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0521817129 - Macroevolutionary Theory on Macroecological Patterns

Peter W. Price

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## Macroevolutionary Theory on Macroecological Patterns

In *Macroevolutionary Theory on Macroecological Patterns*, Peter Price establishes a completely new vision of the central themes in ecology. For the first time in book form, the study of distribution, abundance, and population dynamics in animals is cast in an evolutionary framework. The book argues that evolved characters of organisms such as morphology, behavior, and life history influence strongly their ecological relationships, including the way that populations fluctuate through time and space. The central ideas in the book are supported by data gathered from over 20 years of research, primarily into plant and herbivore interactions, concentrating on insects. The huge diversity of insect herbivores provides the immense comparative power necessary for a strong evolutionary study of ecological principles.

The book is intended as essential reading for all researchers and students of ecology, evolutionary biology, and behavior, and for entomologists working in agriculture, horticulture, and forestry.

PETER W. PRICE is Regents' Professor Emeritus at Northern Arizona University, Flagstaff, U.S.A. Over the past 40 years Professor Price has contributed over 200 research articles, and book chapters to the scientific literature and has been sole author or an editor of 11 books. He has received the Founder's Memorial Award from the Entomological Society of America and is an Honorary Fellow of the Royal Entomological Society.

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*Northern Arizona University*



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## *Preface*

The field of distribution, abundance, and population dynamics has never fully embraced evolutionary theory as a guiding light or a central theme. The field has remained largely ecological in its focus, in spite of many other areas of ecology becoming more integrated with evolutionary thought. However, taking an evolutionary view enables a synthesis of many biological aspects of organisms and their ecology. An integration of behavior, ecology, and evolution is essential in a full understanding of any kind of interaction between a species and its environment. Every species is molded by past events, selective forces, and the “baggage” of its lineage. Hence the ecology of a species is very much a function of evolved traits involving behavior, physiology, and life history.

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It is all the more surprising that population dynamics has remained largely aloof from evolutionary thinking when we recognize that distribution, abundance, and dynamics of organisms have played a central role in the development of ecology. The field is fundamental in solving human problems with pest species in agriculture, horticulture, forestry, and epidemiology, and the history of ecology is full of rich debates among major professional ecologists. These debates would have been enriched, and perhaps resolved, if evolutionary points of view were given equal play.

More than 20 years ago our research group began working on an uncommon sawfly, about which very little was known, and its relatives were poorly known also. The distribution, abundance, and population dynamics turned out to be simple, for experimental approaches were easy to apply, with strong limits on population size set by plant quality. With a low carrying capacity for the population set by severe resource limitation, we began to ponder why many species could escape such limitation to become serious pests that could defoliate forests

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on occasion. We adopted a completely novel perspective on why pest species existed. We entered into a comparison between uncommon and outbreak species to understand why the differences were so great. And an evolutionary approach proved to be the most enlightening, with the broadest possible comparative insights. After many idiosyncratic studies of individual species in various parts of the globe and a few synthesis papers, the time is right for a book-length treatment laying out the rationale, the thesis, the evidence, and the generality of the approach. A macroevolutionary basis, encompassing phylogenetic comparisons, is advocated for understanding big, macroecological patterns in distribution, abundance, and population dynamics. Of necessity, a broad view of the literature is required: to understand current views and our departure from these views, to show how broadly our approach applies to the literature, and to encompass a diverse array of taxa including species in temperate and tropical environments.

The approach is integrative in relation to the taxa it applies to, in bringing evolution, ecology, behavior, and life history to play equally important roles in understanding organisms, and the comparative approach is valid for temperate and tropical latitudes, as well as for multitrophic-level studies. The approach is Darwinian, starting with empirical observations in natural settings, finding patterns in nature, and generating hypotheses to explain mechanistically why such patterns should be evident.

Therefore, this book is intended for researchers and students in evolutionary biology, ecology, behavior, botany, and entomology and for entomologists working in agriculture, horticulture, or forestry. An attempt is made at applying the principles to plants and vertebrate groups near the end of the book. The main focus is on plant and herbivore interactions, concentrating on insects. Insect herbivores provide an almost unending richness of form, behavior, ecology, and dynamics, but also immense comparative power because of their diversity. This diversity is the key to a strong evolutionary foray into the bastions of ecology: distribution, abundance, and population dynamics.

Peter W. Price  
Flagstaff, Arizona  
May, 2002

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## *Acknowledgments*

During the writing of this book I have drawn on my experiences over the past 50 years, for in the “olden days” schools provided excellent education in the sciences, especially botany and zoology in my case. Hence, my ideas and knowledge have been influenced by hundreds of important people in my life which I acknowledge mentally, but will not mention by name. Certainly, my parents were most influential in developing my love of nature and my fascination with all wild things. Also included in the most informative and interesting of friends have been the many graduate and undergraduate students in my research programs at the University of Illinois, Urbana-Champaign and at Northern Arizona University. Without them my research productivity would have been minor both in volume and in scope. They have enriched my life immeasurably with their knowledge and their friendship.

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Once I had prepared a draft, several reviewers were generous with their time, energy, and expertise in contributing ideas that improved the book. While we did not agree invariably, their reviews were thought-provoking, insightful, and challenging. Timothy G. Carr at Cornell University, Timothy P. Craig at the University of Minnesota, Peter J. Cranston at the University of California, Davis, and an anonymous reviewer all provided excellent constructive criticism. Further expertise was provided by Louella J. Holter at the Bilby Research Center, Northern Arizona University, whose competence, accuracy, and alacrity in word processing has rendered my scribbled manuscript into formal text on this occasion and on many others over the past 15 years or so. I have appreciated her outstanding services over these many years. I was fortunate to meet Ward Cooper, Commissioning Editor in the Biological Sciences at Cambridge University Press at Iguassu Falls, Brazil in 2000, at the International Congress of Entomology. A most pleasurable interaction has resulted for which I am grateful.

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