

Preface

The first edition of *Elements of Ecology* appeared in 1976 as a short version of *Ecology and Field Biology*. Since that time, *Elements of Ecology* has evolved into a textbook intended for use in a one-semester introduction to ecology course. Although the primary readership will be students majoring in the life sciences, in writing this text we were guided by our belief that ecology should be part of a liberal education. We believe that students who major in such diverse fields as economics, sociology, engineering, political science, law, history, English, languages, and the like should have some basic understanding of ecology for the simple reason that it impinges on their lives.

Structure and Content

The structure and content of the text is guided by our basic belief that: 1) the fundamental unit in the study of ecology is the individual organism, and 2) the concept of adaptation through natural selection provides the framework for unifying the study of ecology at higher levels of organization: populations, communities, and ecosystems. A central theme of the text is the concept of tradeoffs—that the set of adaptations (characteristics) that enable an organism to survive, grow, and reproduce under one set of environmental conditions inevitably impose constraints on its ability to function (survive, grow, and reproduce) equally well under different environmental conditions. These environmental conditions include both the physical environment as well as the variety of organisms (both the same and different species) that occupy the same habitat. This basic framework provides a basis for understanding the dynamics of populations at both an evolutionary and demographic scale.

The text begins with an introduction to the science of ecology in Chapter 1 (The Nature of Ecology). The remainder of the text is divided into eight parts. Part One examines the constraints imposed on living organisms by the physical environment, both aquatic and terrestrial. Part Two begins by examining how these constraints imposed by the environment function as agents of change through the process of natural selection, the process through which adaptations evolve. The remainder of Part Two explores specific adaptations of organisms to the physical environment, considering both organisms that derive their energy from the sun (autotrophs) and those that derive their energy from the consumption and break-down of plant and animal tissues (heterotrophs).

Part Three examines the properties of populations, with an emphasis on how characteristics expressed at the level of the individual organisms (life history characteristics examined in Part Two) ultimately determine the collective dynamics of the population. Part Four extends

our discussion from interactions among individuals of the same species to interactions among populations of different species (interspecific interactions). In these chapters we expand our view of adaptations to the environment from one dominated by the physical environment, to the role of species interactions in the process of natural selection and on the dynamics of populations.

Part Five explores the topic of ecological communities. This discussion draws upon topics covered in Parts Two to Four to examine the factors that influence the distribution and abundance of species across environmental gradients, both spatial and temporal.

Part Six combines the discussions of ecological communities (Part Five) and the physical environment (Part One) to develop the concept of the ecosystem. Here the focus is on the flow of energy and matter through natural systems. Part Seven continues the discussion of communities and ecosystems in the context of biogeography, examining the broad-scale distribution of terrestrial and aquatic ecosystems, as well as regional and global patterns of biological diversity.

Part Eight focuses on the interactions between humans and ecological systems. It is here that we examine the important current environmental issues relating to population growth, sustainable resource use, declining biological diversity, and global climate change. The objective of these chapters is to explore the role of the science of ecology in both understanding and addressing these critical environmental issues.

Throughout the text we explore this range of topics by drawing upon current research in the various fields of ecology, providing examples that enable the reader to develop an understanding of species natural history, the ecology of place (specific ecosystems), and the basic process of science.

New for the Seventh Edition

For those familiar with the sixth edition of this text, you will notice a number of changes in this new edition of *Elements of Ecology*. In addition to updating many of the examples and topics to reflect the most recent research and results in the field of ecology, we have made a number of changes in the organization and content of the text.

The objective of Chapter 1 (The Nature of Ecology) is to introduce students to the science of ecology and to provide a framework for understanding the organization of the remainder of the book. In keeping with this objective, we have expanded our discussion of the hierarchical structure of ecological systems. This framework helps the student to both understand the way ecologists view and study nature, as well as providing a framework

for understanding why the text is structured the way it is—from individuals to ecosystems. In addition, we have expanded the current discussion of the scientific method and use it as a framework for presenting the discussion of the different approaches used by ecologists to understand pattern and process in natural systems (direct observation, experimentation, modeling, etc.).

In the sixth edition, the text's second chapter, *Adaptation and Evolution*, provided an introduction to the concepts of natural selection, inheritance, and speciation. In initially developing this chapter, we assumed that students using the text would fall into two general categories. The first category included students who had not taken a college biology course. For those students, the chapter was meant to provide a basic review of Mendelian genetics as well as the concepts of natural selection and speciation. For the second category, students who had a background in biology, it was hoped that the representation of the materials would function as a review and place the material into a new "ecological context." From my use of the textbook in the classroom, as well as comments from reviewers, we now believe that the chapter fell short of its objective, particularly in light of the advances and growing importance of genetics in ecological research. In response, we have reduced the emphasis on reviewing concepts of basic genetics, and placed the emphasis on natural selection and adaptation, providing a framework for addressing the role of the physical (aquatic and terrestrial) and biological (species interactions) environment as agents of natural selection presented in later chapters, emphasizing the role of tradeoffs and constraints in the evolution of adaptations.

