

BOOK REVIEWS

Copeia 2010, No. 4, 735–737

Fish Locomotion: An Eco-Ethological Perspective. Paolo Domenici and B. G. Kapoor (eds.). 2010. Science Publishers. ISBN 978-1-57808-448-7. 534 p. \$139.95 (hardcover).—The recent edited volume, nominally focused on the ecological and behavioral aspects of fish locomotion, provides an interesting and timely review of recent progress in the study of locomotion in both bony and cartilaginous fishes. The most recent previous volumes of similar topical breadth, but lacking an ecological bend, were published between 17 and 27 years ago (Blake, 1983; Webb and Weihs, 1983; Videler, 1993). Like these books, the chapters in the new volume edited by Domenici and Kapoor combine findings from classic biomechanical studies with the results of more recent work using relatively newly developed experimental and analytical techniques (i.e., PIV: particle image velocimetry, CFD: computational fluid dynamics). In contrast to the previous books, however, chapters in the new volume also include a thorough consideration of the ecological implications (predator–prey interactions, patterns of community assembly) and behavioral consequences (feeding, migratory ability) of interspecific and, to a lesser extent, inter-individual variation in locomotor performance. In addition, the new volume includes several chapters that emphasize the fisheries applications of research on fish locomotion.

The book's 15 chapters are authored by a collection of the field's experts and cover a wide range of topics with the goal of understanding the broader implications of locomotor function in fishes. It is notable, however, that the volume almost entirely neglects discussion of the anatomical and physiological features underlying locomotor function, especially the skin and musculature of the body and fins. Instead, the book begins with a pair of chapters providing a detailed overview of the physical aspects of the aquatic environment and describing the nature of the forces and flows with which the piscine inhabitants of these environments must necessarily contend. In the first two chapters, considerable attention is paid to both benthic and pelagic fishes engaged in station-holding behavior in high flow environments. This is a marked improvement from the treatment received by rheotaxis in Blake's (1983) book. There, the behavior is mentioned only as an "other issue" in the book's final chapter.

The next few chapters discuss the energetics of steady swimming, the kinematics of escape responses (C- and S-starts), and the swimming behaviors associated with barrier passage. The chapters following these describe the importance of locomotion in key ecological tasks, such as feeding, predator avoidance, and reproduction, while also providing data on the potential evolutionary consequences of inter-individual variation in locomotor performance. An additional chapter relates known variation in interspecific swimming ability among wrasses and parrotfishes (Labridae) to patterns of community assembly and habitat partitioning on coral reefs. The volume closes with a pair of chapters that consider the ecological and physiological correlates of large-scale movement patterns in large pelagic bony and cartilaginous fishes.

Overall, the chapters vary in readability and overall quality, making for a somewhat uneven read. Most chapters present and summarize previously published data to provide an informative and more or less insightful synthesis. However, the chapter authored by Langerhans and Reznick (Chapter 7) stands out by including new data and analyses. Specifically, the authors ask whether external morphological features correlated with swimming performance vary predictably with predation pressure and habitat complexity across a wide variety of bony fish taxa. An additional section of the chapter describes the authors' new test for a relationship between body shape (fineness ratio) and water flow speed among 12 species of *Gambusia* (Poeciliidae).

Overall, the edited volume is a worthwhile read for those interested in fish locomotion and represents a timely addition to literature on the topic. Researchers and students alike will find that, in combination, the chapters facilitate a more broadly integrative understanding of the various aspects of fish locomotion and their ecological, evolutionary, and behavioral consequences.

LITERATURE CITED

- Blake, R. W. 1983. *Fish Locomotion*. Cambridge University Press, Cambridge.
- Videler, J. J. 1993. *Fish Swimming*. Chapman & Hall, London.
- Webb, P. W., and D. Weihs. 1983. *Fish Biomechanics*. Praeger Publishers, New York.
- Rose L. Carlson, *Department of Organismic and Evolutionary Biology & Museum of Comparative Zoology, Harvard University, 26 Oxford Street, Cambridge, Massachusetts 02138; E-mail: rcarlson@oeb.harvard.edu.*

