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# **Ecology of Protozoa**

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**ECOLOGY OF PROTOZOA: The Biology of Free-living Phagotrophic  
Protists**

*By Tom Fenchel*

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# Ecology of Protozoa

The Biology of Free-living  
Phagotrophic Protists

With 47 Figures



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# Preface

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This book is written for ecologists and protozoologists. Ecologists who study environments and biotic communities in which protozoa are important should find this book especially useful. During the last decade it has become clear that protozoa play important roles in natural ecosystems, but few ecologists have a feeling for the functional properties and the diversity of these organisms. Protozoa pose or exemplify many general problems of population and community ecology, and of evolutionary biology. In most respects the general ecological properties of protozoa are not fundamentally different from those of larger organisms; yet, due to their small size, short generation times, and ubiquitous occurrence they often present ecological phenomena in a new and different light. To this should be added that protozoa are well-suited for experimental work. Despite these advantages, the study of protozoa has played a relatively modest role in the development of ecology and evolutionary biology, primarily, I believe, because most ecologists are unfamiliar with these organisms. I hope this book will attract more attention to these favorable characteristics of protozoa.

I also hope that this book may make protozoologists aware of new aspects of their pet organisms. For a long time (that is, until the fundamental distinction between prokaryotic and eukaryotic cells was recognized) protozoa were believed to represent the simplest form of life. They were therefore extensively used for the experimental study of basic questions of cell biology. Protozoa (and not least the ciliate *Tetrahymena*) are still used in the laboratory as cell models, but prokaryotes and plant and animal tissue cultures have to a large extent taken over this role. Protozoa are eukaryotic cells which are exposed directly to

the environment and they are subject to natural selection as individual organisms. Protozoan cells therefore show a variety of specialization and complexity of structure and function which are unchallenged among other types of eukaryotic cells. Cell biology may therefore still harvest much from the study of protozoan cells, not because of their "primitive" or "generalized" nature, but because of their specializations, which permit the study of certain features of cells which are somehow amplified in a particular species. However, in order to fully exploit this aspect of protozoa, it is necessary to understand the relationships between the organisms and their environments and the adaptive nature of the studied traits. Throughout this book I emphasize the role of physiological and structural constraints for understanding the role of organisms in nature and the close relationship between cell physiology and ecological insight.

This book is divided into twelve chapters. The first one gives a general introduction to the nature of unicellular eukaryotic organisms in general and to protozoa (defined functionally as phagotrophic, unicellular organisms) in particular. The following five chapters are devoted to the functional biology of protozoa: how they move and orient themselves in the environment, their bioenergetics, symbiotic relationships with other organisms, etc. These chapters serve as a necessary background for understanding protozoa in their natural environments. Chapter 7 treats general ecological principles (dynamics of food chains, environmental patchiness, niche diversification and biogeography) with special reference to protozoan populations and communities. Together with the physiological properties of protozoa, the considerations offered in this chapter explain properties of protozoan ecology which are common to all types of ecological systems. The following four chapters discuss protozoan communities belonging to different types of habitats. The treatment emphasizes the role of environmental patchiness in time and space, food resource specialization, and protozoan diversity, as well as the role of protozoa in food chains and in the flow of carbon and other elements in a particular ecosystem. The book is concluded by a chapter which offers some general considerations.

I believe that the publication of this book is worthwhile. Although protozoan diversity has recently been monographed (Lee et al., 1985) and many aspects of protozoan physiology and biochemistry have been reviewed by Levandowsky & Hutner (1979–81), there is no general treatment of the ecology of protozoa. I have tried to write a book which will be easy to read and which will inspire the readers with new ideas (rather than a reference book or an annotated bibliography). Consequently, I have chosen to discuss some examples in more detail but I have not attempted to be comprehensive. I apologize to colleagues who may feel that their work is inadequately cited, although it may be as

interesting and illuminating as the examples I do discuss. A recent comprehensive bibliography on the ecology of free-living protozoa is found in Finlay & Ochsenein-Gattlen (1982). I have not treated methodology in any detail, but the reference list should be helpful. The section on protozoa in Burns & Slater (1982) treats methods of collecting, enumerating, culturing, and identifying protozoa and gives additional references.

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TOM FENCHEL

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