scientific methods, with many recent advances arising from the application of new geological and genetic tools. The 2007 International Biogeography Society (IBS) meeting (Tenerife) illustrated that biogeographers are now making important contributions across a range of scientific topics. In addition, the interdisciplinary scope of biogeographic research, incorporating local and global perspectives, and a broad temporal range, implies relevance to a vast number of scientists and lay-people alike. The rapidly increasing membership of the IBS seems to be a reflection of this growing appeal.

The time is certainly right for an overview of biogeographic research, but it is important to focus on the future rather than dwell in the past. *Biogeography in a Changing World* presents a diverse assemblage of biogeographical methodologies and viewpoints, a collection ranging, in terms of scientific merit, from the sublime to the—well—less sublime. The book's back cover notes that this field is "hampered by a confusing plethora of approaches and methods." If this were the case already, then it might be argued that the "muddle" is only exacerbated by this new offering. Although the editors' inclusive approach can certainly be applauded in the name of scientific diversity—at least in principle—it is hard to envisage comparable scientific fields proposing similar juxtapositions of such mutually contradictory theses. Would we expect evolutionary biologists, for instance, to invite contributions from proponents of intelligent design? Although the book contains several fine papers, the eclectic mixture offered by *Biogeography in a Changing World* might perpetuate the false impression that biogeography is indeed a rudderless ship. And, although such comments may be seen by some to be divisive, I do believe that standards are required if biogeography is to cement its place at the cutting edges of ecology and evolutionary biology. This book seems to promote diversity at the expense of coherence.

Biogeography in a Changing World begins with some disgruntled voices from the past (Chapters 1 to 3), and ends with a paper that seems completely "out of left field" (Chapter 8). Although this "framing device" is odd, to say the least, the intervening chapters will reward those who choose to keep reading: Hausdorf and Hennig (Chapter 4: Vicariance Biogeography); Stuessy (Chapter 5: Island Floras); Sanmartín (Chapter 6: Event-Based Biogeography); and Riddle and Hafner (Chapter 7: Phylogeography) provide constructive and timely overviews of their respective subjects. They also point to some innovative paths for future biogeographic research.

The book seems to get off on a contestable note. Williams (Chapter 1) tells the reader that "Biogeography is the study of the interrelationships of areas (classification)," whereas "Chorology is the study of the mechanisms of distribution related to taxon origins" (p. 29). If this were correct, then I suspect many, if not most, biogeographers would number themselves among the chorologists. It is tempting to believe that Williams' statement here is merely an issue of semantics, but this is apparently not the case: "If chorology is about the mechanisms to discover the origin of species, and the study of origins is a futile enterprise, then what is left?" He then asks "without a classification of areas, what generalities, really, are there to explain?" (p. 33). The implication that "true" biogeographers are merely the accountants or librarians of the natural world is underlined when he signs off with "The revived threefold parallelism—systematics, biogeography, geology—does not aim at discovering ancestry, origins or any matters related to those things" (p. 44). Such doctrinaire messages do little to pave the way for evolutionary biogeographic research (see also McDowall's 2004 response to Ebach et al., 2003). If *Biogeography in a Changing World* truly seeks to embrace broad perspectives, why does it promote such a narrow view in the opening chapter?

Williams' dour sentiments are echoed in Chapter 2 (Historical Biogeography), where Parenti defines biogeography simply as "a science based on the proposal of hypotheses of distribution that are tested with additional distribution patterns" (p. 63). She also states that "separating identification of a pattern from inferences about the processes or mechanism that caused it remains a challenge for historical biogeography." This view seems akin to a systematist declaring that serious consideration of

evolution, for instance, is “out of bounds.” So biogeographers are apparently not supposed to think, as this is apparently counterproductive: “the revolution in biogeography has been stalled by attempts to generate explanations rather than to discover patterns” (p. 63). Later, to her credit, Parenti does note that “if they are to be useful, patterns must have explanatory and predictive power” (p. 75). But given her oft-repeated edict concerning the secondary (almost inconsequential?) nature of biogeographic processes (and the study thereof), it seems odd that she then defends the supposed primacy of vicariance. Based on one example in which molecular analyses have apparently yielded equivocal results, for instance, she claims that DNA studies “are as yet unable to reject the ancient differentiation of lineages as predicted from biogeographic patterns” (p. 77). Although the jury may indeed be out in some cases, she neglects to note the wealth of DNA studies that unequivocally support long-distance dispersal (e.g., O’Foighil et al., 1999; Coyer et al., 2001; Waters and Roy, 2004; Donald et al., 2005; Knapp et al., 2005). The irony here is that most young students of biogeography would have little trouble—in principle—in accepting either dispersal or vicariant explanations, or indeed any combination of the two. Her final call for biogeographic “revolution” (p. 77) seems to be a plea to return to bygone decades when pattern-based historical biogeography ranged free, unconstrained by empirical data.