In addition to the changes in content, the discussion of natural selection and adaptation has been moved from the opening of the text, where it was presented before the discussion of the physical environment, to its current place as Chapter 5 (*Ecological Genetics: Adaptation and Natural Selection*) in Part Two, where it now provides a framework for the discussion of specific adaptations of plants and animals in Chapters 6 (*Plant Adaptations to the Environment*), 7 (*Animal Adaptations to the Environment*), and 8 (*Life History Patterns*).

Although the majority of this new edition retains the general structure of the sixth edition, we have added additional and expanded coverage of a wide variety of topics throughout the text including: water balance in plants, density-dependent population regulation, allometry and animal metabolism, long-term dynamics of decomposition, role of the rhizosphere in decomposition and nutrient cycling, and the relationship between species diversity and ecosystem productivity.

A historical feature of the *Elements of Ecology* text is our focus on applying the science of ecology to current environmental issues, providing students with a first-hand understanding of the importance of ecology in the

relationship between the human population and the natural environment. Since publication of the sixth edition, advances have been made in our understanding of the issues that are presented in Part Eight: Human Ecology (Chapter 26: Large-Scale Patterns of Biological Diversity; Chapter 27: Population Growth, Resource Use, and Sustainability; Chapter 28: Habitat Loss, Biodiversity and Conservation; and Chapter 29: Global Climate Change). In response we have updated many of the research results presented in these chapters to reflect the most current understanding of these issues, such as the Climate Change 2007 (Fourth Assessment) report of the IPCC (Intergovernmental Panel on Climate Change).

A feature new to the sixth edition was the inclusion of Researcher Profiles associated with specific chapters. This feature serves two functions. First, it introduces students to the new generation of ecologists pursuing questions relating directly to concepts presented within the chapter. Secondly, each functions as a case studies, allowing a more detailed presentation of methods, analyses, and results. Each profile integrates the work from a number of research papers, which together address a broader research question. This feature remains in the seventh edition under a new name: Field Studies. We believe this title more accurately reflects the emphasis of these short essays in providing students with a view of the new frontiers in ecological research and the new generation of ecologists that are defining the future directions for the science of ecology.

Ecology is a science rich in concepts, yet as with all science, it is quantitative. As such, a major objective of any science course should be the development of basic skills relating to the analysis and interpretation of empirical data. As with the sixth edition, the Quantifying Ecology feature in this new edition functions to provide students with an understanding of how concepts introduced in the chapters are quantified. In many chapters, the Quantifying Ecology boxes focus on assisting the reader with the interpretation of graphs, mathematical models, or quantitative methods that we have introduced within the main body of the text. In the seventh edition, however, we have added an additional feature to assist students in the development of quantitative skills. Interpreting Ecological Data is associated directly with various figures and tables in the text. The feature consists of two or more questions relating directly to the interpretation of data and analyses presented in the associated figure or table. It has become a common practice in many new textbooks to embellish figures and tables with annotations that function to provide the reader with an interpretation of the graph or data. Although we also use this technique for a number of complex graphics, our annotations are meant only as an extension of the figure or table captions. Rather, we believe that it is better to ask specific questions that will both encourage and assist the reader in the interpretation and understanding of the

data and analyses that are presented. In doing so we hope to assist the reader in building the basic skills that are necessary to move beyond the examples presented in the text and begins to explore the wealth of ecological studies published in the books and journals that are referenced throughout the text. It is our belief that the development of these basic quantitative and interpretative skills are as important as understanding the body of concepts presented in the text that form the framework of the science of ecology. The answers to the questions presented in the Interpreting Ecological Data features are provided at the associated website.

Associated Materials

- Instructor's Resource DVD (0-3215-6786-2)
- Instructor's Guide/Test Bank (0-3215-6788-9)
- Computerized Test Bank: (0-3215-6787-0)
- Ecology Place Companion Website:
(www.ecologyplace.com)
- Ecology on Campus Lab Manual: (0-8053-8214-3)
- Course Management Options (All CourseCompass and Blackboard courses offer pre-loaded content including tests, quizzes, and more.)

Acknowledgments

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