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## A manifesto of panbiogeography, Australasian edition

Biogeography of Australasia: A Molecular Analysis. Michael Heads, 2014, Cambridge University Press. 503 pp. \$112.00 (Hardback), \$90.00 (Kindle) ISBN: 9781107041028; <http://www.cambridge.org/>

Australia and the surrounding areas of New Guinea, New Zealand, Oceania, and the Philippines are home to many endemic taxa. Moreover, many “basal” lineages (early diverging groups) with globally distributed sister taxa are found in the region: New Caledonian *Amborella* is sister to the remaining angiosperms, New Zealand wrens (Acanthisittidae) are sister to all other perching birds, and monotremes are sister to placental and marsupial mammals. Recent molecular phylogenetic studies of extant taxa have brought to light surprising affinities between taxa from this region and other areas of this world (Sanmartín and Ronquist 2004), and this book is the most comprehensive synthesis of this burgeoning body of work.

The author, Michael Heads, has left no stone unturned in gleaning biogeographic patterns from the molecular phylogenetic literature and synthesizing them in a useful format. Moreover, there is no apparent taxonomic bias: distribution patterns of snakes are discussed alongside ferns. The book starts with a chapter about evolution in space and time and a chapter on global affinities of the region’s biota before a series of chapters on the biogeography of Australia, the Tasman-Coral Sea, the Tasman region, New Zealand, New Caledonia, New Guinea, and the Philippines. Most of the later chapters are formulaic. After discussing the focal region’s geology, common patterns of distribution serve as headings (e.g., *Philippines connections with areas further east*), and these structure the remainder of the chapter. Under each heading, lineages with the biogeographic pattern under consideration are discussed. Note that “biogeography” in this book deals only with the geographic affinities of related lineages. There is no mention of uncertainty in evolutionary inference (such as clade support), nor discussion of hypothesis testing, optimality criteria, ecological niche modeling, or statistical phylogeography.

Despite the book’s subtitle, “A Molecular Analysis,” there isn’t a single molecular phylogeny of organisms in the book. Instead, phylogenetic trees are presented as area cladograms written as indented paragraphs. In discussing Philippine *Copsychus* (Aves: Muscicapidae), for example, areas and species are represented as (p. 392):

Luzon, Panay, Negros (*C. luzoniensis*)  
Palawan (*C. niger*) and Cebu (*C. cebuensis*)  
India and Sri Lanka to Borneo and Java (*C. malabaricus*)

This representation is equivalent to the Newick tree (*C. luzoniensis* ((*C. niger*, *C. cebuensis*) *C. malabaricus*)) (Lim et al. 2011), but guidance on interpretation of these “phylogenies” is never clearly explained. This unorthodox representation of trees is one of several shortcomings that muddle the text.

One problem is that Heads has written a book for a narrow audience. The reader must be versed in the lexicons of molecular phylogenetics, Indo-Pacific cartography, geology, and some rarefied terms from panbiogeography (e.g., Croizat’s “tracks”; Page 1987) to fully understand the prose. The glossary defines only geological terms, and the lack of clearly labeled maps makes the text difficult to follow. Although the book contains dozens of maps to illustrate the distribution of select groups, few of these are labeled with the names of countries, islands, or prominent geographical features discussed at length in the text. One must therefore already know this region well or frequently refer to other sources to understand the biogeographic discussion that constitutes the focus of the book. The inclusion of detailed, labeled maps in the leaves—where they could be easily referenced—would have been a helpful addition.

The most irksome aspect of the book, however, is Heads’ adherence to panbiogeography, “a synthesis of plant geography, animal geography and geology ... This method dissects the geo-

graphic patterns of molecular groups, compares them with patterns in other groups, and synthesizes the results with current ideas on Earth history” (Preface, p. x). Notably, this paradigm denies the possibility of what Heads calls “chance dispersal,” which most would simply term “dispersal,” including long-distance dispersal over water, with subsequent evolution and diversification. While acknowledging that all organisms move to some degree, the ideas of founder effect speciation or dispersal of terrestrial organisms over large bodies of water are rejected outright, despite a long history of research (Stace 1989, Sanmartín and Ronquist 2004, Matzke 2014).

Additionally, Heads rejects the use of fossils to calibrate molecular phylogenies (Chapter 2, Heads 2005). He finds the “transmogrification of minimum (fossil-based) ages into maximum ages” (p. 35), often accomplished with BEAST (Bouckaert et al. 2014), to be particularly egregious. Using an island’s age to calibrate the maximum age of its endemic species is also viewed as error-prone (p. 45, Heads 2011), and, consequently, Heads does not trust the inferred ages of most published phylogenies. Much of the text is spent reinterpreting published studies through the lens of panbiogeography, using vicariance of major landmasses to re-evaluate divergence times and the possibility of long-distance dispersal.

This seems to be a common theme of the author’s published work. Much of Heads’ previous work criticizes commonly used methods and the results of scientists who use them (Heads 2005, 2011). For example, Heads (2011) criticizes the invocation of dispersal to explain the sister relationship of two Asteraceae: *Abrotanella submarginata* in South America and *A. mucosa* in New Zealand. A fossil-calibrated phylogeny suggests that the pair is too young to have diverged by vicariance, but Heads suggests using the break-up of Gondwana to calibrate this node. Swenson et al. (2012) re-evaluate the phylogeny based on Heads’ preferred tectonic calibration and find that this recalibration places the origin of Asteraceae at ~1.5 billion years before present—hundreds of millions of years before the accepted age of the angiosperms and the appearance of any known multi-

cellular fossils. A similar recalibration following Heads’ suggestion places the origin of primates 130 million years before the appearance of any known primate fossils (Goswami and Upchurch 2010).

*Biogeography of Australasia: A Molecular Analysis* is an exhaustive review. Summaries of regional tectonic history and the book’s organization by biogeographic pattern are, in our view, the most valuable aspects of this volume. If one finds a particular biogeographic pattern in their study taxon, reference to this book allows readers to find similarly distributed groups for comparison. However, we suspect that many readers will heartily disagree with Heads’ panbiogeographic perspective.

There is certainly room for a diversity of opinion about methods of phylogenetic and biogeographic interpretation, and skepticism regarding purported new advances is healthy. Heads rightly points out that some authors misuse fossils in age calibration and then adhere to the inferred ages dogmatically, but his preferred alternative of phylogenies dated with tectonic events appears to sometimes offer wildly inaccurate results (Goswami and Upchurch 2010, Swenson et al. 2012). This panbiogeographic viewpoint makes the book read like a work of advocacy rather than an objective scientific text.

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