Preface

Microbial ecology encompasses the study of how microorganisms interact with their environment. Microoganisms are distributed across every ecosystem, and microbial transformations are fundamental to the operation of the biosphere. Yet, whilst microbial ecology arguably represents one of the most important areas of biological research, for many years our understanding of microorganisms in the environment has been based primarily on those microorganisms that we could culture on media, and which represent between only 0.1 and 10% of the total microbial flora within any given environment. However, the last 25 years have seen a revolution in microbial ecology, catalyzed by the application of molecular (largely nucleic-acid-based) approaches to enable the previously uncultured and numerically dominant microbial groups to be studied. Such research has been driven in particular by the development of methods to isolate nucleic acids directly from environmental samples and by the subsequent application of polymerase chain reaction (PCR) approaches to amplify gene sequences for further study by fingerprinting and/or sequencing, enabling investigation of microbial diversity and functional potential within any given environment.

This text aims to provide a theoretical and practical approach to molecular studies in microbial ecology and is written by some of the world's leading authorities in this area. The text begins with the isolation of nucleic acids from environmental samples and then details PCR-based approaches to study prokaryotic systematics via ribosomal RNA analysis and related methodologies allowing the study of microbial community structure, molecular typing of environmental isolates, investigation of gene expression and abundance in environmental samples, and the targeting of specific functional groups via stable isotope probing. Subsequent chapters introduce the application of DNA hybridization approaches to microbial ecology, and importantly the use of fluorescent *in situ* hybridization to enable investigation and localization of microorganisms within their environment. Chapters 10 and 11 consider the implications of, and potential for, genomic and metagenomic approaches in microbial ecology, whilst Chapters 13 and 14 discuss how molecular approaches can be utilized to investigate fungal microbial ecology, and the application of microorganisms as tools for environmental assessment of contaminated ecosystems. Chapters 12 and 15 provide a molecular toolbox for the molecular microbial ecologist with coverage of PCR primer systems for the analysis of functional genes and an introduction to key bioinformatics resources.

Whilst the scope of this text is limited to nucleic acid-based techniques, it is important to appreciate, given the complexity of the environments under study, that the most insightful discoveries in microbial ecology will be gained from polyphasic approaches combining molecular studies with microbial physiology and biochemistry and with physico-chemical characterization of the environment. With the additional development of microarray-, proteomic- and metabolomic-based methods and the potential for miniaturization in lab-on-a-chip systems, we have unparalleled opportunities to advance our understanding of microbial ecology over the next decade.

Finally we would like to take this opportunity to thank all of the contributors to this text for their enthusiasm and also their patience during the book's development. We

would also like to thank all of the staff at Taylor & Francis, and in particular Dominic Holdsworth, for their continued support during this project. We also thank Nigel Farrar for his input into the early development of the text.

Dr A. Mark Osborn, Dr Cindy J. Smith