Journal of FISH BIOLOGY

fsbi An International Society for Fish Biology

Journal of Fish Biology (2015) **86**, 1224–1225
doi:10.1111/jfb.12616, available online at wileyonlinelibrary.com

BOOK REVIEW

SYMBIOSIS IN FISHES: THE BIOLOGY OF INTERSPECIFIC PARTNERSHIPS. By I. Karplus. 449 pp. Published by Wiley Blackwell, Oxford, U.K., 2014. Price £130.00. ISBN: 978-1-4051-8589-9.

Symbiotic associations, ranging from casual and commensal interactions to specific and obligately interdependent relationships, characterise much of life on Earth and in some cases provide the biological foundations of marine and terrestrial ecosystems. That fishes form various different kinds of symbiotic associations with other organisms is not surprising, but the remarkable diversity of these interspecific partnerships and their importance in the biology of host and symbiont has been difficult to appreciate until now. This new book by Ilan Karplus, in bringing together in one volume for the first time the diversity and detailed biology of these associations, provides a valuable panoramic synthesis of symbiosis in fishes.

The book's eight chapters present in detail the various interspecific associations of fishes with other organisms, with a focus on beneficial interactions. The first chapter addresses bioluminescent symbioses of luminous bacteria with fishes, and the seven following chapters examine fishes as symbionts, hosts and parasites of invertebrates, divided by invertebrate group, specifically sponges, anthozoans, siphonophores, scyphozoan medusae, molluscs, crustaceans and echinoderms. Themes presented in each chapter include the taxonomy of symbionts and hosts involved in each kind of association, aspects of symbiont–host specificity, benefits and costs of the association for symbiont and host, and evolution of the association. In addition, topics specific to the different kinds of association, such as symbiont–host communication and behavioural and developmental interactions, together with detailed descriptions of each individual association or kind of association, are also given. Excluded from the book are bacterial commensal enteric associations of fishes, for example, analysis of the gastrointestinal microbiome of the zebrafish *Danio rerio*, and specific associations harmful to fishes, *i.e.* those involving pathogenic bacteria (*e.g. Aliivibrio salmonicida* infecting salmonids) and parasites of fishes (*e.g.* isopod ectoparasites).

The chapters begin with a description of the general biology of the invertebrate host or symbiont, or of luminous bacteria in the case of bioluminescent associations. Much of this material can be found in current textbooks and recent reviews, but its presentation here provides the reader with a useful biological perspective that complements the detailed descriptions of the symbioses that follow. Each chapter, in examining the different associations and interactions, provides substantial material on the biology of fishes and their symbionts and hosts, including behaviour, reproduction and ecology. This material, focused on and relevant to symbiosis, brings depth to the book and gives it substantial value for students of fish and invertebrate biology as well as for those interested in symbiotic associations.

The treatment of the topics and themes in the book is encyclopaedic, delving deeply into the literature from first reports of the association to current status of understanding. The author uses a reportorial style to relate with care and detail what was found, how that information was interpreted and what conclusions were drawn. Chapter length consequently varies with the amount of available information, which may serve to stimulate more research on less well-known associations. The depth of coverage and detail in some sections and chapters might be daunting to a non-expert reader, but the material provides comprehensive access to the scientific literature, making the book valuable both as an effective text for an advanced level undergraduate course on inter-specific interactions of fishes and as a source book for researchers examining specific aspects of the subject.

The coverage of the topics and themes is very current into 2012. An unavoidable exception is Chapter 1, which, due to the gap in time between completion of writing and publication of the book, lacks some valuable recent publications on the symbiotic bacteria of anomalopid and macrourid fishes and on a fourth increasingly well-documented fish-bacterium symbiosis, the bioluminescent symbiosis of the apogonid *Siphamia tubifer* with *Photobacterium mandapamensis*. Along with this and other new material, a ninth chapter, on symbioses of fishes with fishes, *e.g.* marine and freshwater cleaner fishes, would fit well in the possible second edition of the book mentioned by the author. Cleaner symbiosis in fishes is alluded to at some points in the book, but it warrants a full chapter, given the extensive research in this area and its relevance to the overall subject of the book, and its inclusion in a future edition would bring the book full-circle phylogenetically.

Overall, the book reflects an exceptional breadth of knowledge and depth of integrative thinking, together with a deep appreciation for the subject of interspecific partnerships in fishes. As such, the book provides a superb resource and foundation for learning, teaching and further scientific inquiry.

PAUL DUNLAP
Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI, U.S.A.

