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A great many terrestrial plants live in close association with fungi. The features of this association, which is known as a mycorrhiza, are those of a mutualistic symbiosis. Almost all plants form mycorrhizae whereby the fungus provides soil resources to the plant in exchange for energy provided by the plant. The symbiosis means greater productivity under stress for the plant and a steady energy supply for the fungus.

This book addresses the diverse and complex ways in which mycorrhizae affect plant survival as individuals and populations, and community structure and functioning. An evolutionary/ecological approach is used to describe how and under what conditions mycorrhizae influence basic ecological processes. Applications of these mycorrhizal symbioses range from managing natural and agricultural lands to biotechnological processes that enhance agricultural productivity and sustainability.

*The ecology of mycorrhizae* will be an invaluable book, applicable to all levels of theoretical and applied research in agronomy, botany, ecology, environmental microbiology, and plant pathology.

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**The ecology of mycorrhizae**

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MICHAEL F. ALLEN

*Department of Biology, Systems Ecology Research Group,  
San Diego State University, San Diego, California, USA*



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## Preface

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Mycorrhizal associations represent an enigma to most ecologists. For decades, theoretical ecologists have treated mutualisms, including mycorrhizae, primarily as interesting oddities. Moreover, one of the partners is a fungus, a microorganism, and therefore too small to be seen and bothered with. To see a mycorrhiza, one must look down at the ground instead of admiring the scenery. If anything, the mycorrhizae are either incorporated into the infamous microbial biomass black box (extramatrix hyphae) or as a component of the root biomass (internal mass). A classic example of out-of-sight, out-of-mind.

Despite this oversight, research on the ecology and applied biology of mycorrhizae has continued for over a hundred years and the number of published papers is increasing at an exponential rate. Nevertheless, even many mycorrhizasts (following the terminology of J. L. Harley) have not yet grasped the immense variety of types and roles that mycorrhizae play in both native and human-altered ecosystems. The mycorrhizal fungi are found in every terrestrial ecosystem and may well represent the second largest biomass component of many terrestrial ecosystems.

It is to both groups that this book is addressed with the hopes that it will stimulate a new mutualism between mycorrhizal scientists and ecologists.

Any effort attempting to present an overview of a research field as broad as the ecology of mycorrhizae must necessarily restrict and reduce the emphasis in some areas. For this reason, I have intentionally minimized a general overview of the structure of mycorrhizae, the physiology/biochemistry of mycorrhizae and the applied biology of mycorrhizal ecology. I would refer the reader to a number of outstanding books in these subject areas. I especially refer anyone interested in mycorrhizae to the books by J. L. Harley and the most recent edition by Harley and S. E. Smith (*Mycorrhizal Symbiosis*). These writings inspired my own interest in mycorrhizae as they have for countless numbers of my colleagues.

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Several agencies have been extremely helpful in the preparation of this book. The National Science Foundation Ecosystems Studies Program and the United States Department of Agriculture Competitive Grants Program funded most of the research that formed the framework of my ideas. Utah State University Ecology Center provided funds for the literature computer search and the Grey Herbarium Library of Harvard University was especially helpful in finding the obscure and important older references. San Diego State University provided resources to complete the volume.

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A number of individuals have been especially helpful in the preparation of this volume. Anne Anderson, Carl Friese and Ralph Boerner reviewed the manuscript and made suggestions for improvements. Martha Christensen, my mentor, started my career in mycorrhizal studies and spent considerable hours in reviewing this effort as she has so many others. Jillyn Smith edited the book and made numerous suggestions for improving its clarity. David Read not only reviewed the book, he also nominated me for the task. If the reader wished to place blame for this book, please tell David. I take responsibility for any oversights, omissions, and mistakes within the volume.

Finally, I wish to acknowledge my colleague and wife, Edith, who not only read every word of every draft, but also put up with me during the writing, the re-writing, and all times in between. I would like to dedicate this volume to Bill Maben and my parents, Olin and Donna, and to the hikes in the Rocky Mountains of Colorado and Wyoming that started me on this trail.