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The Biology of Reefs and Reef Organisms

By Walter M. Goldberg, 2013, University of Chicago Press, 401 pages, ISBN 978-0-226-30168-6, Hardcover \$145 US, Paperback \$55 US

REVIEWED BY LAURA D. MYDLARZ

Walter Goldberg dedicates his new reference book, *The Biology of Reefs and Reef Organisms*, to “the condition of the reefs the way I remember them, with the hope that they might be that way again someday.” He follows this simple, emotional, dedicatory plea with thorough descriptions of reef formation and colorful reef inhabitants, and ends with a note of hope.

Throughout Goldberg’s career as a coral biologist at Florida International University, he has flourished as an expert in the structural biology of corals as well as their anatomy and physiology. Building on this long experience, he provides a definitive guide to reefs. Written in an interdisciplinary manner, the text frequently crosses over to other scientific fields. While his academic expertise is evident in the chapters dedicated to reef corals, his passion for reef biology in general shines through the entire book.

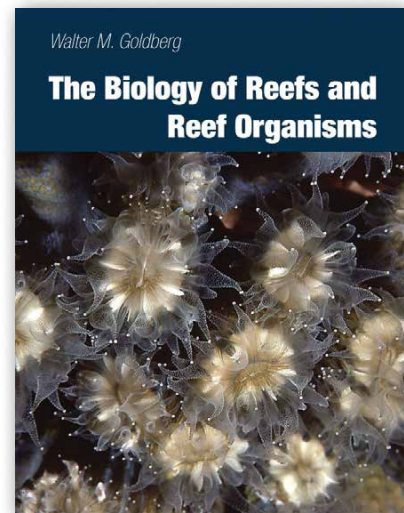
With abundant references from the primary literature and a thorough glossary, this book should be on the bookshelves of any aspiring marine biologist and can be used in upper-level undergraduate to graduate-level courses. The book is well laid out and easy to read, with important points in bold punctuating the chapters and subtopics. However, it would be helpful if the informational boxes complementing the text in each chapter were listed in the table

of contents so that readers could look at topics out of order to supplement their reading. Copious figures, photographs, conceptual models, and the beautifully precise illustrations of Noel Sirivansti make this book *almost* as beautiful as the ecosystem it represents.

The first two chapters take the reader through the formation, mineralization, and erosion of biogenic reefs. The beautiful aerial photos of fringing and barrier reefs represent the major coral reefs on the planet. These chapters include geology, chemistry, crystallography, and physics lessons that are appropriately described for non-expert readers but that offer enough detail to help them appreciate the entirety of the interwoven processes that produce and sustain reefs.

Chapters three and four are dedicated to cyanobacteria, reef algae, and foraminifera. After a brief overview of the cyanobacterial and algal cells, the main focus of these chapters is on the structure and function of these reef inhabitants. The author walks the reader through some of the most important features of cyanobacteria and algae, from trophic cascades to harmful toxic blooms and their roles in cementing and calcification. Goldberg highlights the role of crustose coralline algae in providing settlement sites for coral larvae as well as the important anthropogenic factors that threaten their populations.

Chapter five begins a series of chapters on the invertebrate inhabitants and producers of reefs that take us from the most basal metazoans through echinoderms. These chapters offer elegant structural descriptions and general information on reproduction before



diving into the diversity and complex interactions that characterize coral reefs. This chapter on reef sponges is very thorough and describes the importance of sponge symbionts to nitrogen fixation, sponge chemical ecology, and sponges as habitats or “living hotels” for other species.

To coral reef biologists, chapter six, Reef Corals and Their Allies, is one of the highlights of this book. Descriptions of cell types, tissue layers, and anatomy are detailed but kept in context of the whole organism for reference. The variations in coral cnidae and gorgonian sclerites are intricately detailed in several figures. From uncalcified to calcified anthozoans, Goldberg introduces the reader to some of the most recognizable reef builders and inhabitants. Taxa descriptions are interspersed with current challenges such as understanding the contributions of algal symbionts and overfishing of precious corals.

Chapters seven through nine on annelids, molluscs, and lophophorates are packed full of pertinent information, including equal time to sabellarid and oyster reef formations. The author emphasizes the importance of

commercial oyster production and dedicates a very thorough discussion to the contributions of giant clams to coral reef biomass. These chapters are nicely complemented by detailed illustrations of the anatomy and physiology and life cycles of many of these organisms.

Conspicuous reef creatures such as crustaceans, echinoderms, and fish are the topics of chapters ten through twelve. Taxonomic characterization and anatomy and morphology discussions are accompanied by each group's ecological significance to the reef and effects on coral populations. Examples from the Crustacea include the relationship between cleaner shrimp and corals, mucus-eating crabs, and the variable nature of coral decapod communities. The importance of *Diadema* and *Acanthaster* (Crown of Thorns starfish) to coral populations is the focus of the echinoderm chapter. The effects of the changing populations of these echinoderms are well described and referenced, including recent hypotheses as to the causes and effects of *Diadema* population losses and *Acanthaster* population booms.

Coral reef fishes are described in chapter twelve by their feeding patterns and effects on corals. Top-down vs. bottom-up control of algae growth is a theme that continues from the *Diadema* discussion to herbivorous fishes. The importance of parrotfish in shaping algal communities and in reef bioerosion is well articulated and accompanied by a great illustration of the variations in jaw morphology. The peculiar behaviors of other fish, such as aggressive territorial damselfish, coral crouching gobies, and dancing cleaner gobies, are also of interest.

Chapter thirteen, A Brief History

of Reefs and Corals, takes the reader through geologic time. It not only describes the types of reefs that dominated each era but also the environmental and global processes that led to the types of reefs and species prevalent at that time. From the microbialite reefs present in the Precambrian to the appearance of the first scleractinian coral reef in the late Triassic, the abundant information in this chapter is very well organized and summed up in several engaging infographics and informative boxes. This chapter also provides a good launching point for the remaining chapters on the current and projected status of coral reefs.

Coral reproduction, biogeography, and centers of diversity are fluidly discussed in chapter fourteen, Ecology, Diversity, and Biogeography of Coral Reefs. The overarching processes are pulled together in thorough descriptions and discussions of diversity on reefs ranging from the coral triangle to the tropical eastern Pacific and the Caribbean. These descriptions lead the reader into the next chapter, aptly titled *Reefs Now and in the Next 100 Years*. In this chapter, the author outlines the main threats to coral reef survival, through global (climate change) to local (overfishing, mining, and nutrient addition) processes. Coral bleaching and disease are well described, and the reader can navigate from large-scale to cellular and molecular processes with ease. The discussion of coral diseases includes the definition of Koch's postulates and the issue with fulfilling them, especially in some polymicrobial diseases.

It is impressive that, after describing the major threats to coral reefs and their staggering losses, Goldberg follows with a chapter on solutions: Reef Resilience,

Loss of Biodiversity, and the Role of Conservation. The chapter begins with the natural ways reefs are coping with stress, through acclimation, resistance and resilience, and phase shifts. Human interaction and management strategies round out the book and leave the reader with some questions about designing marine reserves and measuring their effectiveness. The last section of the book is a short, on-point dialog titled *What Must be Done*, which asks the reader, both the lay person and the manager, not give up on coral reefs.

Overall, this book provides a detailed account of all things reef-related: what they are, where they came from, and where they are going. While the book discusses current controversies and challenges to both the study of reefs and reef health itself, it does not have a pessimistic tone. In fact, the beautiful illustrations and pictures, and the facts and information about reefs and their inhabitants, will go a long way toward inspiring a new generation of students to appreciate reefs in all their intricate detail.

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