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Adams, R. A., and S. C. Pedersen (eds.). 2000. ONTOGENY, FUNCTIONAL ECOLOGY, AND EVOLUTION OF BATS. Cambridge University Press, New York, 398 pp. ISBN 0-521-62632-3, price (hardback), $100.00.

The biology of bats has long interested biologists. Bats are remarkable not only for their adaptations to flight, but also because they possess, as a group, nearly every feeding and reproductive strategy known for the class Mammalia. When one considers that bats represent nearly 20% of the world's extant mammalian species, they seem an obvious candidate taxon for the study of organismal biology.

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Nearly 2 generations ago, bat biologists used the 3-volume treatise *Biology of Bats,* edited by Wimsatt (1970, and subsequent volumes), as a foundation for initiating studies on bat biology, especially those concerning evolution, anatomy, physiology, functional morphology, echolocation, and ecology. Since then, our understanding of bat biology has grown substantially, thanks to major works by a legion of researchers (e.g., Crichton and Krutzsch 2000; Fenton 1985; Fenton et al. 1987; Findley 1993; Kunz 1982, 1988; Kunz and Racey 1998; Racey and Swift 1995).

Ontogeny, Functional Ecology, and Evolution of Bats, edited by Rick Adams and Scott Pedersen (2000), complements these recent works and provides new data and perspectives on bat evolutionary relationships, anatomy, physiology, and functional morphology. Each chapter focuses on an anatomical–physiological system that underlies a major aspect of bat biology. The book's conceptual theme is to incorporate ontogenetic data from these systems into modern systematic, functional morphological, and ecological studies.

Following the editors' introduction, the volume begins with a chapter by Simmons that provides a phylogenetic context for all that follows. The chapter not only reviews current knowledge of bat evolutionary relationships, but it also shows how ontogenetic data contribute to integrative and comparative studies. The review of bat phylogeny is copiously referenced (to 1999) and points to areas of emerging congruence, as well as contradictory and opposing positions. A brief synopsis of how character data are treated in phylogenetic analyses is excellent. Simmons includes her latest findings on higher taxonomic relationships, which will contribute significantly to future comparative studies.

Karim and Bhatnagar discuss early embryology, fetal membranes, and placentation. Because fetal membranes are conserved phylogenetically in most mammalian orders, they provide potentially useful data for inferring interfamilial evolutionary relationships. The authors note that despite the variation in reproductive data among families of bats, the phylogenetic significance of these data remains elusive. It seems that much of the variation in chiropteran fetal membranes is unique to specific families (and therefore autapomorphic) or is so variable that hypotheses of homology are difficult to resolve.

Reep and Bhatnagar review brain morphology and its implications for ecomorphology, especially in feeding, flight, and echolocation. New data on the development of bat brains are described and classical studies reviewed. The patterns of variation in different regions of bat brains suggest that this system could be a fruitful area of future study. Unfortunately, it remains difficult to assess the significance of the development of brain structures without integrating data from other approaches to the study of the brain.

Vater addresses the evolutionary plasticity and ontogeny of bat cochlea. This is a fine anatomical chapter that reviews and extends the work she published in *Bat Biology and Conservation* (Kunz and Racey 1998). Bat cochlear anatomy and physiology plays a central role in the understanding of echolocation, a sense that plays a very large role in bat ecology and behavior. Biosonar research has increased dramatically in universities throughout the world. The present chapter should contribute significantly to those studies by presenting the anatomical and ontogenetic bases of echolocation.

Two chapters focus on ontogeny of the chiropteran basicranium. Pedersen's contribution is an innovative approach to understanding how ontogenetic data can elucidate questions in functional ecology and evolution. Pedersen argues that the basicranial floor forms a foundational anatomical axis that is later modified to affect the rostral and caudal components of the bat skull in fundamentally different ways. Ecomorphological predictions derived from this idea, including the evolution of oral and nasal omission of echolocation calls among bat taxa, seem to be ripe for testing by other researchers.

Wible and Davis provide a comparative anatomical review of ontogeny of basicranial anatomy in bats and present new data on *Megaderma lyra*. This chapter aims to make a case for the utility of basicranial morphology as comparative data for phylogenetic studies within and among bat taxa. The authors begin with a brief review of the important contributions made by studies of the basicranium in mammals and note the roles that this area has played in chiropteran phylogenetics. The authors argue that basicranial anatomy has had limited impact on studies on bat evolution to date, with some notable exceptions (e.g., the debate on chiropteran monophyly). Basicranial anatomy of prenatal specimens of *M. lyra* is carefully described and illustrated. *Megaderma* has basicranial features that both support and raise questions about previous hypotheses of bat phylogenetic relationships. Whereas *Megaderma* has several features that distinguish bats from other eutherian mammals, it lacks at least 2 that are considered synapomorphies for a monophyletic Chiroptera.

Phillips presents a theoretical consideration of dental morphology, ontogeny, and evolution. He asks how dentition contributes to functional ecology in bats and how it has been shaped during evolution. An introductory section, entitled ''Viewing dentition in a biological context,'' challenges the reader to view dentition from many perspectives—as being affected by functional morphological factors, body size and jaw mechanics, growth rate and craniofacial developmental dynamics, lifespan of the individual, and even by chemical and microbial characteristics of the oral environment. The most interesting and thought-provoking part of the chapter is what amounts to an essay on factors that have shaped the evolution of chiropteran dentition. Questions are asked and observations tossed about that challenge us to think in both comparative and integrative terms. For example, it is argued that several of the most interesting questions about bat dental evolution concern the divergence of mega- and microchiropterans, which have fundamentally different dental morphologies. How does one interpret the nearly featureless cheek teeth of many megachiropterans or the lack of convergent features of dentition in nectarivorous pteropodids and phyllostomids? Phillips also pursues an integrative approach to understanding the evolution of specific dietary preferences (e.g., insectivory, frugivory), reminding readers to include consideration of contributions of the biochemistry and physiology of digestion.

