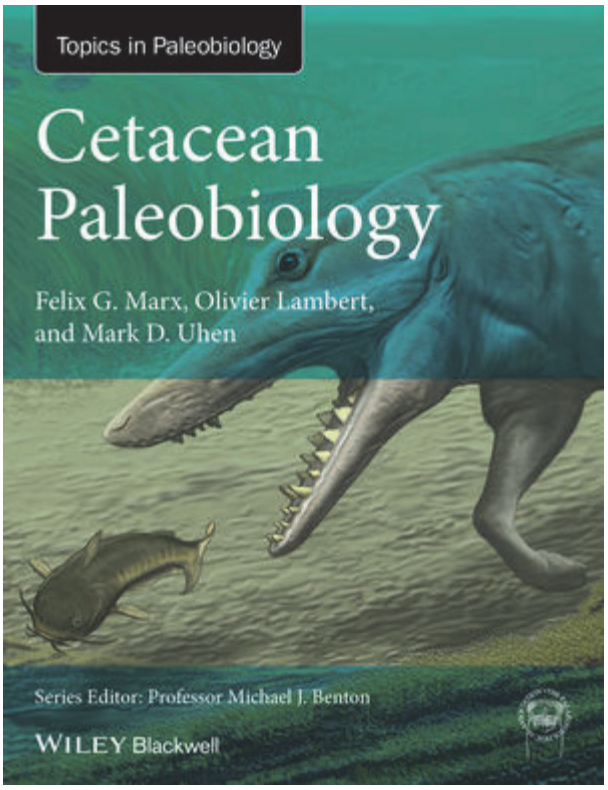
Palaeontologia Electronica
http://palaeo-electronica.org

Topics in Paleobiology: Cetacean Paleobiology

Review by Ashley W. Poust

Topics in Paleobiology: Cetacean Paleobiology. Marx F.G., O. Lambert, and M.D. Uhen. 2016. Wiley-Blackwell Paperback $74.95 (e-book $59.99). 336 pages

Whales are no longer the "monstrous" mystery of Darwin's era, instead representing one of the best understood macroevolutionary transitions in modern biology. This incredible explosion of knowledge, excellently covered in Marx, Lambert, and Uhen's recent book, has happened in only the last few decades, but has resulted in a remarkably solid framework supporting our current understanding of the origin and evolution of whales. And if there are still small mysteries in this well-constructed case, what of it? It is this very combination of fast, substantial progress with continuing discovery which makes cetaceans an ideal fit for this book series. The Topics in Paleobiology series is aimed at "advanced undergraduates, postgraduates, and researchers in both the paleontological and biological sciences" and has already produced such valuable volumes as Stephen Brusatte's *Dinosaur Paleobiology* (Wiley-Blackwell, 2012). *Cetacean Paleobiology* illustrates the evolution of an important clade at an accessible but thorough level appropriate to beginning "cetologists" and fossil whale fanciers who already have some background in paleontology or biology.



After a quick introductory chapter that covers some of how we know what we know about fossil whales, including a basic refresher on fossil distributions and cladistics, the book's second chapter dives into the history of the field of paleocetology, including the composition of important formations and the first discoveries of significant taxa. Stemming in large part from Uhen's efforts as a contributor to the Paleobiology Database, Chapter 2 delineates what we know about the fossil record of whales and some of the potential biases that might affect that knowledge. This relatively brief chapter is a particular strength of the book. By situating their enumeration of the world's important fossil whale localities within a discussion of the quality of

Ashley W. Poust. Department of Integrative Biology, University of California Museum of Paleontology, Berkeley, California, 94720 USA. ashley.poust@berkeley.edu

Poust, Ashley W. 2018. [Review of *Topics in Paleobiology: Cetacean Paleobiology,* written by Marx F.G., O. Lambert, and M.D. Uhen]. *Palaeontologia Electronica* Vol. 21, Issue 1; 1R:3p;
palaeo-electronica.org/content/2018/2129-review-paleobiology

the fossil record, the authors have transformed what, in other hands, would have been merely a dry list into an exercise in thinking about data. The questions that arise naturally from this approach (e.g., Why does this region produce so few fossils? How well sampled might a particular interval be?) are classic paleobiological problems that savvy scientists will enjoy seeing addressed for these taxa. It is also a good example of why this book would be great for teaching: after reading the first two chapters, students would have both a sense of how science works and the beginning of a toolkit to take apart a paper about whale diversification and query its treatment of the primary data. Getting students to ask where the data come from is a huge step up from just asking them to memorize which early odontocetes are from the Chandler Bridge formation. If there is a flaw in this early section it is that these patterns are sketched largely before illuminating exactly what the taxa *are*. If I were using this text in a class I would build in a review those groups early on. Lone readers or students without this familiarity can gain it by flipping to Chapter 4.

