

An Introduction to Ecology¹

Introduction

Ecology, the study of the relationship between organisms and their environment, is a relatively new subdiscipline of biology that has emerged over the past century. It grew from an initial database of observations of the natural history of plants and animals, especially those that described the associations and interactions between organisms and the distributions of organisms in various habitats. As is generally true of the scientific process, these early systematized observations eventually lead to some inductive generalizations (one would probably not call them laws) and eventually the robust theory construction and experimentation that characterizes the field today. Historically, the theorists (often termed "model builders" or more simply "modelers") dominated the field from 1930 to about 1960. Since then, empiricists have increasingly attempted to test hypotheses that have been derived from theoretical models. However, theoretical modeling continues to be a very important part of ecology. Thus, glance through an issue of the premier journals such as *Ecology* or *Oecologica* and you will typically see a balance of empirical and theoretical work. Overall, however, progress on the increasingly important problems addressed by ecologists has been very slow -- due to the complexity of the problems attacked by ecologists and perhaps also the occasional politicization of the science.

Throughout our discussions of ecology we will encounter the term "environment". This term has many meanings. However, for the moment, we will assume that the environment of an organism can be subdivided into two components:

- **Abiotic Environment** – the **non-living features of the environment**.
Physical and chemical conditions external to the organism that potentially affect an organism but which are not primarily the result of another living

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Overview of Ecology

organism. Temperature, salinity, daylight, oxygen partial pressure, pH, are all examples of features that are usually thought of as being primarily abiotic (although to varying degrees they need not be strictly so).

- **Biotic Environment** – the features of the environment that are primarily related to interactions with other organisms, either of the same species (**conspecifics**) or different species or with the immediate results of the presence of these individuals. Thus, predator/prey and host/parasite interactions are biotic factors in an organism's environment. For most organisms, biotic environments are by far the most important factor in determining an animal's ability to survive and reproduce (its reproductive success).

Suppose that a tree lives near a stream. A beaver builds a dam and floods the area where the tree lives. This changes not only the wetness of the soil around the plant but also the availability of oxygen to the tree's roots, the types of soil animals and microbes (and other plants) near the tree – just to name a few.
? Discuss biotic and abiotic interactions between the plant and the beaver and the plant and the abiotic environment.
In this case, can features of the environment (for example – the amount of water in the soil) be discussed as both abiotic and biotic? Explain.

Range of Ecological Study

The units studied by ecologists range from individual **organisms** to the entire **biosphere**. Likewise, there are a number of ways to study these units.

Below are listed a number of different specialties within ecology:

- **Physiological ecology**: the adaptations possessed by **organisms** that allow them to cope with a particular environment; often this relates primarily to the abiotic environment.
- **Evolutionary and behavioral ecologists** use a broad range of techniques including population genetics to learn how environmental forces act as selective pressures to modify the genetic characteristics of populations and species. Behavioral ecology is a very popular form of evolutionary ecology

where the subject matter is the evolution of animal behavior in response to different environments.

- **Population ecologists** study the growth and regulation of populations (groups of individuals belonging to the same species)
- **Community ecologists** study the interactions (biotic) between the assemblages of species that occur in a particular area.
- **Ecosystem ecologists** specialize in the study of the interaction between the biotic community and the physical environment in which the community lives.

The difference among ecologists can be seen in the **particular questions they are asking**. Ecologists taking samples from a pond might be:

- Ecosystem ecologists if they are interested how nutrients cycle between the living and nonliving components of the ecosystem (the pond),
- Community ecologists if interested in the interactions between the different species that inhabit the pond,
- Population ecologists if interested in fluctuations in the number of individuals belonging to a particular species, or
- Physiological ecologists if they are obtaining samples to study how organisms of different species are adapted in terms of their physiological systems to meet the challenge imposed by the unique conditions of life in a fresh water environment.
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Who does what in the Holy Cross Biology Department?

- Professor **Bertin** is an evolutionary and community ecologist who works in terrestrial systems and who is very interested in conservation;
- Professor **Sobczak** is a community and ecosystem ecologist who is primarily interested in aquatic systems and their restoration, and
- **Yours truly (KNP)** is a physiological and behavioral ecologist who is interested in energy use by terrestrial arthropods (spiders and insects).
- We also have two research associates who are ecologists, -- Dr. **Langtimm**, a population ecologist who studies manatees, and Dr. **Wolfe-Bellin**, a plant ecologist interested the effects on increased CO₂ and temperature.
- Although **geology** is separate discipline from biology, it has very important roles in ecology. **Dr. Mitchell** is our geologist and I encourage all students to take one of her courses.

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