

## The X-Book

**BIOLOGY OF THE XENARTHRA.** Edited by Sergio F. Vizcaíno and W. J. Loughry. Gainesville, Florida: University Press of Florida. 2008. 370 pp., \$100.00 (cloth). ISBN 978-0-8130-3165-1

Bruce J. Shockey

Published online: 24 February 2009  
© Springer Science + Business Media, LLC 2009

As one of the four major clades of placental mammals, the Xenarthra should be of considerable interest to any mammalogist. The fact that these “strange-jointed” beasts have interesting-to-bizarre characteristics adds to the pleasure of their study. *The Biology of the Xenarthra* (affectionately known as “The X-Book”), edited by Sergio Vizcaíno and Jim Loughry, is a multidisciplinary, eclectic update and summary of research regarding these wonderful animals. Succinctly put by the editors, the X-Book is “what we know and where we stand” (p. 4), though the contributors occasionally stood in different places.

Desiring to update the classic 1985 work, *The Evolution and Ecology of Armadillos, Sloths, and Vermilinguas* (edited by Gene Montgomery), the editors and diverse authors exceeded their goals by producing not only a more advanced work, but one that includes far more and balanced perspectives. In this regard, the X-Book excels as a boundary buster, uniting paleontology and neontology, as well as South

and North American perspectives with their Latin American and Anglo American scientific literatures. The authors are mostly from South American institutions, but there are nearly as many North Americans, plus a few Europeans. In terms of their specialties, they are paleontologists, systematists (molecular and morphological), ecologists, reproductive biologists, microbiologists, pathologists, wildlife biologists, zoologists, and zoo-ologists (sic). There is even a leprologist. Though the texts of each chapter were written in the international language of English, Spanish and Portuguese abstracts are also provided.

Following the editors’ general comments, the X-Book contains five parts: 1) *Phylogeny* (both molecular and morphological); 2) *Fossil Xenarthra* (a must for a group that has such a rich and diverse past but only a depauperate present); 3) *Physiology and Genetics*; 4) *Conservation* (the most critical of all); and 5) *Ecology and Behavior*. The Phylogeny section contains both a molecular summary (Chap. 2) and a morphological one (Chap. 3). One major advance since Montgomery (1985) is the overwhelming consensus that the Xenarthra represents a monophyletic group and does not include pangolins and other Old World beasts (e.g., armadillos) that had been grouped in the now abandoned Edentata. Both molecular and morphological studies support the diphyly of the two extant genera of sloths, *Bradypus* and *Choloepus* (see references in Chaps. 2 and 3), making these bizarre upside-down-hanging arboreal, algae-carrying beasts one of the most remarkable

---

B. J. Shockey (✉)  
Biology Department, Manhattan College,  
Manhattan College Parkway,  
New York, NY 10471, USA  
e-mail: bshockey@amnh.org

B. J. Shockey  
Department of Vertebrate Paleontology,  
American Museum of Natural History,  
Central Park West at 79th Street,  
New York, NY 10024, USA

stories of convergence known among mammals. The molecular timescale places the separation of their lineages at  $21 \pm 3$  myr, which if true is in conflict with the morphological hypothesis of *Bradypus* being the sister to all other sloths (Chap. 3 and references therein), because mylodontids and megalonychids were already present and distinctive by the late Oligocene, about 29–24 million years ago (Chap. 4). Other conflicts remain between molecular and morphological phylogenies, but the authors note progress and consensus building. Indeed, consensus has developed regarding most of the major lineages.

As one might expect for a group with an impoverished living fauna, but such a rich fossil record, the Fossil section is of considerable interest. Here, most of the major groups (sloths, anteaters, and the cingulates—Chaps. 4, 6, and 7, respectively) are thoroughly reviewed, though the dasypodids are best discussed in the phylogeny section (Chap. 3). Happily, researchers (Chap. 7) have begun to try to clean up the taxonomic mess that glyptodonts have been in for over a hundred years. Andean megatheres (Chap. 5) and functional morphology (Chap. 8) receive special attention in this section. The fossil record of the Vermilingua, however, is so poor that the authors could conveniently list all known specimens. This chapter gave detailed descriptions of the skeletons of these unusual beasts, but regrettably only images of skulls were provided.

