



ZOOLOGY

HANDBOOK OF THE MAMMALS OF THE WORLD. Volume 9: Bats.

Chief Editors: Don E. Wilson and Russell A. Mittermeier; Associate Editors: Albert Martínez Vilalta, David Leslie, Jr., Marc Olivé, and Andrew Elliott; Color Plates Illustrators: Ilian Velikov, Alex Mascarell, Lluís Sogorb, Blanca Martí, Francesc Jutglar, Faansie Peacock, and Jesús Rodríguez-Osorio; Photographic Editor: José Luis Copete; Authors: Luis F. Aguirre et al. Barcelona (Spain): Lynx Edicions. €160.00. 1008 p.; ill.; index. ISBN: 978-84-16728-19-0. [CD-ROM included.] 2019.

Bats need friends. Although only future research will settle the origin of SARS-CoV-2, the genome of the virus shows telltale signs of its history in wildlife (Y.-Z. Zhang and E. C. Holmes. 2020. *Cell* 181:223–227). A close evolutionary relationship between the human pathogen and a virus of unknown pathogenicity previously found in a *Rhinolophus affinis* bat was uncovered early on (P. Zhou et al. 2020. *Nature* 579:270–273). But subsequent analyses revealed that a key piece of the viral genome, the receptor-binding domain of the spike protein that enables entry into host cells, is more closely related to that of viruses found in pangolins (T. T.-Y. Lam et al. 2020. *Nature* 583:282–285; T. Zhang et al. 2020. *Current Biology* 30:1346–1351.E2). Since SARS-CoV-2 is not a direct recombinant of any of the wildlife viruses sampled to date and bat viruses diverged from the human pathogen some 40–70 years ago (M. F. Boni et al. 2020. *bioRxiv* 2020.03.30.015008), the precise identity of the wild reservoirs that resulted in the spillover to humans remains obscure.

Notwithstanding these specifics, reactions against bats have been swift, with attempts to evict hibernating bats from buildings and suggestions of mass slaughter (H. Zhao. 2020. *Science* 367:1436). Most people may not know it, but we too need bats, and not just because they are indispensable for forest regeneration, pollination of key commercial crops such as agave or durian, and keeping insect pest populations in check (S. J. Ghanem and C. C. Voigt. 2012. Increasing awareness of ecosystem services provided by bats. Pages 279–302 in *Advances in the Study of Behavior*, Volume 44, edited by H. J. Brockmann et al. Waltham (MA): Academic Press). We also need bats because insofar as bat immune systems have been studied, they reveal a series of molecular adaptations to viral infection that could well inform future human therapies and prevention strategies (A. Banerjee et al. 2020. *Frontiers in Immunology* 11:26). This is why education and public un-

derstanding of the natural history of bats—from their diversity, ecological roles to their conservation status and, yes, even the risks from viruses that circulate among bats in the wild—are more urgent now than ever before.

One could do no better than to start an education on bats with the present volume, the result of efforts by 52 contributors comprising a who's who of bat scientists around the world, from Swaziland and Australia to Brazil and Argentina, and from Thailand to Germany and Canada. Despite the Herculean task of comprehensively outlining the biology of more than 1400 species, this volume achieves exactly this with close to no mistakes. However, one noted error is the bat on page 470 is not *Monophyllus plethodon*, but *Phyllonycteris poeyi*. With plates depicting every single species known to date, an introduction that piques interest with its summaries for each family, and spectacular photographs of bats in their natural environment, this handbook combines the vicarious and anticipatory pleasures of leafing through a field guide, with the heft and beauty of an admittedly massive coffee-table book.

Although the field guide-like species accounts for every species have no precedent, the syntheses on individual bat families are the most rewarding to read. To condense thousands of pages of research into brief chapters reveals most of all how much more work is needed to understand the conservation status and human impacts on most bat species (W. F. Frick et al. 2019. *Annals of the New York Academy of Sciences* 1469:5–25). Such briefs naturally take up more space for the most species-rich families, such as Vespertilionidae (85 pages), Pteropodidae (45 pages), Phyllostomidae (43 pages), or Molossidae (21 pages), but most family accounts are considerably shorter reflecting less past research and sparking greater curiosity. What extreme genomic adaptations to life in their arid habitats have yet to emerge from studying the few species in the family Rhinopomatidae? Could *Craseonycteris*, the only extant member of its eponymous family, reveal the limits to body size across mammals? Even the longer accounts inspire. Which particular phyllostomid species inspired the intricate gold breastplates and ornaments of the Tayrona and Calima jewelers or the Mayan representations of the bat of death, Camazotz?