The ontogeny of bat wings and the impact of ontogenetic data on ecology and evolution are discussed by Adams. The growth and development of wings in bats is a process that is unique among mammals. It provides bats with unparalleled opportunities for ecological specialization, but it also presents them with challenging constraints. The most interesting section is what the author entitles ''Developmental ecology of flight.'' Adams incorporates data from numerous studies, including his own, to explore the relationship of wing growth and development to flight ability (performance). This is perhaps one of the best examples of how ontogenetic data can directly impact functional ecology.

Adams and Thibault address the ontogeny and phylogeny of the hindlimb and calcar. Although both hindlimb and calcar have been studied in bats from a variety of perspectives, little is known about their ontogeny. This chapter reviews ontogenetic literature and presents new data by the authors on *Myotis lucifugus*, *Artibeus jamaicensis*, and *Megaloglossus woermanni*. A discussion of the evolution of the calcar in both extinct and extant bats is hampered by a paucity of data for most bat taxa, which limits the conclusions that can be drawn at this point.

A comparative perspective on the ontogeny of flight muscles is presented by Hermanson. This contribution integrates muscle anatomy and physiology at scales from molecules to entire muscle groups. Following an introduction to literature on terrestrial mammal muscle ontogeny, data and hypotheses concerning ontogeny of flight musculature in bats are reviewed.

The concluding chapter by Jones addresses the ontogeny of behavior in bats from a functional perspective. Nearly every aspect of behavior encountered by neonatal and juvenile bats is considered, with a focus on the interactions between offspring and their parents (typically mothers). The goal of this contribution is to understand how infants shift from being largely dependent on maternal behavior to becoming independent.

The volume is well edited and produced. Most contributions have numerous references (to 1999), and I noted very few typographical errors. The illustrations are generally of high quality, and the figure legends do a good job of ex-

plaining the figures and referencing sources (where appropriate). There is a short cumulative subject and taxon index at the end of the volume, but it is so limited that it is really not very useful. The editors were clearly successful in keeping the authors focused on integrating form, function, and ontogeny in functional ecological and evolutionary. It is evident that ontogenetic data are difficult to obtain, and yet, from the contributions here it seems that there is much that can be learned by integrating these data into comparative studies of bat biology.—CRAIG S. HOOD, *Department of Biological Sciences, Loyola University, New Orleans, LA 70118.*

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Mittermeier, R. A., N. Myers, and C. G. Mittermeier (eds.). 1999. HOTSPOTS: EARTH'S BIOLOGICALLY RICHEST AND MOST ENDANGERED TERRESTRIAL ECOREGIONS. CEMAX, S.A., Mexico City, 430 pp. ISBN 968-6397-58-2, price (hardcover), US$65.00.

How much biodiversity is the world in danger of losing? Even for scientists, this question is difficult to answer because some 4–40 million species are unknown and unmonitored, and other elements of biodiversity such as genes, populations, communities, and habitats are equally hard to assess. There is no doubt that our planet's forests are under attack, and indeed about 200 million ha were lost between 1980 and 1995 alone—an area larger than Mexico (Bryant et al. 1997). In this murky situation, we have no choice except to protect forests that are known to harbor a maximum diversity of species.

Hotspots is timely, and it highlights the ongoing struggle to save endangered terrestrial habitats that are home to numerous endemic species. The editors have compiled data with assistance from 100 specialists, 72 of whom are contributors to this volume. One drawback of the book is that it would have been much easier for readers to browse specific topics if the editors had provided a subject index. Common names provided in the text do not always coincide with those suggested by Wilson and Cole (2000), but otherwise, *Hotspots* is well written and easily readable for both professional and nonprofessional biologists.

This book highlights 25 biodiversity hotspots that cover about 2% of Earth's land surface, yet represent 50% of all terrestrial species diversity. Norman Myers is one of the few visionaries who alerted the world to the loss of biodiversity by coining the catch phrase ''biodiversity hotspots.'' Over a decade ago, he identified 10 tropical rain forest hotspots that contain an estimated 13% of all plant diversity in just 0.2% of our planet's land area (Myers 1988). The influence of Myers' work is fundamental to this book; indeed, a recent paper of his provides a synopsis of this book (Myers et al. 2000).

Endemism in vascular plants is the main criterion for identifying hotspots because each hotspot harbors about 2,500 species of endemic vascular plants or 1% of the total known diversity. The degree of threat was determined by the percentage (under 25%) of natural habitat that it retained in its original state. The tropical rain forest hotspots generally have very high vertebrate diversity with high levels of endemism, mirroring global trends of plant diversity and endemism. In contrast, temperate and drier tropical hotspots have high plant diversity but low vertebrate diversity and endemism.

Hotspots is divided into 25 chapters including a foreword from the Hollywood legend, Harrison Ford, who has donated US$5 million to protect the hotspots outlined in this book. The editors provide a brief introduction to hotspots, and subsequent chapters follow the list of hotspots cited in table 2 (p. 33) that starts from the Tropical Andes and ends in southwestern Australia. Each chapter has a description of the region, de-