Department of biology

2025-2026

((Ecology))

Stage (-3-)

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Introduction to Ecology and Ecosystem

By

Prof. Dr. Dhurgham Ali Al-Sultany

Introduction to Ecology and Ecosystem

Meaning of Ecology

With the growing environmental movement of the late 1960s and early 1970s, Ecology was not known only to a relatively small number of academic and applied biologists. Even now, people confuse it with terms such as environment and environmentalism. Environmentalism is activism with a stated aim of protecting the natural environment. While environment represents everything that makes up our surroundings and affects our ability to live on the earth the air we breathe, the water that covers most of the earth's surface, the plants and animals around us, and much more.

So what is ecology? Ecology is a science. According to one accepted definition, ecology is the scientific study of the relationships between organisms and their environment. Environment includes the physical and chemical conditions.

However, the term ecology comes from the Greek words oikos, meaning home or place to live or habitation and logy, meaning “the study of”. The German zoologist Ernst Haeckel, who originally coined the term ecology in 1866 to refer the intr-relationships of living organisms and their environment.

Ecology has complex roots

The genealogy of most sciences is direct. Tracing the roots of chemistry and physics is relatively easy. The science of ecology is different: its roots are complex. You can argue that ecology goes back to the ancient Greek scholar Theophrastus, a friend of

Aristotle, who wrote about the relations between organisms and the environment. On the other hand, ecology as we know it today has vital roots in natural history (Natural history provides a descriptive account of organisms and their environment).

Early plant ecologists were concerned mostly with terrestrial vegetation and using the terms producers and consumers marked the beginning of ecosystem ecology, the study of whole living systems.

Mendel's work on inheritance and Darwin's work on natural selection provided the foundation for the study of evolution and adaptation and emerged population genetics. Focusing on adaptations led to a science physiological ecology, this science concerned with the responses of individual organisms to temperature, moisture, light, and other environmental conditions.

Closely associated with physiological ecology is community ecology, which deals with the physical and biological structure of communities and community development. It began with 19th-century behavioral studies including insect, birds and fish, gave rise to ethology.

Other observations led to investigations of chemical substances in the natural world. Scientists began to explore the use and nature of chemicals in plant and animal defense. Such studies make up the specialized field of chemical ecology.

Recent years have seen the development of the use of mathematical models to relate interaction of parameters and predict effects (ecological modeling).

Finally, with the development of our understanding of radiation gave rise to the radiation ecology which is deals with the study of effect of radiation over the environment and living organisms.

Ecology has so many roots that it probably will always remain many-faceted—as the ecological historian Robert McIntosh calls it, “a polymorphic science.” Insights from these many specialized areas of ecology will continue to enrich the science as it moves forward into the 21st century.

Ecology has strong ties to other sciences

The complex interactions taking place within ecological systems involve all kinds of physical, chemical, and biological processes. To study these interactions, ecologists must draw on other sciences. The study of how plants take up carbon dioxide and lose water for example, belongs to plant physiology. Ecology looks at how these processes respond to variations in rainfall and temperature. This information is vital to understanding the distribution and abundance of plant populations and the structure and fun ction of ecosystems on land.

Likewise, other physical sciences, such as geology, hydrology, and meteorology. They will help us chart other ways organisms and environments interact. For instance, as plants take up water, they influence soil moisture and the patterns of surface water flow.

As they lose water to the atmosphere, they increase atmospheric water content. The geology of an area influences the availability of nutrients and water for plant growth.

In the 21st century, ecology is entering a new frontier, one that requires expanding our view of ecology to include the dominant role of humans in nature. Among the many environmental problems facing humanity, three of them are very important: human population growth, biological diversity, and global climate change. As the human population increased from approximately 500 million to more than 6.7 billion in the past two centuries, dramatic changes in land use have altered Earth's surface.

The removal of forests for agriculture has destroyed many natural habitats, resulting in a rate of species extinction (loss of biodiversity) that is unique in Earth's history.

Due to growing demand for energy from fossil fuels, the chemistry of the atmosphere is changing in ways that are altering Earth's climate (global climate change).

These environmental problems are ecological in nature, and the science of ecology is essential to understanding their causes and identifying ways to mitigate their impacts. In general, there are many branches of sciences with highly relation with ecology as explain in following diagram:

