

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.

New for the Eighth Edition

For those familiar with 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. An important objective of the text is to use the concept of adaptation through natural selection as a framework for unifying the study of ecology, linking pattern and process across the hierarchical levels of ecological study: individual organisms, populations, communities, and ecosystems. Many of the changes made in previous editions have focused on this objective, and the changes to this edition continue to work toward this goal.

Life History Patterns Chapter Returned to Part Three

Despite all previous efforts, we feel that we did not fully meet this objective in the discussion of populations (Part Three) in the seventh edition. In hindsight, we believe that this shortcoming was a result of our decision to move the presentation of Life History from Part Three (Populations) to Part Two (The Organisms and Its Environment) in the sixth edition. By moving Life History to Part Two we were trying to maintain the theme of trade-offs and constraints in the evolution of characteristics that is developed in Chapter 6 (Plant Adaptations to the Environment) and Chapter 7 (Animal Adaptations to the Environment). However, it is the discussion of life histories, specifically the discussion of adaptations relating to age-specific patterns of survival and fecundity (reproduction), that provide a direct link between natural selection and population dynamics. For this reason, we have returned the chapter on Life History to Part Three (Populations). The chapter now follows Chapter 10 (Population Growth). In addition, we have revised the materials that are presented to make explicit the links between life history characteristics and population dynamics using the framework of life tables that is developed in Chapter 10 (Population Growth).

Restructured Part Four: Species Interactions

Another major change that we have introduced in the eighth edition to emphasize the concept of adaptation through natural selection as a framework for unifying the study of ecology is in the restructured presentation of Part Four, Species Interactions. In previous editions, Part Four consisted of three chapters that introduced the four major species interactions of competition, predation, parasitism, and mutualism (and the broader topic of facilitation). This format, however, did not provide a general framework for viewing the role of population interactions in the process of evolution by natural selection that is common to all species interactions—the process of coevolution.

New Species Interactions Introductory Chapter

To meet this need, we now open Part Four (Species Interactions) with a new chapter entitled Species Interactions, Population Dynamics, and Natural Selection. The objective of this new chapter is to introduce the variety of species interactions that occur among populations, and to explore how these interactions influence the respective populations (species) involved

at two timescales: (1) the influence of species interactions on the processes of mortality and reproduction, which directly influence population dynamics, and (2) the role of species interaction as agents of natural selection by influencing the relative fitness of individuals within the population(s). The chapter provides a common framework for exploring the specific species interactions that are introduced in the chapters of Part Four that follow.

Expanded Coverage of Key Ecological Topics

Although the majority of this new edition retains the general structure of the seventh edition, we have added additional and expanded coverage of a wide variety of topics throughout the text including coevolution, metacommunities, landscape connectivity, sources of organic carbon in aquatic ecosystems, and the evolution of life history characteristics.

Updated Research Results: Part Eight

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 seventh edition, advances have been made in our understanding of the issues that are presented in Part Eight: Human Ecology (Chapter 28: Population Growth, Resource Use, and Sustainability; Chapter 29: Habitat Loss, Biodiversity, and Conservation; and Chapter 30: 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.

Expanded Quantitative Features

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 seventh 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 added an additional feature, Interpreting Ecological Data, to assist students in the development of quantitative skills. We have retained and expanded this feature in the eighth edition. 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 begin 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.

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 trade-offs—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 ultimately determine the collective dynamics of the population. As such, population dynamics are viewed as a function of life history characteristics that are a product of evolution by natural selection. 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 through 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.

Associated Materials

- Instructor's Resource DVD (0-321-74290-7)
- Instructor Guide (0-321-74288-5)
- Computerized Test Bank (0-321-74289-3)
- Ecology Place Companion Website (www.ecologyplace.com)
- Course Management Options (All CourseCompass and Blackboard courses offer preloaded content including tests, quizzes, and more.)

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