The Physiology and Genetics section covers pathologies (Chaps. 9, 10), various aspects of reproductive biology including placentation (Chaps. 16, 17), sperm evolution (Chap. 14), and the interesting and scientifically useful fact that some armadillos regularly give birth to litters of clones (Chap. 12). Genetic studies (molecular, chromosomal, and population genetics) are also included (Chaps. 18, 19, and 20, respectively). Owing to its wide range, including its colonization of southern North America, its ability to be a host of the causal agent of leprosy, and belonging to the only genus of vertebrates known to have obligate polyembryony, the long-nosed armadillo, *Dasypus novemcinctus*, is the star of this section.

The brief Conservation section is of particular interest. The chapter on conservation status (Chap. 21) provides a concise natural history of xenarthrans that includes numerous bits of colorful (but sometimes disturbing) trivia. It is a great read. Likewise, the chapter on maintaining xenarthrans in captivity (Chap. 22) is well written and vivid. Indigenous use of xenarthrans in

the Bolivian Chaco is documented and efforts to make this sustainable are discussed (Chap. 23).

The Ecology and Behavior section provides general overviews of anteaters (Chap. 24), sloths (Chap. 25), and armadillos (Chap. 26). The book continues with some particular works regarding taxa from the Chaco of Paraguay and Bolivia (Chaps. 27, 29) and the Pampas and western region of Argentina (Chaps. 28, 30).

With so many authors having a primary language other than English, one might be concerned regarding the “ease of read.” The authors and editors, however, have produced a work that is generally a reading pleasure. Native language had nothing to do with the few places where clumsy or confusing writing occurred—indeed, the best-written chapters were by South Americans (e.g., Chaps. 21, 22). Having such a broad range of specialists, however, there were places where discipline-specific jargon was used without any effort to help communicate with those outside the writer’s particular field. Mercifully, Chang and Adams (Chap. 18) provided a glossary for their terms. They also included frequent parenthetical comments to help readers not conversant in molecular genetics. At times, however, peeking into the discipline of others was quite fun or odd or even macabre. Consider the matter-of-fact advice for care of captured armadillos from Suprina et al. (Chap. 22: 236): “Sick or injured armadillos need to be separated, as open wounds and fresh blood are licked by conspecifics and can lead to cannibalism.”

The figures are generally good. The artistic reconstruction of fossil cingulates by Marcelo Canevari (Fig. 7.1) is quite pleasing. The histology slides (e.g., Chaps. 16, 17) were sharp and adequately labeled. The paleontologists, however, rarely pointed out anatomical features on their figures; a failure that keeps the fascinating osteology of these beasts obscure from non-specialists. The mixture of photos with line drawings was unsuccessful—the photos in Figs. 4.1 and 4.2 are too dark to be of any use. Indeed, most of the photos throughout the book are a bit too dark.

In considering whether one would want to own such a volume (or not), one would consider its utility. In this regard, the X-Book will be an efficient means to begin many studies regarding xenarthrans. For example, several of the cladograms are simplified and illustrated (Figs. 2.1, 3.1, 3.2, 3.3), showing the general relationships quickly and providing references to the details in the figure legends. Appendix 3.1 from Gaudin and McDonald (Chap. 3) lists synapomor-

phies for Xenarthra and its major clades. McDonald and de Iuliis (Chap. 4) have descriptive paragraphs for each of the major groups of sloths. Table 8.1 of Vizcaino et al. (Chap. 8) is a quick reference for body masses of the most massive of extinct glyptodonts and sloths. Aguiar and da Fonseca (Chap. 21) provide maps of the distributions of most living pilosan species and armadillo genera, and Table 26.2 gives data and references for natural diets of armadillos (Chap. 26).

