
PREFACE

Ecology is the science of the interrelations between living organisms and their environments. These interrelations are complex, varied, and hierarchical. As such, it is a broad and diverse discipline that covers topics from natural selection to population dynamics to biogeochemistry to ecosystem health and sustainability. Our aim in this compendium is to aggregate, in one major reference work, a thorough overview that does justice to this diversity and, at the same time, makes connections between the topics. The result is the five-volume work before you, containing over 530 expertly authored entries. The entries together form a comprehensive picture of the science of ecology and its major sub-disciplines. Individually, the entries are succinct, informative, state-of-the-art reviews for use as research references or teaching aids. The *Encyclopedia of Ecology* covers many facets of this wide-ranging and far-reaching field including:

1. Behavioral ecology
2. Ecological engineering
3. Ecological informatics
4. Ecological modeling
5. Ecological processes
6. Ecosystems
7. Ecotoxicology
8. Evolutionary ecology
9. General ecology
10. Global ecology
11. Human ecology
12. Population dynamics
13. Systems ecology

The encyclopedia is based on a broad and inclusive view of ecology with an emphasis on holistic perspectives. Holism arises because organisms are irreducible from each other and their environments. Therefore, tone and tendency in ecology is toward the holistic range along the continuum of holism–reductionism in science. We can observe and study trees, but we must never forget that the trees are components within the forest system. Ecology deals with the structure and functioning of nature as a system.

The section on general ecology is the largest in the encyclopedia since it forms the bedrock of knowledge developed over a century of ecological research. These characteristics of fundamental ecology are what one would expect to find in any textbook. Additional entries cover the major ecosystem types, including their distribution and unique features. Key basic ecological processes are given a wide coverage in the encyclopedia, as are aspects of global ecology. Both natural and abiotic components are considered. The central question in this context deals with ‘How are natural ecological dynamics influenced by the introduction of new components?’. This question draws from the well-represented field of ecotoxicology. As we move away from primary questions dealing with pristine natural environments, the interplay of organisms and their environment extends to include human action.

Ecology also plays an important role in the management and stewardship of environmental resources. In the mid-1960s, we experienced a renewed awareness and concern for the environment, sparked in part by Rachel Carson’s *Silent Spring*, growing human population, and conspicuous air and water pollution. Environmental problems are rooted in how humans influence nature and to understand these interactions between man and nature fully, we need ecology, because ecology focuses on the organization, processes, and changes in nature. There is no doubt that the environmental

problems have accelerated the development of ecology while at the same time our increased knowledge about the functioning of ecosystems has been implemented in ecologically friendly design. Each successive environmental alarm, from ozone depletion to biodiversity loss to eutrophication to climate change, has pushed the envelope of ecological knowledge. More and more resources are directed towards research to help us understand the natural world and our role as a dominant species in it. Our policies towards environmental management require us to be able to ask and answer ecological questions such as: What will be the impact of a particular chemical released into nature? What is nature's buffer capacity to accept the release? How can we better manage and design systems to prevent such releases? The answers to these questions require a profound knowledge of nature as a whole, the core questions of ecology.

Out of the need for a better ecological understanding have grown several new subdisciplines in ecology. Many examples are covered in the encyclopedia, but let us mention here three: ecological modeling, ecological engineering, and ecological indicators. First, ecological modeling provides a formal, structured approach to quantify ecological processes in order to understand the methods by which they function. Second, ecological engineering brings design principles from nature into application for basic human needs such as wastewater treatment, sustainable agroecosystems, and lake restoration. The objective is to develop systems that work within the natural order rather than at odds with it. Ecological engineering is based on a close cooperation between humans and nature for the benefit of both. Third, ecological indicators are easy-to-understand metrics to 'measure the pulse of the ecosystem'. The selection of the appropriate indicators requires accurate knowledge of the ecosystems and their functioning, exactly as indicators for human diseases require knowledge of the medical sciences. The application of ecological indicators to assess ecosystem health is drawing heavily on the entire spectrum of ecological knowledge. Key ideas, methods, and examples of ecological modeling, engineering, and indicators are described in detail in the encyclopedia.

The encyclopedia and entry layout are designed to maximize usability and usefulness of the material for the reader. The entries are alphabetically arranged within ecological subcategories, with running titles. Each entry has a concise synopsis followed by the body of the work, and ending with suggested further readings of the key references related to the subject. As ecology is a holistic science, it is not possible to completely separate one topic from the others. Therefore, cross-references to other entries within the encyclopedia are also given. The appendix contains several informative tables more appropriate to the whole body of work than to any one specific entry topic. The encyclopedia has a comprehensive index allowing the reader to quickly search the wide range of topics. Together, the many entries, like knots in an ecological network, weave together to make a rich tapestry of the science of ecology.

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Copenhagen, 29 February 2008

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