Overall, *Biogeography in a Changing World* seems littered with contradictions. The various contributors, for example, reach no consensus as to the value of DNA data in biogeographic analyses. Riddle and Hafner (Chapter 7) and Sanmartín (Chapter 6), among others, note the success of molecular data in addressing a range of ecological and historical biogeographic issues and in resolving some long-standing biogeographic controversies. But, in the course of his “Brief look at Pacific biogeography,” Grehan (Chapter 3) labels phylogeographers as “molecular theorists” (p. 84) and dismisses their molecular clock approach. Given a choice between phylogenetic evidence based on a handful of morphological characters versus an entire genome, for instance, he apparently prefers the former (Grehan, 2006). Parenti (Chapter 2) similarly views the application of phylogeographic methodology as “detrimental, as it has revived untestable hypotheses ... and [has led to] dismissal of the importance of Earth history at all levels” (p. 62). There are two major problems with Parenti’s statement. First, although it is certainly true that some DNA studies are descriptive rather than question-driven, the old claim that centers of origin and dispersal are not testable is simply out of date: “these hypotheses are highly tractable by using statistical phylogeographical analyses to assess the likelihood of each alternative” (Riddle and Hafner, p. 172). Second, the phylogeographic literature is riddled (no pun intended) with the genetic signature of Earth history (e.g., Fleischer et al., 1998; Knowlton and Weigt, 1998; Schneider et al., 1998; Hewitt, 2000; Riddle et al., 2000; Burridge et al., 2006, 2007). It is also interesting that Parenti appears happy to accept molecular results when it suits her (e.g., Meyer

et al.’s 2005 work on turbinid gastropods), but not when it does not (e.g., de Queiroz, 2005). What the editors of *Biogeography in a Changing World* expect students of biogeography to take away from these contradicting themes remains a mystery.

The contrasting contributors to this book also reach no consensus about the possible explanations for repeated biogeographic patterns (i.e., congruent patterns across multiple taxa). The first three chapters consistently assume that such congruence can only be effected by vicariance, usually in the form of tectonic events: that is, the geological “common cause” noted by Parenti, in particular. But Sanmartín (Chapter 6) reminds us that asymmetric dispersal (e.g., via the West Wind Drift) can give similar repeated patterns that have little or nothing to do with vicariance (“concerted dispersal”; p. 135). She notes, for instance, that trans-Tasman dispersal (predominantly from west to east) best explains the Australia–New Zealand sister relationships evident in many southern plant taxa (see also McDowall, 2004; Sanmartín and Ronquist, 2004; Knapp et al., 2005).

A third example of the divergent themes presented coincidentally in this book relates to island biotas. Stuessy (Chapter 5) presents a thorough discussion of island plant biogeography, including a temporal treatment of oceanic island “evolution.” Along the way, Stuessy notes that although “Emphasis on long-distance dispersal has resurged of late ... for oceanic islands there has never been any reasonable alternative” (p. 122). He also comments that “Mosaic archipelagos, such as the Galapagos Islands, offer many more alternatives for dispersal ... and they are more difficult to interpret” (p. 129). Nevertheless, it seems easy enough to accept that terrestrial taxa do not survive for millennia on submarine strata, nor do they colonize newly formed volcanic islands without dispersal. But Grehan (Chapter 3) takes issue with such statements and instead supports an ancient vicariant (panbiogeographic) interpretation for Galapagos biota: “as if the Galapagos were embedded within a continent rather than the ocean” (p. 85). As with Hawaiian *Drosophila* (Beverley and Wilson, 1985; Lewin, 1985), it certainly seems possible that some elements of the Galapagos biota are relatively ancient, dating back to historical (now “extinct”) islands. But any geological evidence for Galapagos islands older than 15 Ma has disappeared due to subduction (Werner et al., 1999). Reading Grehan’s contribution, it is possible to get the impression that panbiogeographers consider their pattern-based method essentially immune to falsification (see also Wallis and Trewick, 2001). Likewise, Grehan’s claim of ancient vicariant origins for the widespread buoyant “seaweed *Macrosytus*” [sic] (p. 90) ignores recent data supporting dispersal (Coyer et al., 2001; Macaya et al., 2006; Hernández-Carmona et al., 2006). More generally, his iconoclastic dismissal of mainstream geological (*Geology First?*; pp. 84–85) and genetic (*Molecular Mythology*; p. 84) data illustrates how far the panbiogeographic program has diverged from the broader scientific community.

On the other hand, and happily, *Biogeography in a Changing World* outlines several important new directions for biogeographic research. Riddle and Hafner (Chapter 7), for instance, seek to address some perceived weaknesses of the phylogeographic program by promoting multi-taxon approaches, and interactions “between phylogeography and area-based historical biogeography” (p. 172). In addition, Sanmartín (Chapter 6) has already gone some way towards testing for the evolutionary importance of asymmetric dispersal using novel event-based methods. Hausdorf and Hennig (Chapter 4) profile a detailed empirical approach that can be used to statistically assess the importance of vicariance. By outlining clear predictions used to test for vicariance across a variety of codistributed taxa, these methods can help to pinpoint valuable systems for ongoing biogeographic research. Compared to the book’s early chapters, Hausdorf and Hennig’s flexible view of biogeography (“the discipline that investigates the spatial distribution of organisms and attributes of organisms”; p. 96) seems like a breath of fresh air. Although the case studies presented here (European and Mediterranean landsnails) do not directly incorporate phylogenetic information, the authors explicitly encourage such data. Their worldly view of biogeography notes that “It should not simply be presupposed that vicariance was the predominant diversification mode” (p. 112). In addition, Hausdorf and Hennig realize that vicariant patterns can become obscured by subsequent evolutionary events such as range expansion, range contraction and extinction.

As the title of this book implies, we live in a changing world, and it is therefore essential that biogeographers move with the times. The constructive offerings presented here by Hausdorf and Hennig, Riddle and Hafner, Sanmartín, and Stuessy, in particular, encapsulate a bright and innovative future for biogeographic research. These contributors provide broad, balanced, analytical views of biogeography that encompass historical and ecological perspectives, dispersal and vicariance, pattern and process. Such programs have potential to uncover important generalities through multispecies research, implement new “tools” as they become available, and point the way forward for biogeography.

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