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# Bats

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The subdisciplines selected for this volume fit into major themes that are widely recognized as fundamental to the field: foraging theory, population dynamics, predator–prey interactions, metacommunities, succession, the equilibrium theory of island biogeography, ecosystem ecology, global change, and gradient theory. More recent theoretical advances, such as the unified neutral theory of biodiversity and biogeography and the metabolic theory of ecology, are given only passing attention. The latter theories are noted in the book primarily to illustrate key points concerning the role of empirical patterns in the development of models or to add support to the major topics presented. The neutral theory and metabolic theory have generated much recent debate but have also sparked controversy, and it may be that the editors considered these developments to lack the level of maturity required for inclusion in a general theory at this time.

As is customary in the field of ecology, theoretical ideas and models are, for the most part, presented verbally and graphically (e.g. flow charts) with minimal use of mathematical formalism. (Chapter 7, "Natural enemy–victim interactions," is the sole exception.) Ecologists have traditionally turned first and foremost to descriptive narrative—often with the use of compelling conceptual arguments—to expound theoretical explanations for natural phenomena. This preference for conceptual description (and the use of null-hypothesis testing, see below) has earned ecology a reputation as a "soft" science in some circles. The editors and most of the contributors of this book clearly feel otherwise and have framed ecological theory as being mature, predictive, explanatory, and eminently useful. For example, in chapter 2, Jurek Kolasa argues that conceptual ideas and qualitative propositions are every bit as fundamental and useful as quantitative models for the development of theory. By contrast, Robert Holt, in chapter 7, writes, "It may not be possible to adequately describe, understand, or even identify the basic propositions of a theory without having a formal model at hand" (p. 126). I think many would agree with Holt, particularly scientists outside of ecology. Prediction and verification are particularly dependent on formal models, and despite the editors' enthusiasm for a conceptual framework, the integration of concrete formalism remains a major challenge for a general theory of ecology.

On the whole, Scheiner and Willig have succeeded in assembling the essential components of a general theory. However, although the content of the book is broad and philosophically rich in its exposition, the editors have overlooked two important problems: The first is the Sisyphean task of integrating into a whole the immense scope of topics that ecology investigates. The second is the many failings of the current approach to testing and validating theory. During the mid-twentieth century, ecologists adopted deductive falsification as their principal experimental method. In both natural and manipulative experiments, ecologists continue to rely heavily on null-hypothesis significance tests (NHST) to ascertain the validity of a theory. But it is now widely recognized that by constraining hypotheses to those that can be falsified, NHST leave out a universe of alternatives that could illuminate a much broader range of possible explanations. The use of NHST steers the development of theory along canalized conceptual constructs that limit advancement. This failing has led other fields that once relied on NHST, such as medicine and psychology, to abandon this method for less restrictive ones, such as model selection and Bayesian analysis. To their credit, ecologists are beginning to incorporate these methods as well. Yet until ecologists address the impact of NHST on their ability to test and validate constituent theories, the goal of developing a rigorous, predictive general theory will remain elusive. These failings aside, I believe *The Theory of Ecology* will enliven the debate over what should encompass a general theory of ecology—and whether that is even possible.

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## *EPTESICUS* OBFUSCATION

**Bats.** Phil Richardson. Firefly Books, 2010. 128 pp., illus. $19.95 (ISBN 9781554078035 paper).

According to its back cover, the book *Bats* is intended to provide "a guided tour of the nocturnal world of bats," illustrating the major aspects of bat diversity, biology, ecology, and conservation, with examples of species from around the world. Developed and published in the United Kingdom by the British Natural History Museum, *Bats* is written for a general audience. Author Phil Richardson was a career science teacher and is a dedicated bat ecologist who has been working to promote bat conservation and research in the United Kingdom for more than 30 years. Had I received this book to review some 15 years ago, I would have considered it a fairly enjoyable introduction to bat families and bat natural history. I might have expressed some concern about the technical inaccuracies, inconsistencies, and generalizations that are scattered throughout the volume, but I would have acknowledged the book's nice illustrations and its wealth of color photographs, and complimented the author's comprehensive treatment of the material and his engaging style of writing. Today, however, I am immediately aware that much of the opening chapter, "Bat evolution and biology," is at least 10 years



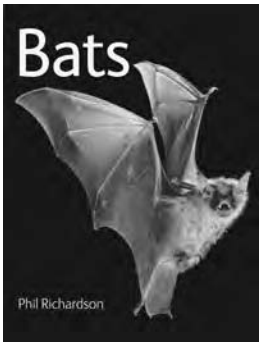
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out of date and does not reflect current evidence and consensus on key elements of bat evolutionary history and classification.