Deep-Sea Fishes of Peru. K. Nakaya, M. Yabe, H. Imamura, M. Romero Camarena and M. Yoshida (eds.). 2009. Japan Deep Sea Trawlers Association. 355 p. \$150.00 Available for purchase by writing Akiko Yoshioka (nittoro@jdsta.or.jp), Japan Overseas Fishing Association, NK-Bldg. 6F, 3-6 Kandaogawa-Cho Chiyoda-Ku, Tokyo 101-0052, Japan.—This book is a thorough descriptive text of Peru's deep ocean ichthyofauna with lavishly printed photographs on nearly every laminated page. The text that is in English, Spanish, and Japanese from the title to the index is, in most cases, clear and straightforward. The bulk of the text consists of one-page species descriptions providing an up-to-date taxonomy, the common names in three languages, distributional information, and remarks (typically comparing close relatives). The book itself is the product of a joint investigation by the Japanese and Peruvian governments. They conducted a study of El Niño oceanic conditions and Peruvian fisheries sustainability from 1998–2002. Fishes were collected to 1,500 meters and contributors include

many well-known ichthyologists from the Smithsonian, several private American and European institutions, and several authors from Japan and Peru.

The photographs of some of the deep-sea fishes look a little worse for wear, as they often do, having been dragged by a trawler a kilometer to the surface, but some are in remarkable condition. The barbeled dragonfish (*Astro-nesthes lampara*) on p. 125, shown with a gleaming blue outer ring of the eye and undamaged smooth black skin, is as perfect a specimen as likely was ever collected of this animal. The anglerfishes with their guts peaking from their mouths and frayed fins are still photographed with esca and illicium clearly extended, showing the great care that was taken with each image. While the deep-sea coverage is excellent, some mesopelagic forms are also included such as *Scomber japonicus* (Chub Mackerel), *Bagre panamensis* (Chilhuil Catfish), and for good measure a couple of shrimp and squid species. Most taxa are identified to species, but the dreaded "sp." does appear sporadically, as would be expected with the rigorous sampling efforts. Many similar regional guidebooks save money by placing all the color plates on a few dedicated pages where the images are crowded together. This book eliminates the tiresome flipping back and forth between description and images by having the images and descriptions on the same page. The major flaw is the lack of dichotomous keys at any level. An investigator of this Peruvian ichthyofauna will be resigned to flipping through the images until they find a match: not the most efficient method given the 279 taxa photographed. In the days of Fishbase and a myriad of other online sources, perhaps this book's limited practicality can be overlooked because of its pleasing esthetics. This is one of the few regional guides that could play equally well as a conversation piece at the coffee table or the wet lab.

Prosanta Chakrabarty, *Museum of Natural Science, Louisiana State University, 119 Foster Hall, Baton Rouge, Louisiana 70803; E-mail: prosanta@lsu.edu.*

Biology of Subterranean Fishes. E. Trajano, M. E. Bichuette, and B. G. Kapoor. 2010. CRC Press, Taylor and Francis Group, Science Publishers. ISBN 978-1-57808-670-2. 480 p. \$120.16 (hard cover).—*Biology of Subterranean Fishes* is an interesting, sometimes flawed and scattered, treatise on the poorly understood stygobitic ichthyofauna of the world. Subterranean taxa have always perplexed biologists: even Darwin (1859) resorted to Lamarckian "disuse" to explain the loss of eyes in cave fishes. We continue to know remarkably little about the biology and evolution of these animals. This new text is a good summary of what is known and remains to be known. Although largely focusing on North American taxa, the volume does devote large sections to the subterranean fishes of other continents. This book is by no means exhaustive, but it does a reasonable job of filling the gaps left out by similar attempts at the subject. In recent years it seems that there have been more books on the subject of subterranean fishes than journal articles (Romero, 2001, 2009; Proudlove, 2006); despite its flaws this book is possibly the most useful of these attempts.

The book is dedicated to Thomas Poulson (Professor Emeritus, University of Illinois–Chicago) and he appropri-

ately provides the first chapter. Unfortunately, he does not supply the introductory chapter this book should have. Instead the first chapter is a scattering of personal thoughts and conjectures. It is also essentially a call-to-action for researchers to study cave fishes and test his many hypotheses of cave adaptations. Poulson's conjectures come in a rapid-fire purge of pent-up ideas from years of note-worthy experience. In a later chapter he exclaims in the third person, "Poulson has had a bit of an epiphany as he has spent three months reviewing old data, working up old unpublished data, and carefully re-reading what he thinks are the best studies available." Unfortunately, a student interested in the topic will have problems with the many *Astyanax* vs. amblyopsid comparisons Poulson uses as examples in this chapter. However, the author does reach out to novice readers in including a strange section called the "Protocol for study of a new or endangered species" which includes tidbits about, "Short term studies of days to a week" and "Data without dissection." At times, the author stretches beyond his expertise in order to fulfill some desire to achieve comprehensiveness, "We may have to wait for complete genome sequencing to find single nucleotide changes that are not part of genes." Perhaps the editors simply gave Poulson a pass to be uninhibited because of his role as honored and invited author.