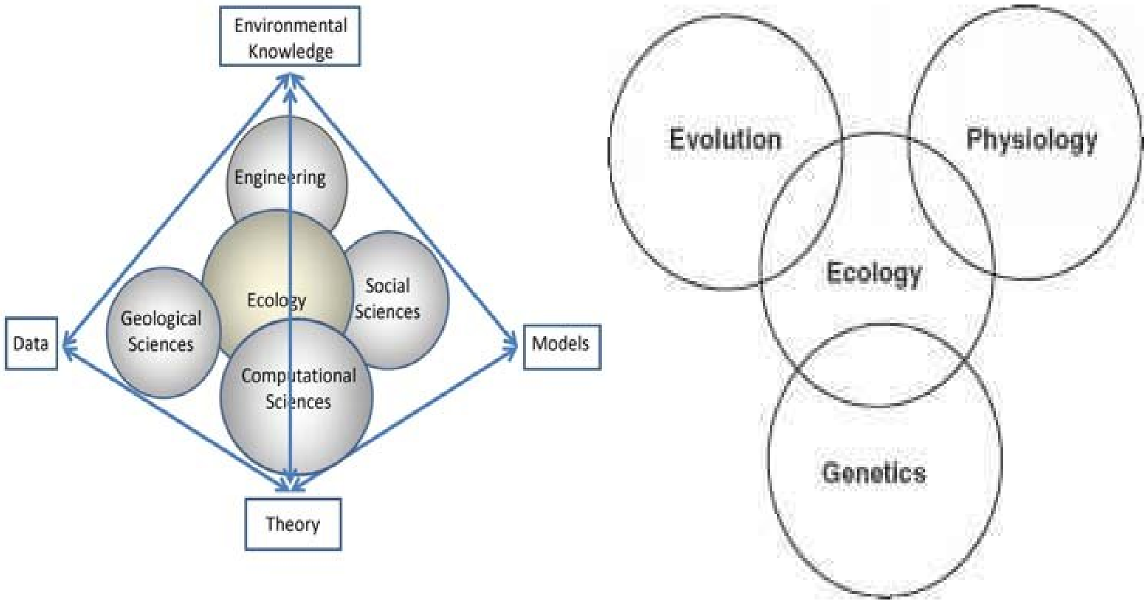

Figure 1: The relationship between ecology and other sciences

Ecosystems

You know that earth is perhaps the only planet in the solar system that supports life. The portion of the earth which sustains life is called biosphere. Biosphere is very huge and cannot be studied as a single entity. It is divided into many distinct functional units called ecosystem. All the living and nonliving things that interact in a particular area make up an ecosystem. The term 'ecosystem' was coined by Sir Arthur George Tansley in 1935. An ecosystem is a functional unit of nature encompassing complex interaction between its biotic (living) and a biotic (non-living) component.

Components of an ecosystem

They are broadly grouped into:-

(A) A biotic components (Nonliving): The a biotic component can be grouped into following:-

(1) Physical factors: Such as sun light, temperature, rainfall, humidity and pressure. They sustain and limit the growth of organisms in an ecosystem.

(2) Inorganic substances: Carbon dioxide, nitrogen, oxygen, phosphorus, sulphur, water, rock, soil and other minerals.

(3) Organic compounds: such as carbohydrates, proteins and lipids. They are the building blocks of living systems and therefore, make a link between the biotic and a biotic component.

(B) Biotic components (Living)

(1) Producers (autotrophs, i.e. self-feeders): The green plants manufacture food for the entire ecosystem through the process of photosynthesis. Green plants are called autotrophs, as they absorb water and nutrients from the soil, carbon dioxide from the air, and capture solar energy for this process.

(2) Consumers (heterotrophs, i.e. other feeders): They are called heterotrophs and they consume food synthesized by the autotrophs. Consumers, depending on their food habits, can be further classified into three types

(A) Herbivores (Primary consumers),e.g. deer, rabbits, cattle, etc., are plant eaters and they feed directly on producers. In a food chain, they are referred to as the primary consumers.

(B) Carnivores (Secondary consumers) are meat eaters and they feed on herbivores (primary consumers). They are thus known as secondary consumers. They are animal eaters, e.g. lions, tigers.

(C) Omnivores (Third- and higher-level consumers) eat both plants and animals, e.g. pigs, rats and humans.

(3) Decomposers: Also called saprotrophs. These are mostly bacteria and fungi that feed on dead decomposed and the dead organic matter of plants and animals by secreting enzymes outside their body on the decaying matter. They play a very important role in recycling of nutrients. They are also called detrivores or detritus feeders. Below, a diagram explains the components of an ecosystem:

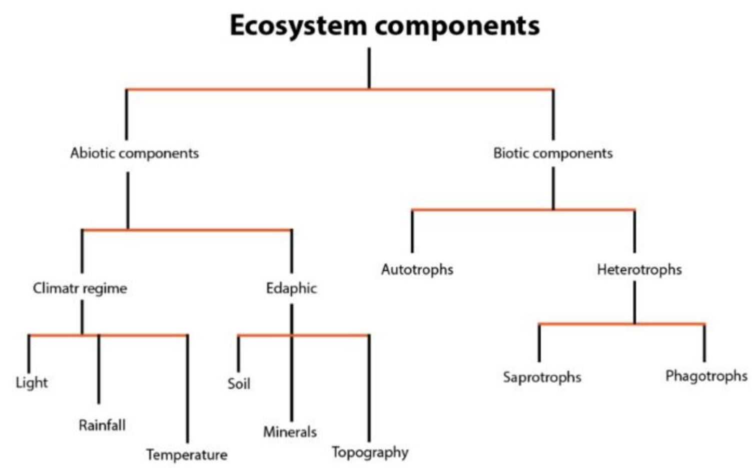

Figure 2: The main components of an ecosystem

Functions of ecosystem

Ecosystems are complex dynamic system. They perform certain functions. These are:-

(1) Energy flow through food chain

(2) Nutrient cycling (biogeochemical cycles)

(3) Homeostasis (tendency of ecosystem to resistance the changes)

Types of ecosystems

Ellenberg, (1973) has classified the world into a hierarchy of ecosystems. Biosphere is the largest. Next lower level is mega-ecosystems such as marine ecosystems, limnic ecosystems (ecosystems of fresh water) and terrestrial ecosystems. The lower level is macro-ecosystem (forsts, etc.) within each mega – ecosystm. Macro-ecosystems which divided into microecosystems (such as mountain and valleys).

We can also divided ecosystems according to diversity of these systems , such as freshwater systems, estuaries ecosystems, marine ecosystems and terrestrial ecosystems. While , it can be divided the ecosystems depending on the presence of the major components (a biotic substances ,producers, consumers and decomposers) to a complete ecosystems and incomplete ecosystems.

The ecosystems which do not contain all the four basic components of ecosystem and they may lack one or more are called incomplete ecosystems. For example, depths of the sea and caves lack producers but contain only consumers and decomposers.