Richardson provides basic summaries of the morphology and ecology of most of the bat families in chapters 3–5, and he highlights research findings relevant to individual species, but I had lost faith in the content of this book by page 9. To start, the author finds it likely that Old World fruit bats (Pteropodidae) "evolved along a very different path from the insectivorous bats, one that branched off from the primates" (p. 7). This statement refers to the debate over whether bats are *monophyletic* (all living species ultimately having descended from a common ancestor) or *diphyletic* (having two independent origins). This "flying primate hypothesis" was based primarily on morphological differences between Old World fruit bats and all other bats and was rigorously championed by Jack Pettigrew in the late 1980s and early 1990s. Counterarguments raged for a while, but ultimately, several multigene molecular phylogenies—notably, those produced by Emma Teeling and colleagues beginning in 2001—offered no evidence for diphyly in bats, and today, the vast majority of evolutionary biologists accept the monophyletic origin of bats. For those interested in tracking this debate, John Altringham gave a nice summary in his second edition of *Bats: From Evolution to Conservation* (Oxford University Press, 2011).

Furthermore, the first box in chapter 1 covers the classification of bats, which is used to organize much of the material in subsequent chapters. Chapter 3 covers "megabats," and chapters 4 and 5 review several of the larger "microbat" families, reflecting the previous division of the order Chiroptera into two suborders—the Megachiroptera, which consisted of only the family Pteropodidae, and the Microchiroptera, which contained all other families. However, evidence that this traditional classification does not reflect evolutionary history began to emerge, primarily from molecular analyses exploring the "flying primate hypothesis," some 14 years ago, with a flurry of papers culminating in a *Science* publication in 2005 from Emma Teeling and colleagues. Their multigene phylogeny generated a very different evolutionary tree, one that has since been universally adopted by the research community and has dissolved the Megachiroptera–Microchiroptera division for good.

The current evolutionary tree identifies two major lineages: the suborders Yinpterochiroptera and Yangochiroptera. Critically, the Yinpterochiroptera unites the plant-visiting Pteropodidae (the old "megabat" group) with five insectivorous "microbat" families grouped into the superfamily




Rhinolophoidea. It seems likely that this group evolved in Asia, and its range is currently restricted to the Old World. The remaining "microbat" families fall into three superfamilies that make up the Yangochiroptera, the geographical origins of which are unclear but which currently has a global distribution.

The last 15 years have been a very exciting and transformational time in the study of bat evolution; there has even been progress in the quest to find a "missing link" in the fossil record with the discovery of the *Onychonycteris finneyi* from the Green River Formation in Wyoming. Limb proportions of this primitive bat from the Early Eocene were between those of nonflying mammals and known bats, and it had claws on all fingers. This intriguing find has fueled the ongoing debate as to whether flight in bats evolved before or after echolocation or whether the two traits coevolved. Richardson's volume fails to reflect the excitement and the findings of this last decade and provides an outdated classification system to organize what constitutes the core of the book. In addition, minor errors in the material that falls within my own specific expertise only reinforce my lack of confidence in the text (there are approximately 330 species of bat in Southeast Asia, not 100) and leave me questioning the accuracy of the other material in the book, with which I am less familiar. Books written for a general audience often do not provide citations to support their statements, so it is all the more essential that they present both accurate and contemporary findings.

The final chapter of *Bats* is focused on bat conservation, and I was disappointed to find this to be a rather cursory and outdated treatment of the topic, in which the substantial global conservation research efforts of the last decade, as well as the emergence of new threats to species, were omitted. No mention is made of the substantial mortality rate of bats from wind-turbine farms; no attempts are given to explain and allay fears about the role of bats in emerging infectious diseases, such as SARS, Nipah virus, and Ebola, and the transmission of the rabies virus. Moreover, there is a growing movement among many bat researchers that work with the public to ensure that images of hand-held bats are limited to those in which the holder is wearing gloves. Although the incidence of bat-borne viruses is very low in most countries—and with most species, the use of gloves clearly reduces the risk of being bitten and the chances of transmission. I suspect that the photograph (p. 117) of a child holding, in her ungloved hand, a Daubenton's bat—the only species in the United Kingdom found with live European Bat Lyssavirus—will not sit well with many practitioners.

