

PREFACE

A report published in the *News Bulletin* of the American Society for Microbiology in December, 1975 concludes that "the teaching of microbial ecology is early in need of a substantial treatment in this field in a single well-documented text on the level of *The Microbial World* [by Scamman, 1967]". In writing this book we have responded to this need. We have attempted to write a comprehensive text for the field of microbial ecology. Our aim was to create a thorough and flexible microbial ecology text, useful not only to microbiology majors, but also to students in general ecology, environmental science, sanitary engineering, resource management and numerous other related study programs. A thorough treatment of basic principles and approaches is followed by an extensive discussion of various applied aspects of microbial ecology. In addition to serving as a text, the book should also be useful as an introduction and reference source for scientists in related fields who wish to extend their knowledge and research into microbial ecology, and should help to bridge the communication gap among ecologists and microbiologists.

As a teaching tool, this text is designed for a one-semester course on the senior undergraduate or graduate level, and intends to familiarize the students with the principles, methodology and practical applications and implications of microbial ecology. As a background, we have assumed that

the student will have had introductory courses in general chemistry, biology and microbiology.

The coverage of the field of microbial ecology in this book is more complete than any other book in this field. The book includes a short historical introduction tracing the emergence of this new field (chapter 1). Microbial diversity and nomenclature are reviewed in chapters 2 and 3. Material normally found in upper level general microbiology textbooks, as far as it is essential to the understanding of microbial ecology, is summarized in these two review chapters. This review considers both prokaryotic and eukaryotic microorganisms. Ecological parameters (environmental determinants, numbers, biomass and activity) and their measurement are discussed in chapters 4 and 5; chapters 6 and 7 are devoted to habitat and community ecology. These topics are usually addressed in general ecology courses, with consideration given to higher plants and animals, but the applicability of ecological principles to microorganisms receives little attention in general microbiology and ecology texts. Interactions among microorganisms, as well as between micro- and macroorganisms, are explored in chapters 8 through 10. These chapters include discussion of the relationship of microorganisms to plant growth and pathology and to animal nutrition and disease. Microbial activities in biogeochemical cycling and applied aspects of

microbial ecology are covered in chapters 11 through 15. The role of microorganisms in biodegradation control, in soils, water- and waste-management, in various environmental pollution problems, in resource recovery, in energy production and in biological control receive detailed and up-to-date coverage. Chapters 16 and 17 discuss sampling designs, statistical evaluation of results and modeling approaches that are gaining an increasingly important role in research in microbial ecology. Modeling and the systems approach have received wide use by general ecologists, but hitherto have been given relatively little attention by microbiologists.

Courses in microbial ecology are now being offered at many universities. The students who attend these courses have a wide diversity of backgrounds and career goals. The study of microbial ecology cuts across traditional academic disciplines and is truly an interdisciplinary science. A challenge in writing this book was to accommodate the different varied backgrounds of students taking a course in microbial ecology. In our experience, some students have strong backgrounds in biology and microbiology, but not in the relevant environmental sciences, such as soil science or limnology. Others have strong backgrounds in ecology, but not in microbiology. Individuals who have taken an introductory course in microbiology may have been exposed almost exclusively to material concerning bacteria with little attention given to algae, fungi, viruses, or protozoa. We, therefore, have included introductory review chapters as "background equalizers". To students with a strong microbiology background, these chapters will merely serve as concise refreshers, but to others they will impart essential background information needed for the subsequent chapters. Depending on the composition of the class, the instructor may choose to emphasize, skim, or skip these two review chapters.

In the chapters of our book that deal with fundamental aspects of microbial ecology, along with the presentation of factual knowledge, we took care to discuss the methodology employed in obtaining

this knowledge. The emergence of the field of microbial ecology has gone hand in hand with technical developments, and the field will continue to expand as new experimental tools become available. Experimental approaches need to be emphasized, because the common introductory laboratory courses in microbiology that stress pure culture procedures do little to prepare the student for the investigation of the dynamic interactions of organisms and their environment.

At the option of the instructor, the last two chapters of the book (statistics and modeling) may be treated either as an integral part of the course material, or as an appendix with special relevance for those students and scientists who wish to pursue themselves for making research contributions in this field.

An advanced text should serve as a reference source to current literature, but the style of citations used in many review articles and textbooks often inhibits efforts to summarize, simplify and interpret. In order to increase the readability of the text, we chose not to list specific citations for our statements. Instead, we have provided an extensive list of appropriate references, sources, and suggested readings at the end of each chapter. Inclusion of full texts with the references should facilitate ready access to the pertinent literature for anyone interested in pursuing further detail on a particular subject. We suggest that advanced students should be required to examine some of these works so that they become familiar with extracting information directly from the scientific literature. Throughout the book we have liberally illustrated general statements with specific figures and tables taken from recent journal articles; the source articles are cited in the legends and are included among my references. They also provide access points to the relevant literature on specific topics.

The field of microbial ecology has experienced dramatic growth during the past twenty years. While prior to 1965 this area of specialization was virtually unknown, it is now everywhere and literature has since accumulated in this field. The rapid dis-

viewpoint of microbial ecology as a scientific discipline was undoubtedly promoted by a concurrent emergence in societal interest in environmental quality. Many of today's environmental problems, as well as their potential solutions, are intimately interwoven with the microbial component of the global ecosystem. Numerous practical implications add relevance and excitement to this new field, and student interest in the subject is increasing. We hope that *Microbial Ecology: Fundamentals and Applications* helps stimulate interest in this exciting field.

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