Chapter

Introductory Chapter: The Benthic Realm

Luis A. Soto

1. Introduction

The present book is an unpretentious editing venture to fill the gap in our current knowledge on the ecological implications caused by anthropogenic disturbances upon benthic communities in several regions of the world ranging from the Western Atlantic, the Mediterranean Sea, and the Eastern Pacific Ocean, including the pristine environments of the Andes in South America. The common goal of the contributing authors in this book was to unravel the complex processes that make possible the life existence of bottom-living animals in different environmental scenarios. In order to achieve such a goal, the authors focus their attention on the emerging issues inherent to the global climate change or the pollution of aquatic systems. These are all themes that might be of interest to scientists active in a wide range of oceanographic subdisciplines. Well-established researches would appreciate the innovative approach adopted in each chapter of the book, which extends from the ecosystem level to refine molecular interpretations.

2. The benthic realm

Benthic organisms are excellent bioindicators of adverse conditions in marine ecosystems. Their sedentary lifestyle, distribution patterns, and community properties may reveal significant changes in their structure and functioning, caused by natural or anthropogenic disturbances. They can reflect the long-term effects of various sources of pollutants since these remain sequestered in sediments for long periods. Both benthic macrofauna (>500 μm) and meiofauna (42–500 μm) are ideal candidates to establish comparative analyses to study the magnitude of an environmental disturbance between "altered" and "unaltered" sites.

Benthic communities in shallow environments play an essential role in maintaining the ecological balance of tropical coastal systems. They are also closely linked to the socioeconomic development of human populations because their diversity and biomass include biotic resources of commercial and industrial importance. The Intergovernmental Panel on Climate Change (IPCC) has expressed concern about the risk and vulnerability of coastal systems, which may arise from disturbances in the marine environment caused by the increase in atmospheric temperature and sea level. Both factors have been associated with hydrometeorological phenomena (storms and hurricanes), whose consequences have been floods, coastal erosion processes, and the alteration of habitats such as wetlands, reefs, and coastal lagoons. In contrast, the increase in the concentration of CO_2 in the atmosphere has been correlated with the acidification levels of the oceans. The balance in the deposition processes of $CaCO_3$ can mean a severe alteration for all the benthic organisms that build their exoskeleton based on $CaCO_3$.

Benthic communities in tropical environments are particularly vulnerable to processes that change the thermohaline regime. Bottom-dwelling organisms are exposed to dilution or salinization, eutrophication processes, as well as to alterations in the deposition of $CaCO_3$. Undoubtedly, one of the phenomena of the most significant concern is coral bleaching as a result of the disruption of the symbiotic relationship between algae and zooxanthellae, attributable to an increase in ambient temperature. In recent years, there has been an exponential increase in the number of publications on the biological effects of ocean acidification (OA), and several recent reviews have covered this topic. The importance of the combined and frequently interactive impacts of multiple stressors (such as temperature, low oxygen, and pollutants) is now recognized, also the potential for multigenerational adaptation. Experimental research confirms that survival, calcification, growth, development, and abundance can all be negatively affected by acidification. However, the scale of response can vary significantly for different life stages among taxonomic groups and according to other environmental conditions, including food availability. Volcanic CO_2 vents can provide useful proxies of future OA conditions allowing studies of species responses and ecosystem interactions across CO_2 gradients. Studies at suitable vents in the Mediterranean and elsewhere show that benthic marine systems respond in persistent ways to locally increased CO_2. At the shelf edge, the ongoing shoaling of carbonate-corrosive waters (with high CO_2 and low pH) threatens cold-water corals, in particular *Lophelia pertusa*, in the Northeast Atlantic. These reefs are rich in biodiversity, but we have a poor understanding of their functional ecology and their reactions to the combined effects of future ocean acidification, warming, and other stressors.

Another condition of a critical nature for benthic organisms is the excessive nutrient load discharged by rivers and lagoons into the environment adjacent to the continental shelf. This process is causing the appearance of areas of hypoxia on the seabed, whose epifaunal diversity decreases significantly. Presently, we are more conscious about the severe physical disturbances on the continental shelf, coral reef, or wetland communities that can leave sequels lasting up to more than a decade. Furthermore, at the same time, our inability to predict and prevent disastrous ecological events has become more evident due to our restricted knowledge of biological diversity, stability, and the resilient capacity of benthic environments.

Author details

Luis A. Soto
Instituto de Ciencias del Mar y Limnología, UNAM, Ciudad Universitaria, Mexico

*Address all correspondence to: lasg1946@gmail.com