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In summary, this book is a missed opportunity. It is clear that the author stopped gathering and reviewing content at least a decade ago. Perhaps this might matter less if recent research were simply refining and augmenting existing knowledge, but in the past 15 years, major changes have developed in our understanding of bat evolutionary history. New threats to bat populations have emerged, and existing threats have worsened. A book with such broad appeal should present the most current body of knowledge possible at the time of publication, particularly if it is intended for a general audience. Failure to do so does a disservice to the interested public.

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## THE LIFE (AND DEATH) OF ISLAND MAMMALS

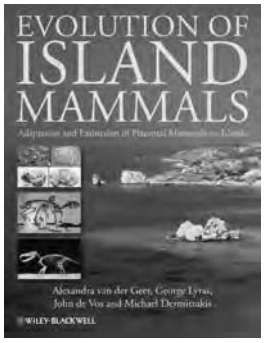
**Evolution of Island Mammals: Adaptation and Extinction of Placental Mammals on Islands.** Alexandra van der Geer, George Lyras, John de Vos, and Michael Dermitzakis. Wiley-Blackwell, 2010. 496 pp., illus. $99.95 (ISBN 9781405190091 cloth).

To understand current patterns of island biogeography and the processes that underlie these patterns, it is essential to have an appreciation of what has gone before. As such, the study of the temporal and spatial distribution of extinct fauna provides much more than a sideshow (albeit fascinating) of weird and wonderful creatures. *Evolution of Island Mammals: Adaptation and Extinction of Placental Mammals on Islands* brings together scattered literature to provide a synthesis of the current state of knowledge on fossil insular mammal fauna with the aim of elucidating modern-day patterns of biodiversity on islands.

*Evolution of Island Mammals* is focused on selected geographic regions and mammalian groups, for which fossil mammal fauna are best known, and provides detailed accounts of faunal composition, faunal turnover, and morphological differences between island fauna and their putative mainland relatives. The book's summary of information on the distribution of extinct insular mammal fauna is itself a valuable contribution to the literature, yet authors Alexandra van der Geer, George Lyras, John de Vos, and Michael Dermitzakis have gone beyond this sizeable task to highlight recurrent insular patterns, with their exceptions, and to speculate on possible mechanisms of speciation, ecological adaptations, and causes of extinction.

Much of the book's information seems to be for the specialized reader, such as detailed anatomical descriptions of dentition and skull morphology that may be less interesting to a nonpalaeontologist. However, the book provides an essential perspective for biogeographers and evolutionary biologists working with extant systems to more fully understand and appreciate biogeographic patterns and evolutionary trends, such as body-size changes. Although the text draws to a limited extent on the ecology and island biogeography of extant mammals (and sometimes other taxa), its focus is on extinct species. This reflects the authors' common research area of vertebrate palaeontology, with a particular emphasis on extinct island mammals. Alexandra van der Geer is an independent researcher at the Netherlands Centre for Biodiversity Naturalis, where John de Vos is the scientific curator. George Lyras is a curator at the Museum of Paleontology and Geology at the University of Athens, Greece, where Michael Dermitzakis is director of the Department of Geology and Historical Geology.

Fossil mammal fauna are examined in the book from two perspectives—first in terms of specific islands or island groups, then by taxonomic group. Although this treatment creates some repetition, it increases the ease with which the information can be accessed, depending on the interest of the reader—whether it be a global perspective of a particular taxon or the extinct mammalian fauna in a specific region. The sections on historical palaeontology, in which the discovery of fossil deposits and the subsequent exploration of each island are described, provide an interesting perspective on the development of the field as the authors explain some initial confusions, subsequent clarifications, and emerging hypotheses relating to the findings.




The chapters are consistently structured, which facilitates comparisons among geographic regions. The shorter chapters are focused on individual taxa and summarize trends observed across regions. The book ends with an attempt to synthesize evolutionary processes, as well as the causes of extinction of mammals in insular environments. It is in this last section that examples from various extant taxa are used to make mechanistic inferences about the patterns seen in the fossil record of mammals. I found these discussions to be somewhat tenuous, especially with regard to mechanisms such as sympatric speciation, which was repeatedly endorsed on the basis of the distributional information of related species alone. Sympatric speciation in animals is thought to be extremely rare and generally

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