These strengths should give the handbook an audience beyond bat specialists. For biologists, the breadth and erudition of coverage from historical taxonomy to bat-human interactions will prove helpful guides to enduring questions in natural history. For budding naturalists, the accounts point to the literature and offer synthetic introductions to vast and growing fields of research. And for families at home hoping to encourage the next generation of

naturalists, the plates and photographs deliver in spades. It may have not seemed that way before this year, but now we know we need to understand bat biology a lot more than bats need to understand us humans.

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THE SOLITARY BEES: BIOLOGY, EVOLUTION, CONSERVATION.

By Bryan N. Danforth, Robert L. Minckley, and John L. Neff; artwork by Frances Fawcett. Princeton (New Jersey): Princeton University Press. \$45.00. xiii + 472 p. + 16 pl.; ill.; subject and taxonomic indexes. ISBN: 9780691168982. 2019.

Public awareness of bee declines and consequences for natural systems and food security has sparked a fascination with pollinators and motivation to help them. Emphasis to date has been focused on honey bees, the well-studied and managed social species that are not native in most of their current range. Their cultural significance and importance for agriculture means the needs of honey bees are generally considered over those of wild, native solitary bees, which are diverse and in gardens and parks all around us, yet more misunderstood. Enter *The Solitary Bees*, arguably the most complete account of solitary bee biology, evolution, and conservation, and filling a textbook gap yearned for by mellittologists for years. No volume is as current and comprehensive on the topic of these important wild pollinators.

To say bees are charismatic is an understatement, and *The Solitary Bees* is filled with entertaining examples, anecdotes, and vignettes that illustrate their unique and incredible lives. Readers are carried chapter by chapter, as the vivid story of solitary bees unfolds beginning with their evolution and diversification, then reproduction, nest building and development and, finally, as pollinators and conservation needs.

This volume is more textbook than field guide; drawn images, photographs, and figures richly illustrate life history, rather than acting as a reference for taxonomic identification. The book is not activity-centered with applied approaches to "saving the bees"; for example, those seeking schematics or instruction to build bee hotels or pollinator gardens. However, the outcome for readers of any skill level is a deep understanding of bees and their needs. Nestled in between field guides and pollinator action-oriented works, *The Solitary Bees* adds synergy to any at-home or in-laboratory library.

Our laboratory selected *The Solitary Bees* as the book club publication we discuss in weekly meetings, and it has upgraded our knowledge of bee natural history and evolution. For example, we had collec-

tive appreciation that bees evolved from hunting wasps but were surprised to learn current understanding hypothesizes a highly derived group of thrip-collecting wasps as the origin of bees (thrips are tiny insects often feeding on flowers). The book is also filled with data-rich tables that are a great source of new research questions and ideas. Tables summarize findings on a variety of topics from the literature, much of which is difficult to collect from regional or societal journals, and seldom accessible to the public. In this regard, *The Solitary Bees* is invaluable for future generations of students and researchers, and this literature-combing exercise exerted by the authors is among the volume's most valuable offerings.

Danforth et al. express that their life-long fascination with solitary bees is partly due to a bee's simplicity of being: rapidly moving from reproduction to nest building to foraging, and over a short activity period. In contrast, the contribution of this volume is nothing near simplistic or short. *The Solitary Bees* represents what will be the standard go-to textbook on these fascinating and diverse pollinators for years to come.

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WASP. Animal Series.

By Richard Jones. London (United Kingdom): Reaktion Books. \$19.95 (paper). 207 p.; ill.; index. ISBN: 978-1-78914-161-0 (pb). 2019.

TROUT AND CHAR OF THE WORLD.

Edited by Jeffrey L. Kershner, Jack E. Williams, Robert E. Gresswell, and Javier Lobón-Cerviá. Bethesda (Maryland): American Fisheries Society. \$79.00. xxvi + 831 p.; ill.; index. ISBN: 978-1-934874-54-7. 2019.

Although the 21 chapters in this volume are not clustered into sections, the book can be easily organized into three. The first section, an introduction plus five chapters, reviews fundamental biology (systematics, ecology, life histories) and cultural values of trouts, chars, and freshwater relatives, subfamily Salmoninae, family Salmonidae. The second section consists of 11 chapters, totaling over 400 pages; each chapter is a review of trouts and chars by geographic region. The last section of four chapters examines management and conservation of native and introduced populations, and the potential effects of global climate change on these coldwater-adapted fishes. Each chapter includes a well-stocked reference section, providing an aspiring fisheries biologist or a veteran ichthyologist with a good resume of significant literature.

The first section of this volume could serve as a stand-alone primer summarizing trout and char