

## **Ecology and the environment: Ecosystem and its characteristics, Structure of Ecosystem**

### **What Is Ecology?**

Ecology is the study of the relationships between living organisms, including humans, and their physical environment; it seeks to understand the vital connections between plants and animals and the world around them. Ecology also provides information about the benefits of ecosystems and how we can use Earth's resources in ways that leave the environment healthy for future generations. Ecology is a branch of knowledge, and it is not synonymous with environmentalism.

Among other things, ecology is the study of:

- Life processes, interactions, and adaptations
- The movement of materials and energy through living communities
- The successional development of ecosystems
- Cooperation, competition and predation within and between species.
- The abundance, biomass, and distribution of organisms in the context of the environment.
- Patterns of biodiversity and its effect on ecosystem processes

Ecology has practical applications in conservation biology, wetland management, natural resource management (agroecology, agriculture, forestry, agroforestry, fisheries), city planning (urban ecology), community health, economics, basic and applied science, and human social interaction (human ecology).

### **Who are Ecologists?**

Ecologists are people who study these relationships among organisms and habitats of many different sizes, ranging from the study of microscopic bacteria growing in a fish tank, to the complex interactions between the thousands of plants, animals, and other communities found in a desert. Ecologists also study many kinds of environments. For example, ecologists may study microbes living in the soil under your feet or animals and plants in a rain forest or the ocean.

### **The Role of Ecology in Our Lives**

The many specialties within ecology, such as marine, vegetation, and statistical ecology, provide us with information to better understand the world around us. This information also can help us improve our environment, manage our natural resources, and protect human health. The following examples illustrate just a few of the ways that ecological knowledge has positively influenced our lives.

### **Ecological impacts**

The world's climate is changing, and it will continue to change throughout the 21st century and beyond. Rising temperatures, new precipitation patterns, and other changes are already affecting many aspects of human society and the natural world. Climate change is transforming ecosystems on an extraordinary scale, at an extraordinary pace. As each species responds to its changing environment, its interactions with the physical world and the organisms around it change too. This triggers a cascade of impacts through-out the entire ecosystem. These impacts can include expansion of species into new areas, intermingling of formerly nonoverlapping species, and even species extinctions. Climate change is happening on a global scale, but the ecological impacts are often local and vary from place to place. To illuminate how climate change has affected particular species and ecosystems, we will discuss some practical examples here.

Human actions have been a primary cause of the climate changes observed today. Fortunately, though, humans are also capable of changing their behavior in ways that can reduce the rate of future climate change and help wild species adapt to climate changes that cannot be avoided. How we approach other human activities that affect ecosystems, such as agriculture, water management, transportation, fishing, biological conservation, and many other activities will influence the ways and the extent to which climate change will alter the natural world and the ecosystems on which we depend.

### Global warming

Human Activities Are Contributing to Climate Change. Both human activities and natural variability are contributing to global and regional warming. From several reseach conducted by most scientists, most of the observed warming over the past 50 years is the result of increased greenhouse gases generated by human activities. The release of greenhouse gases has increased significantly since the Industrial Revolution, mostly from the burning of fossil fuels for energy, agriculture, industrial processes, and transportation. Carbon dioxide, a major

greenhouse gas, is increasing in the atmosphere. Two other greenhouse gases, methane and nitrous oxide, are present in the atmosphere at much lower concentrations than carbon dioxide but have increased rapidly. Methane has increased and it is more effective per molecule at trapping heat than carbon dioxide. Nitrous oxide, nearly 300 times more effective, also has increased. Much remains to be learned about the factors that control the sensitivity of climate to increases in greenhouse gases, rates of change, and the regional outcomes of the global changes. Although scientific knowledge of climate is far from complete, the uncertainties concern the details: the scientific community is highly confident in the basic conclusions.

### Sea Levels Are Rising

Warmer temperatures not only cause glaciers and land ice to melt (adding more volume to oceans) but also cause seawater to expand in volume as it warms.

### Changes Are Rippling Through the Water Cycle

Climate change has complex effects on water supply and demand. The seasonal rhythms of streams and rivers have changed as winter precipitation falls increasingly as rain instead of snow, and as earlier spring temperatures cause snow in the mountains to melt earlier and faster. Climate change may mean that some places will experience more days with very heavy rain; other places may see more frequent, intense, and long-lasting droughts. Warmer temperatures also mean higher evaporation rates and thirstier plants and people, increasing demands for water. A warmer world will experience more precipitation on a global scale, but the changes will not be the same everywhere. Projections indicate that on average dry areas will tend to get drier, and wet areas will tend to get wetter.

### The Ocean Is Acidifying

Much of the carbon dioxide emitted by human activity has already been taken up by the ocean, thus moderating the increase of carbon dioxide in the atmosphere. However, as carbon dioxide dissolves in seawater, it forms carbonic acid, acidifying the ocean. Ocean acidification will likely cause serious harm to such treasured marine organisms as corals, lobsters, and sea urchins.