Chapter 3 presents a comprehensive review of cetacean anatomy. The highly derived nature of whale anatomy, especially the skull and auditory apparatus, is difficult for anyone, and both newcomers and experienced workers will enjoy having this chapter to reference. It provides detailed coverage and avoids becoming an anatomy text, remaining relatively readable throughout. Compared to the degree of detail provided for cranial anatomy, the postcranial skeleton deserved more attention. Of course, extant whales have simplified their limbs and girdles drastically, but, additional details of the forelimb and vertebrae would have provided more balance and a greater link to more terrestrial extinct whales. This complaint is somewhat alleviated by an excellent section (3.4) on soft tissue correlates which covers not only the muscles of the flipper, but also sensory structures such as hearing.

The high quality of the illustrations is another strength of the text. The just over 200 figures in the book are beautiful, comprehensible, and tied together by a uniformity of style that makes comparison convenient and enjoyable. Many of these are line drawings of anatomy, concentrated in the middle chapters. I would have liked more of these figures to be paired with photographs of specimens, but this does little to detract from their usefulness. The drawings, supported by fantastic color life reconstructions by artist Carl Buell, help make the book attractive and add to its appeal, while also increasing the accessibility of the many bolded technical terms.

Chapters 4 and 5 form the meat of the work, reviewing the taxa themselves in a phylogenetic context (4) and from the perspective of key evolutionary innovations discovered in the fossil record (5). This covers the current understanding of relationships between extant and extinct taxa and how these taxa arose as they adapted to life at sea. The latter half of Chapter 5 highlights specific fossils of interest in roughly phylogenetic order. The sheer strangeness of some fossil cetaceans is enough to justify coming to this text, no matter your main interest in paleontology. If you haven't heard of the gigantic, macropredatory *Livyatan* or the (possibly?) walrus-convergent *Odobenocetops*, get this book. These extravagantly bizarre animals are incredible and this book will at times seem stranger than fiction. Beyond that, the collected presentation of this amazing adaptive radiation is of interest to anyone who thinks critically about the connection between disparity and diversity or about how clades explore morphospace. As in Chapter 2, some taxa and concepts are reviewed only briefly, but the comprehensive citations after each chapter, while not exhaustive, are well-chosen to direct readers to the important primary and review literature.

It is no criticism of these sections to note that the field is moving so quickly, with new and strange cetaceans being described at such a rate, that the book is already missing important new discoveries and analyses - the description of fascinating new taxa (*Mystacodon, Inermorostrum* etc.) and the debate about the role of teeth in the evolution of filter feeding being only two examples from the last half of 2017. I hope that with such an active field the book will warrant a second edition.

The last section of the book fulfills the titular promise of the book by providing summation of the biology that can be inferred from the fossil record. It is composed of three chapters: Chapter 6 on determining behavior in fossil taxa, Chapter 7 on evolutionary trends, and Chapter 8 on evolutionary developmental biology. The last is the shortest substantive chapter; nonetheless, the possibility of learning about developmental mechanisms in extinct whales is tantalizing, and the brevity here may reflect as much the novelty of this approach as any choice by the authors. Like so much of the book, it serves as a signpost for the hidden avenues down which the future of cetacean bioscience might travel.

This cognizance of the shape of the field really is the most unique thing about *Cetacean Paleobiology*. It is so authoritative and seems so complete, *and yet* nearly every other paragraph the authors point out a specimen which was reported but not described, a group or region or period which is poorly known, or a tantalizing question as yet unapproached. Both as a teacher and a marine mammal paleontologist I found this invigorating. *Cetacean Paleobiology* demonstrates that answers in science bring new questions and that it is a glorious time for questions in marine mammal research. This book suggests numerous areas that readers might explore in further research. Moreover, for teachers this text affords the chance to show students something integral about how scientists think. Perhaps the authors adopted this style out of their own curiosity, or even because they are frustrated at lacking certain pieces of the puzzle. But in writing this way, in not glossing over what is *not* known, but instead in highlighting it, calling it out, they have given us a real gift.

The authors title their last section “Cetacea – Quo Vadis?” (9.2), but the richness of the preceding work means that the whole book is really answering this question; first pointing out where we stand and then suggesting “where we should go from here”. The clarity with which this map of the field is drawn means the book is not only a valuable reference made especially great by the consistent illustrations, but a textbook I look forward to using with advanced undergraduates. For teachers, the specificity of the subject matter will be balanced by the power of using a text that demonstrates not just what we know about paleobiology, but some of how we know it.