Preface

When we accepted the invitation by Springer to edit a book on “marine microbiology,” the next thing was to think about the contents of such book and about possible authors. There have been a fair number of books published on the topic and we did not want to duplicate any of them. The lucky coincidence was that we were leading a large European consortium “MaCuMBA,” which stands for “Marine Microorganisms: Cultivation Methods for Improving their Biotechnological Applications,” a 4-year one (2012–2016), with 22 partners from 11 European countries. MaCuMBA is a consortium of industrial and academic partners with great variety in expertise in marine microbiology. Hence, it seemed obvious to ask colleagues and principal investigators of the MaCuMBA consortium to contribute to this book, for which we gave the title: The marine microbiome—an untold resource of biodiversity and biotechnological potential.

The term “microbiome” is fashionable and is used to describe the whole microbial community, i.e., all microorganisms and their genetic information in a certain habitat or environment. The marine microbiome refers to the totality of microorganisms living in the ocean, its fringing seas, estuaries, and bays and fjords. This includes the intertidal areas of the coast but also the seafloor and the sub-seafloor, thousands of meters down in the bottom of the sea. It also includes the microorganisms living on and in marine animals, plants (seagrasses), and macroalgae, even though each of them forms its own microbiome.

Microorganisms are basically defined by their size and as a rule of thumb we consider any organism a microorganism when its size is too small to be observed in detail by the naked eye. This would mean everything smaller than 1 mm. In practice, most organisms that we consider as microorganisms are in the micrometer (μm) (one-thousandth of a millimeter) range, the smallest may be only 0.2 μm, but the biggest can be several hundreds of μm. Microorganisms comprise all three domains of life: Bacteria, Archaea, and Eukarya. While the former two domains are traditionally considered microorganisms (bacteria), all macroorganisms (plants, animals, macroalgae, and many fungi) are Eukarya. However, what is often forgotten that by far most Eukarya are in fact microorganisms (protists).
Bacteria and Archaea are often referred to as “Prokaryotes,” (organisms without a nucleus “karyon” in their cells) to distinguish “bacteria” from the eukaryotes that do have a nucleus. We agree with Norman Pace (‘Time for a change’ Nature 441: 289, 2006, and ‘It’s time to retire the prokaryote’. Microbiology Today, May 2009, 85–87) who argues that a prokaryote is defined by what is does not have (a nucleus) and that this is not a good criterion. In this book we decided to avoid this term, even though some authors were not fully convinced. However, as with the knowledge we have today, there is no doubt that Bacteria and Archaea comprise very different domains of life, even though you cannot tell much from the morphology observed under the microscope. The morphology of many microorganisms is anyway devoid of much resolution. The diversity of microorganisms is in their genome and in what they do. Using “prokaryote” is often sloppy, because when one starts asking, often only one of the domains of Bacteria or Archaea is meant. It is therefore more accurate to name that domain. And in the more rare cases that both domains are meant, it is not a big deal to name both. That is what we consequently did in this book.

There is another biological entity that we have not named yet. Viruses are not representing exactly a domain of life (i.e., not belonging to any of the three domains of life), but they are surely a biological entity that needs to be considered when talking about any microbiome. Viruses are not “living” simply by the fact that they need a living cell to replicate. But viruses play an extremely important role in maintaining the biodiversity, maintaining the microbial foodweb, and transferring genetic information between organisms, perhaps even between domains. Recent discoveries also show that the border between bacteria and virus is vanishing. The number of viruses in the ocean is overwhelming with an order of magnitude larger than that of all microorganisms (10 and 1 million per milliliter of seawater, respectively).

It is exactly 70 years ago when Claude E. ZoBell’s book “Marine Microbiology” appeared (C.E. ZoBell, Marine Microbiology. A monograph on hydrobacteriology, Waltham, Massachusetts, USA, 1946, 240 p.). ZoBell was at that time Associate Professor of Marine Microbiology at Scripps Institute of Oceanography, La Jolla, California. His monograph is still worth reading and presents us with a remarkably complete picture of marine microbial life and you could ask yourself how much more we know today. We hope nevertheless that the present edited volume does give a taste of what has been achieved in those 70 years and where we stand now. The marine microbiome is not just interesting from a scientific point of view. Certainly, with 70% of the Earth’s surface covered by the ocean and the ocean probably being the largest continuous habitat, the marine microbiome plays a prominent role in the biogeochemical cycling of elements, is at the basis of the marine foodweb, critical for the ecology of the sea, and essential for climate regulation and counteracting the effects of global change. However, science has also made great discoveries of bioactive compounds made by marine microorganisms that have found applications in biotechnology, bioenergy, and pharmacy, and activities that are displayed by these organisms that find application in bioremediation. Being aware that we might not know most of the microbial diversity that is
out there, marine microbiology holds a great promise for many more of such
discoveries. Therefore, with this book we also wanted to give a podium for the
application of marine microorganisms, for the legal issues using microbial
resources, and to explain the methods for dissemination to a wider public.

We divided the book into three main sections. The first section contains chapters
that describe the diversity and ecology of marine microorganisms. The second
section contains the chapters about marine habitats, their inhabitants, and biogeo-
chemical cycles and the third is about the marine resources (the hidden treasures).

We would like thank all the authors of the chapters in this book for their
excellent work and for making this book what it is.

Finally, we would like to thank project coordinator of Springer, Dr. Andrea
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