
Preface

When *Life and Death of Coral Reefs* came out in 1997, it was just before the 1997–1998 circumtropical warming and bleaching event, an event that awakened us to the realization that processes affecting coral reefs were expanding to a global scale. Our basic perspectives on coral reefs have been changing at an accelerating pace, so each new book is produced with a whole new paradigm. This book is new, not an update or revision. Even in some chapters covering the same subject in the two books, a change in perspective is required by the unfolding of our perception of the nature of forces affecting coral reef systems. For example, in *Life and Death of Coral Reefs*, Barbara Brown provided an excellent timeless review of the conceptual framework of disturbances, organizing her chapter around different scales of tolerances and on the different kinds of natural and human disturbances. In this book, Margaret Miller shifted the focus from disturbance as events to disturbance as continuing trends. The fact that coral disturbance regimes are continuing to worsen while recovery capacities are waning compels us to accept that management strategies must focus on both of these processes.

New perspectives are also being provided by new tools. Nancy Knowlton and Matthieu Leray give a tour through the disparate ways the techniques of molecular genetics have caused major changes in our understanding of the evolutionary history of corals and have transformed our understanding of ecological and biological processes of coral reefs. Molecular biology opens more doors to coral reef science than the telescope did to astronomy because molecular genetics leads us through more dimensions. Dan Barshis follows this with an explanation of the genomic potential for coral survival of global changes in ocean chemistry and climate. The new perspectives of each chapter in this book are important for efforts in conservation, not just science.

Peter Glynn and Derek Manzello explain that while the effects of ocean acidification on the metabolic expense of calcification may vary among genera of corals, the acceleration of bioerosion by lower pH is general and critical. Adapting to ocean acidification by itself is facing an indifferent nonresponsive physical factor, but adapting to bioeroders is coevolving in an arms race. Dennis Hubbard takes us through how changes in seawater temperature, storm intensity, aragonite saturation state, and pH bring major shifts in the balance between carbonate production, destruction, and export. From a global perspective, Pamela Hallock spells out how the production and preservation of reef limestones is intimately connected to the Earth's biogeochemical cycles, especially of carbon, oxygen, nitrogen, and phosphorus. She elucidates how records preserved in limestones provide scientists and policy makers with insights into likely consequences of human activities for the future, not only of reefs but of the diversity of ecosystems on Earth.

Gisèle Muller-Parker, Chris D'Elia, and Clay Cook tell how cost-benefit analysis is a useful approach to examine symbioses in the context of environmental change and human impacts upon corals and coral reefs. By using new tools developed to assess the stability of the symbiosis, we may be better able to understand and predict the effects of future stressors and perturbations that threaten reef ecosystems.

Esther Peters explains how the multitude of stressors affecting reef organisms, particularly along heavily urbanized coastlines, and the introduction of species to distant reefs by global transport are contributing to disease in coral reefs. She presents new developments in disease diagnoses, an overview of diseases of reef organisms, and how diseases have adversely affected coral reefs. The application of concepts from the field of conservation medicine aids our understanding of diseases and their influence on organisms of reef ecosystems

Mark Hixon tells how the coral-seaweed-herbivore triangle is an accepted generalization embedded within a complex web of biotic interactions and abiotic conditions that bring exceptions. He provides rules of thumb for management that are essential for fostering the ecological resilience of coral reefs.

The introductory chapter reveals how the trophic structure of the coral reef ecosystem provides the greatest difference between gross productivity and net productivity, perhaps of any marine system. To export a substantial supply of food for humans, the net production might be enhanced by reducing the upper trophic levels, and this has generally been happening nearly globally before coral reef science became active. The final chapter tells how some islanders harvest reef resources for subsistence and local market yet maintain the integrity of the coral reef system by harvesting the intermediate-sized individuals from fish populations and taking the interest rather than the capital. The Palauans have exemplified the globalization of their economy while maintaining the integrity of their coral reef systems by keeping resource consumption local and having their international economy service-based rather than export-based.

Until recent decades, the conditions during the present Neogene Period were the best experienced for reef building by scleractinian corals since the Middle Jurassic. Although the hermatypic scleractinia were diverse through 130 million years previous to the Neogene, the shallow ocean waters were low in magnesium, low in pH, and high in temperature, so reef construction was meager. The Anthropocene may be returning corals from temporarily magnificent reef accretion to the “norm.” We may keep the corals, but lose the ecosystem services of reefs.

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Coral Reefs in the Anthropocene

Birkeland, C. (Ed.)

2015, XV, 271 p. 95 illus., 43 illus. in color., Hardcover

ISBN: 978-94-017-7248-8