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REPRODUCTIVE BIOLOGY AND PHYLOGENY OF FISHES (AGNATHANS AND BONY FISHES). Edited by B. G. M. Jamieson. 788 pp. Published by Science Publishers, Enfield, NH, U.S.A., 2009. Price £94.00. ISBN: 978-1-57808-580-4.

Reproductive morphology provides a rich source of comparative data on animal phylogeny, character homology and evolution of reproductive modes. B. Jamieson of the University of Queensland is a venerable, tireless and energetic advocate for discovery and description of these data, in particular ultrastructure of spermatozoa, among oligochaetes, insects and vertebrates. Bony fishes and agnathans get the attention in this volume, the ninth in a series, *Reproductive Biology and Phylogeny*, for which Jamieson is also Series Editor. The book is dense with the data and insights of Jamieson and 14 other international experts. An extensive preface is an effective précis of the 17 chapters.

Jamieson began this volume as a revision of his innovative *Fish Evolution and Systematics: Evidence from Spermatozoa* (Cambridge: Cambridge University Press, 1991), only to expand its focus. Three chapters provide fresh details and interpretations of the teleost ovary, folliculogenesis and the major stages of oogenesis (Chapter 2, H. J. Grier, M.-C. Uribe Aranzábal & R. Patiño), unique morphological modifications of the ovary and testis in live-bearing fishes (Chapter 3, M.-C. Uribe Aranzábal, H. J. Grier, G. De la Rosa Cruz & A. García Alarcón) and teleost testis morphology, testicular cycles and spermatogenesis (Chapter 4, H. J. Grier & M.-C. Uribe Aranzábal). Transport of spermatozoa from the testis outside the body is explained in light of the wide range of variation in morphology of the vertebrate spermatic duct and accessory organs (Chapter 5, F. Lahnsteiner & R. A. Patzner). Ostariophysan fishes get two chapters: one on ultrastructure of spermatozoa (Chapter 11, J. R. Burns, I. Quagio-Grassiotto & B. G. M. Jamieson) and the other on sperm modifications and insemination (Chapter 17, R. Javonillo, J. R. Burns & S. H. Weitzman), which underscores the prominence of this large clade in reproductive morphological studies.

The book is rich in illustrations, with many colour plates, yet, overall, the production is coarse. Typographic errors pepper the text and will rile the careful reader. Most errors are benign (p. 611, ‘bleniid’ for ‘blenniid’); others do more damage (p. 461, ‘Cypriniformes’ for ‘Cyprinodontiformes’). Outright misstatements are rarer, but one pops up early, in the Preface (p. X), and again in Chapter 14 (p. 496): the sentence ‘All atherinomorphs are united by the unique telogonic development of the ovary’ should end with ‘testis’, not ‘ovary’. The telogonic testis is also known as the restricted lobular testis, or the atherinomorph testis, following H. Grier and colleagues. There is no glossary here to turn to, which is unfortunate.

Characters may be used to generate phylogenetic hypotheses, or, alternatively, mapped onto phylogenetic hypotheses supported by other data. Previously, Jamieson generated phylogenetic hypotheses of oligochaetes with data on spermatozoal ultrastructure, but here, as in his 1991 book, he largely adopts the second approach. At a gross level, to map ‘phylogenetic trends’ of spermatozoa across major vertebrate lineages, for example, this is a useful tool (Fig. 6·11, ‘acrosome lost’ is an autapomorphy of Neopterygii). At lower taxonomic levels, it is less so, especially because Jamieson ignores many primary sources of phylogenetic hypotheses in favour of general summaries, such as J. Nelson’s *Fishes of the World, 4th edition* (New York, NY:

John Wiley & Sons, 2006) or G. Lauder and K. Liem's *The Evolution and Interrelationships of the Actinopterygian Fishes* (Cambridge, MA: *Bulletin of the Museum of Comparative Zoology, Harvard University*, 1983), and a preliminary molecular hypothesis (Fig. 1·5).

A lucid essay (Chapter 1, G. Ortí & C.-H. Li) introduces molecular data and their application to actinopterygian phylogeny and presents a preliminary molecular phylogenetic hypothesis of 43 clupeocephalan species (Fig. 1·5). The role of this chapter in the book is not immediately obvious, but becomes clear in a series of 11 systematically organized chapters on the ultrastructure of spermatozoa, all authored or co-authored by Jamieson: the preliminary hypothesis is reproduced in these chapters as a systematic touchstone. For example, teleosts have two general types of sperm, as described by Xavier Mattei, co-author of two of the sperm ultrastructure chapters: Type I, a round or ovoid nucleus is perpendicular to the longitudinal axis; and Type II, a round to oblong nucleus is tilted and lies parallel to the longitudinal axis. Type I sperm morphology is broadly distributed among teleosts; Type II sperm morphology is found in a group of perciform fishes *sensu lato* (Table 15·1 and Chapter 15 discussion), including mullets, and possibly some ostariophysans. Polarity of sperm types is equivocal (p. 536), although Jamieson endorses the view that Type II is derived (pp. xi, 670). Nonetheless, Jamieson (p. 496) treats Type II morphology as homoplastic in mullets and perciforms because atherinomorphs (with Type I sperm) and mullets are sister taxa in the molecular phylogeny.

The book is most compelling when authors abandon the general summaries and use characters of reproductive morphology to generate new or support independent hypotheses. Jamieson (p. 616) discusses biflagellar sperm and/or with a spiral nucleus as evidence of a putative relationship among batrachoidiforms, gobiesociforms and lophiiforms. The molecular hypothesis recovers lophiiforms and tetraodontiforms as sister taxa, yet Jamieson cautions that lophiiforms have sperm that are '... very different from known tetraodontiform sperm' (p. 442). This is a phenetic, not cladistic, statement, but valuable when evaluating how to record characters for systematic analysis. These original observations may join others, such as the atherinomorph testis and the complex elopomorph spermatozoa (with a distinctive crescent-shaped nucleus, among other features), in an ever expanding list of reproductive morphological characters to generate, support or test phylogenetic hypotheses. We can then measure the immense weight and wealth of these data for systematics and better appreciate and understand the evolution of reproductive morphology.

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