The second chapter by Graham Proudlove (The Manchester Museum) serves as a much better introductory chapter than the first. This chapter is the most useful to those interested in the diversity of blind fishes in terms of both global distribution and taxonomic affiliation. This chapter provides Proudlove an opportunity to make updates to his (2006) book which described the known hypogean fish diversity of the world four years ago. As an indication of how rapidly these taxa are being discovered, nearly 50 species have been described since that then-comprehensive book was published. As a testament to the usefulness of Proudlove's chapter nearly every other chapter in the book refers to it.

Chapter 3, by two of the editors, Maria Bichuette (Universidade Federal de São Carlos) and Eleonora Trajano (Universidade de São Paulo), is an excellent discussion of the many threats to subterranean habitats. They discuss several obvious problems (e.g., chemical pollution, over-collecting) but also less intuitive problems such as global warming and human visitation.

Chapter 4, by Jakob Parzefall (University of Hamburg) and Trajano, discusses behavior of a variety of blind fish forms and largely tells us about the paucity of *in situ* studies on these fishes. Most studies of behavior of these subterranean organisms are done in laboratory settings. Despite this, the authors describe how the incredible diversity of behaviors known in these organisms are likely due to the diversity of lineages these subterranean taxa are derived from rather than any novel convergence due to shared habitat types. However, the authors do point out a range of behavioral similarities across many hypogean fishes, including a tendency towards solitary habits and moderate to high aggressiveness.

Two of the finest chapters are Richard Borowsky's (New York University; Chapter 5: "The Evolutionary Genetics of Cave Fishes: Convergence, Adaptation and Pleiotropy") and William Jeffery and Allen Strickler's (University of Maryland; Chapter 6: "Development as an Evolutionary Process in *Astyanax* Cave Fish") works that take a molecular, cellular, developmental, and quantitative genetic approach to studying the blind Mexican tetras (*Astyanax* spp.). This genus is certainly the best studied of all hypogean fish taxa. Borowsky's chapter in particular has perhaps the highest level of scholarship in the entire volume. His review of his

own work and the works of others reveal several important insights into the pleiotropic link between blindness and loss of pigmentation that commonly result in subterranean fishes being white and eyeless. Borowsky clearly explains how QTL (quantitative trait loci) mapping reveals a connection between retinal epithelium in the eye and melanin on the body. Borowsky also effectively argues that there is direct selection against eyes in caves while melanin is subsequently lost through the pleiotropic effects of indirect selection. However, despite this link, the loci involved in the loss of eyes are not even common among populations of *Astyanax*. As Borowsky states quite eloquently, "evolution's palate is enormously varied and numerous genes are available to effect convergent trait changes." Jeffery and Strickler, on the other hand, use ontogenetic studies of surface- and cave-dwelling populations of *Astyanax* to study the loss of eyes. The authors provide revealing illustrations and photographs of development of sighted versus eyeless members of *Astyanax*. The ontogenetic approach and lens transplant experiments by the authors reveal that in cave fishes the development of the lens and retina initiate but quickly degenerate and that the cornea, iris, and ciliary bodies fail to form at all. However, the authors do note how actual phenotypic degeneration of eyes may be unique in every hypogean lineage. Both chapters reveal why *Astyanax* is unique but may be important in the study of all hypogean fishes and potentially blindness in general. These two chapters exemplify how a multi-authored volume can be successful because the independent results and discussions can complement each other by taking different approaches to answering similar questions. It would have been interesting to see how the authors of these two chapters interpreted each other's work, instead of having each stand independently. Other chapters of this volume suffer from too much redundant overlap, and it is clear that the authors would have improved their own work if they had incorporated information from other chapters.

