
Evolutionary Developmental Biology of Invertebrates 6

Andreas Wanninger
Editor

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Deuterostomia

 Springer

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Cover illustration: Scanning electron micrograph of a tornaria larva (Metschnikoff stage) of a hemichordate, the acorn worm *Balanoglossus misakiensis*. See Chapter 2 for details

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Preface

The evolution of life on Earth has fascinated mankind for many centuries. Accordingly, research into reconstructing the mechanisms that have led to the vast morphological diversity of extant and fossil organisms and their evolution from a common ancestor has a long and vivid history. Thereby, the era spanning the nineteenth and early twentieth century marked a particularly groundbreaking period for evolutionary biology, when leading naturalists and embryologists of the time such as Karl Ernst von Baer (1792–1876), Charles Darwin (1809–1882), Ernst Haeckel (1834–1919), and Berthold Hatschek (1854–1941) realized that comparing ontogenetic processes between species offers a unique window into their evolutionary history. This revelation lay the foundation for a research field today commonly known as Evolutionary Developmental Biology, or, briefly, EvoDevo.

While for many of today's EvoDevo scientists the principle motivation for studying animal development is still in reconstructing evolutionary scenarios, the analytical means of data generation have radically changed over the centuries. The past two decades in particular have seen dramatic innovations with the routine establishment of powerful research techniques using micro-morphological and molecular tools, thus enabling investigation of animal development on a broad, comparative level. At the same time, methods were developed to specifically assess gene function using reverse genetics, and at least some of these techniques are likely to be established for a growing number of so-called emerging model systems in the not too distant future. With this pool of diverse methods at hand, the amount of comparative data on invertebrate development has skyrocketed in the past years, making it increasingly difficult for the individual scientist to keep track of what is known and what remains unknown for the various animal groups, thereby also impeding teaching of state-of-the-art Evolutionary Developmental Biology. Thus, it appears that the time is right to summarize our knowledge on invertebrate development, both from the classical literature and from ongoing scientific work, in a treatise devoted to EvoDevo.

Evolutionary Developmental Biology of Invertebrates aims at providing an overview as broad as possible. The authors, all renowned experts in the field, have put particular effort into presenting the current state of knowledge as comprehensively as possible, carefully weighing conciseness against level of detail. For issues not covered in depth here, the reader may consult additional textbooks, review articles, or web-based resources,

particularly on well-established model systems such as *Caenorhabditis elegans* (www.wormbase.org) or *Drosophila melanogaster* (www.flybase.org).

Evolutionary Developmental Biology of Invertebrates is designed such that each chapter can stand alone, and most chapters are dedicated to one phylum or phylum-like taxonomic unit. The main exceptions are the hexapods and the crustaceans. Due to the vast amount of data available, these groups are treated in their own volume each (Volume 4 and Volume 5, respectively), which differ in their conceptual setups from the other four volumes. In addition to the taxon-based parts, chapters on embryos in the fossil record, homology in the age of genomics, and the relevance of EvoDevo for reconstructing evolutionary and phylogenetic scenarios are included in Volume 1 in order to provide the reader with broader perspectives of modern-day EvoDevo. A chapter showcasing developmental mechanisms during regeneration is part of Volume 2.

Evolutionary Developmental Biology of Invertebrates aims at scientists that are interested in a broad comparative view of what is known in the field but is also directed toward the advanced student with a particular interest in EvoDevo research. While it may not come in classical textbook style, it is my hope that this work, or parts of it, finds its way into the classrooms where Evolutionary Developmental Biology is taught today. Bullet points at the end of each chapter highlight open scientific questions and may help to inspire future research into various areas of Comparative Evolutionary Developmental Biology.

I am deeply grateful to all the contributing authors that made *Evolutionary Developmental Biology of Invertebrates* possible by sharing their knowledge on animal ontogeny and its underlying mechanisms. I warmly thank Marion Hüffel for invaluable editorial assistance from the earliest stages of this project until its publication and Brigitte Baldrian for the chapter vignette artwork. The publisher, Springer, is thanked for allowing a maximum of freedom during planning and implementation of this project and the University of Vienna for providing me with a scientific home to pursue my work on small, little-known creatures.

This volume is dedicated to the Deuterostomia, comprising the Echinodermata and Hemichordata (usually united as Ambulacraria) as well as the Cephalochordata and the Tunicata.

Tulbingerkogel, Austria
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