There were just a few disappointments. One is that the union of the world's greatest authorities regarding Xenarthra failed to come to a consensus regarding the formal name for the most interesting clade of xenarthrans—the sloths. The formal names used in the X-Book for sloths were Tardigrada, Phyllophaga, and Folivora. Not referenced in the X-Book is the recent recommendation of McKenna et al. (2006) to use Tardigrada for the crown clade and Phyllophaga as a more inclusive group (to include *Pseudoglyptodon*, which almost certainly lies outside the clade that includes the last common ancestor of *Bradypus* and *Choloepus* and all of its descendents). However, this too fails to address a major problem: tardigrades are also tiny, invertebrate, arthropod-like beasts, best known as “water bears,” and *Phyllophaga* are New World scarab beetles (e.g., June bugs). Since the specialists failed to decide what to call sloths, then perhaps generalists should. It is undesirable to have taxonomic names duplicated (such are explicitly forbidden for genera) and, like it or not, we live in a digital age and search engines encounter hundreds of “water bear” references for tardigrade queries and hundreds of scarab “hits” for *Phyllophaga* searches. Thus, a Zoology/Google doctrine should be asserted: Tardigrada are water bears and *Phyllophaga* is a genus of beetle. Folivora (Delsuc et al. 2004) are sloths.

The editors look forward to the day when this X-Book, like Montgomery's, will be outdated. Happily, new information comes, some just a little too late to have made it into the X-Book before it went for printing, but before its publication. For example, McKenna et al. (2006) described a partial skull of the most primitive sloth known, *Pseudoglyptodon*. The side-by-side placement of the caniniforms of this beast suggests an intermediate stage of transformation from the general eutherian position of canines to the placement seen in the caniniform teeth of sloths: the upper caniniforms of sloths are anterior to the lowers, whereas the lower canines of other eutherians occlude

in front of the uppers. The form in *Pseudoglyptodon* hints at the possibility that sloth caniniforms are homologous to the canines of other eutherians.

Regarding *Pseudoglyptodon*, I must insert a correction. The statement by McDonald and De Iuliis (Chap. 4: 44) that Federico Anaya and I have cranial remains of *Pseudoglypton* under study was a serious *lapsus calami* that illustrates the need for an editorial requirement for written verification of personal communications. Most likely, one of the authors confused news of our discovery of a late Oligocene mylodontid skull (see Shockey and Anaya 2008) with that of the then pending McKenna et al. (2006) study.

Although a consensus is developing regarding many of the phylogenetic relationships among xenarthrans, the cleanliness of the cladograms in the X-Book suggests that we know nothing about basal xenarthrans—all the xenarthrans in all the cladograms are grouped in either the Cingulata or Pilosa. This may be a function of a possible 50-million-year “ghost” lineage (Chap. 2), but it might also be a result of the exclusion of poorly known taxa like *Pseudorophodon* or *Paleopeltis* (see discussion in Chap. 7). Likewise, the habit of constraining Pilosa as an outgroup for cingulate phylogenetic analyses and cingulates as the outgroup for pilosans appears tautological and thus may give a false impression of neat monophyletic groups. Work in progress (Gaudin and Bramblett 2008) promises to rectify this latter problem by using non-xenarthrans for outgroup comparison.

So, the X-Book will soon be dated and we can't wait another 20 years for the companion volume. Hopefully, the “Xamigos” (sensu p. xvi) and colleagues will meet again and produce the next book in half that time.

Personally, I love the X-Book. It lies at my fingertips for a couple of projects and I think that anyone with an interest in the natural history of South America will also want to find a copy within their reach.

## References

- Delsuc F, Vizcaino SF, Douzery EJP (2004) Influence of Tertiary paleoenvironmental changes on the diversification of South American mammals: a relaxed molecular clock study within xenarthrans. *BMC Evol Bio* 4:11 (13 virtual pages)
- Gaudin TJ, Bramblett J (2008) Phylogenetic analysis of Cingulata (Xenarthra) based on postcranial data. *J Vertebr Paleontol* 28(3 supplement):82A

- McKenna MC, Wyss AR, Flynn JJ (2006) Paleogene pseudoglyptodont xenarthrans from central Chile and Argentine Patagonia. *Am Mus Novitates* 3536:1–18
- Montgomery GG, ed (1985) *The Evolution and Ecology of Armadillos, Sloths, and Vermilinguas*. Smithsonian Institution Press, Washington, D.C.
- Shockey BJ, Anaya F (2008) Postcranial osteology of mammals of Salla, Bolivia (late Oligocene): form, function, and phylogeny. In: Sargis EJ, Dagosto M (eds) *Mammalian Evolutionary Morphology: a Tribute to Frederick S. Szalay*. Springer, Dordrecht, The Netherlands, pp 135–157