The most significant work in the volume may be Chapter 7 by Matthew Niemiller (Ph.D. candidate, University of Tennessee) and Poulson. It is the longest (over 100 pages) and most comprehensive regional study in the book. This chapter, "Subterranean Fishes of North America: Amblyopsidae," is in part fantastic and thorough and in other ways awkward and misguided. The chapter is special in that much of the work has not been published elsewhere. Before reading this chapter I was under the impression that little was known about amblyopsid fishes; it turns out that much work has been done but little has been published. The authors integrate a thorough review of both published data and many unpublished works that give us the most complete picture of American blind fishes to date. Some of the most useful aspects of the chapter are the comparative tables of the six species of amblyopsids. These tables, which include comparisons of meristics, eye development, melanophore counts, and sensory systems, are intriguing and help build the case for the authors' hypotheses of trends from surface dwellers to more troglodytic forms. However, in describing the biology of these fishes the authors sometimes overreach: "The sense of taste (contact chemoreception) does not seem to be important for Amblyopsids. . . . This suggests that they are not as good as human babies that can selectively sort and spit out peas from a mush of potatoes or oatmeal (Poulson, personal observations)." Although comments like these may be in jest (not clear that they are), they take away from the value of the text. There are a slew of these awkward sentences, and, as was the case with the first chapter, it appears that a good dose of

editing would have helped. This chapter often reads like a student's dissertation with random interjections by a senior advisor. Still the value of the chapter is numerous unpublished or obscure works that range from the notable to the odd, including "Tolerance of temperatures from 5 to 25°C" and "Starvation Resistance."

The final five chapters are reviews of regional subterranean ichthyofauna from Mexico (Chap. 8), Brazil (Chap. 9), Africa (Chap. 10), China (Chap. 11), and India (Chap. 12). There is a great deal of variability in these chapters. Chapter 8 is essentially a review of Martin Plath (J. W. Goethe University Frankfurt) and Michael Tobler's (Texas A&M) excellent work on the cave-dwelling forms of *Poecilia mexicana*. No comments are made about Mexico's other cave-dwelling forms, including the numerous blind catfishes in *Prietella* or *Rhamdia*, or the synbranchid *Ophisternon infernale*, the bythitid *Ogilbia pearsei*, or the aforementioned species of *Astyanax*. The Brazilian chapter by Trajano and Bichuette is a straightforward review of the hypogean Brazilian ichthyofauna: it is excellent although short. "The Subterranean Fishes of Africa" chapter by Roberto Berti and Giuseppe Messana (University of Florence and National Research Council of Italy, respectively) focus on only eight African taxa, including three Malagasy forms. The low number may be due to how little exploration has been done on this continent, or it may point to a truly depauperate African stygofauna. Notably the only blind cichlid, *Lamprologus lethops*, is not discussed. The chapter on subterranean fishes of China is very short, which is notable because China has more hypogean fishes than other parts of the world and has perhaps the most bizarre forms. Also surprising is that no mention of the recent exhaustive publication on Chinese subterranean fishes is given (Romero et al., 2009). As with the other regional chapters, the final chapter on India's subterranean fishes shows more of how little we know than about how much we do know. India's paucity of known hypogean forms almost certainly has to do with limited exploration. Five of the seven known hypogean species are listed as "data deficient" or "not evaluated" for IUCN's Red List of Threatened Species.

The volume provides a wonderful new source of data and information about a too-little-studied subject; unfortunately it suffers from poor editing that obscures its value. As with many multi-authored edited volumes there is a great disparity in the quality of the figures, writing, and the scholarship of the science. However, any biologist interested in learning more about subterranean fishes will benefit from owning this book.

LITERATURE CITED

- Darwin, C. 1859. On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. J. Murray, London.
- Proudlove, G. S. 2006. Subterranean Fishes of the World. International Society for Subterranean Biology, Moulis.
- Romero, A. 2001. The Biology of Hypogean Fishes. Kluwer, Dordrecht.
- Romero, A. 2009. Cave Biology: Life in Darkness. Cambridge University Press, Cambridge.
- Romero, A., Y. Zhao, and X. Chen. 2009. The Hypogean Fishes of China. Environmental Biology of Fishes 86:211–278.

Prosanta Chakrabarty, *Museum of Natural Science, Louisiana State University, 119 Foster Hall, Baton Rouge, Louisiana 70803; E-mail: prosanta@lsu.edu.*