Preface

Fungi are ubiquitous in the aquatic and terrestrial environments, occurring as unicellular yeasts, polymorphic and filamentous fungi, and as both free-living and symbiotic forms. In the terrestrial environment, that part of the biosphere most closely associated with fungal activities, fungi are of fundamental importance as decomposer organisms, plant pathogens and mutualistic symbionts (mycorrhizas and lichens), playing important roles in carbon, nitrogen and other biogeochemical cycles. In soil they can comprise the largest pool of biomass (even exceeding that of other microorganisms and invertebrates) and also play a role in maintenance of soil structure owing to their filamentous branching growth habit and exopolymer production. Despite their important roles in the biosphere, fungi are frequently neglected within broader environmental and microbiological spheres, in contrast to bacteria. For example, symbiotic mycorrhizal fungi can be associated with the majority of plant species and are responsible for major transformations and re-distribution of inorganic nutrients as well as carbon flow, while free-living fungi have major roles in decomposition and solubilization of plant and other organic materials, including xenobiotics, and low-solubility phosphate compounds. As well as this general neglect, mycological interests can be somewhat fragmented between traditional microbiological and botanical activities and the fields of cell biology, plant symbiosis, and pathogenesis and genetics. This symposium volume provides a unique account of modern environmental mycology and includes accounts of major recent advances in molecular, imaging and modelling methodologies, which have the potential to draw together these disparate areas of mycology.

The book is divided into six general sections, each dealing with an important area in environmental mycology, but with a considerable degree of complementarity between all the sections. The first section, *Imaging and modelling of fungi in the environment*, includes modern contributions in the

areas of cell biology where molecular tools and dyes have revealed unsuspected complexity in fungal cell structure, and allowed key questions to be answered in relation to roles of sub-cellular organelles. A chapter on peroxisomal roles in the ascomycete lifestyle is complemented by chapters on cellular structure and how environmental signals influence hyphal and colony morphogenesis. Complex nutrient dynamics in mycelial networks can be dissected by using novel radiolabelling imaging techniques, and mathematical modeling using sound biological data enables understanding of mycelial form and function, particularly in complex realistic systems. The section on *Functional ecology of saprotrophic fungi* includes modern approaches to study saprotrophic growth in soil that reveal unsuspected fungal roles in mineral transformations and biogeochemical cycles, the adaptability and importance of the mycelial habit being a recurring theme. *Mutualistic interactions in the environment* includes chapters on mycorrhizas, which not only influence cycling of major elements such as carbon and phosphorus but can even determine plant community composition. Lichens represent a unique fungal lifestyle of global importance, not least because of their success as pioneer organisms on rocks and other exposed environments where water relations are an important survival determinant. In contrast, *Pathogenic interactions in the environment*, as well as being a significant part of ecosystem function, may cause serious crop diseases, such as rice blast, potentially affecting millions of human lives. Nematode-trapping fungi are important predators that have relevance to the biocontrol of nematode populations. Aspects of fungal structure can be significant determinants of virulence and this is the case for human as well as plant pathogens: the glucans of *Aspergillus fumigatus* provide an example from the human health perspective. Within the human built environment, contamination, spoilage and potential health effects are well known and are also highlighted in this section. Advances in molecular biology techniques are leading to greater understanding of *Environmental population genetics of fungi*; some of the approaches are highlighted in a case history with *Penicillium marneffei* as the lead player in a complex system of relationships. In complement to this, the final section on *Molecular ecology of fungi in the environment* details examples where molecular approaches provide understanding of the gut mycoflora of beetles, and fungal populations in saltmarsh decomposition systems.

This book arises from the British Mycological Society Symposium on *Fungi in the Environment* held at the University of Nottingham in September 2004 and the editors would like to thank those authors who

contributed enthusiastically to this book. Special thanks also go to Diane Purves in Dundee, who greatly assisted communication, collation, editing and formatting of chapters. The prime objective was to produce a volume that would highlight the roles and importance of fungi in the environment together with the modern approaches and tools that are now revealing the importance of fungi in a wider biological context. We think that has been achieved and hope the volume has broad appeal not only to mycologists of all persuasions but also to cell biologists, molecular biologists and geneticists who routinely rely on fungal model systems. It will be interesting to see how the new interdisciplinary and systems approaches influence developments over the next few years.

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