### Climate Change Is Reflected in Extreme Weather

It is considered very likely that increasing global temperatures will lead to higher maximum temperatures, more heat waves, and fewer cold days over most land areas. More severe drought in some areas, combined with other factors, has contributed to larger and more frequent wildfires, tsunamis and tornadoes. Living things are intimately connected to their physical surroundings. Even small changes in the temperature of the air, the moisture in the soil, or the salinity of the water can have significant effects. Each species is affected by such changes individually, but those individual impacts can quickly reverberate through the intricate web of life that makes up an ecosystem. As the Earth warms, many species are shifting their ranges to areas with more tolerable climate conditions, in terms of temperature, precipitation, and other factors. A sizeable percent of wild plants and animals that have been studied over decades are relocating to stay within their tolerable climate ranges. Some organisms those that cannot move fast enough or those whose ranges are actually shrinking are being left with no place to go. For example, as arctic sea ice shrinks, so does the habitats of animals that call this ice home, such as polar bears and seals shrink. Migrant birds are arriving earlier, butterflies are emerging sooner, and plants are budding and blooming earlier. If all of the species in an ecosystem shifted their seasonal behavior in exactly the same way. But when a species depends upon another for survival and only one changes its timing, these shifts can disrupt important ecological interactions, such as that between predators and their prey. For example, a small black-and-white bird called the European pied flycatcher has not changed the time it arrives on its breeding grounds even though the caterpillars it feeds its young are emerging earlier. Missing the peak of food availability means fewer chicks are surviving, in turn causing the flycatcher's population to decline. In addition to shifting ranges and seasonal behaviours, other ecological impacts of climate change include changes in growth rates, in the relative abundance of species, in processes like water and nutrient cycling, and in the risk of disturbance from fire, insects, and invasive species.

### **Ecosystem.**

An ecosystem is any geographic area that includes all of the organisms and non-living parts of their physical environment. An ecosystem can be a natural wilderness area, a suburban lake or forest, or a heavily used area such as a city. The more natural an ecosystem is, the more ecosystem services it provides. These include cleansing the water (wetlands and marshes) and air (forests), pollinating crops and other important plants (insects, birds, bats), and absorbing and detoxifying pollutants (soils and plants). The ecosystem is the structural

and functional unit of ecology where the living organisms interact with each other and the surrounding environment. In other words, an ecosystem is a chain of interaction between organisms and their environment. The term “Ecosystem” was first coined by A.G.Tansley, an English botanist, in 1935.

### **Types of Ecosystems**

An ecosystem can be as small as an oasis in a desert, or as big as an ocean, spanning thousands of miles. There are two types of ecosystems:

- Terrestrial Ecosystem
- Aquatic Ecosystem

#### Terrestrial Ecosystems

Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones. They are as follows:

1. Forest Ecosystems
2. Grassland Ecosystems
3. Tundra Ecosystems
4. Desert Ecosystem

#### Forest Ecosystem

A forest ecosystem consists of several plants, animals and microorganisms that live in coordination with the abiotic factors of the environment. Forests help in maintaining the temperature of the earth and are the major carbon sink.

#### Grassland Ecosystem

In a grassland ecosystem, the vegetation is dominated by grasses and herbs. Temperate grasslands, savanna grasslands are some of the examples of grassland ecosystems.

#### Tundra Ecosystem

Tundra ecosystems are devoid of trees and are found in cold climates or where rainfall is scarce. These are covered with snow for most of the year. The ecosystem in the Arctic or mountain tops is tundra type.

#### Desert Ecosystem

Deserts are found throughout the world. These are regions with very little rainfall. The days are hot and the nights are cold.

## Aquatic Ecosystem

Aquatic ecosystems are ecosystems present in a body of water. These can be further divided into two types, namely:

1. Freshwater Ecosystem
2. Marine Ecosystem

### Freshwater Ecosystem

The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands. These have no salt content in contrast with the marine ecosystem.

### Marine Ecosystem

The marine ecosystem includes seas and oceans. These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.

## **Structure of the Ecosystem**

The structure of an ecosystem is characterised by the organisation of both biotic and abiotic components. This includes the distribution of energy in our environment. It also includes the climatic conditions prevailing in that particular environment. The structure of an ecosystem can be split into two main components, namely:

- Biotic Components
- Abiotic Components

The biotic and abiotic components are interrelated in an ecosystem. It is an open system where the energy and components can flow throughout the boundaries. This will further be discussed in lecture 9.

## **Biodiversity**

Short for biological diversity, biodiversity is the range of variation found among micro-organisms, plants, fungi, and animals. Some of this variation is found within species, such as differences in shapes and colours of the flowers of a single species of plants. Biodiversity also includes the richness of species of living organisms on earth.

## **Environment**

The environment is the surroundings of an organism including the physical and chemical environment, and other organisms with which it comes into contact. This term is most frequently used in a human context, often referring to factors affecting our quality of life.

## **Natural Resources**

Natural resources are living and non-living materials in the environment that are used by humans. There are two types: renewable (wildlife, fish, timber, water) and non-renewable (fossil fuels and minerals).

## **Population**

A group of individuals belonging to one species (of bacteria, fungi, plant, or animal) living in an area.

## **Community**

Populations of organisms of different species that interact with one another.

## **Difference Between Environment and Ecology**

Environment is everything that surrounds us, whereas, ecology is how all those work. It refers to the study of interaction of the organisms with their environment. Ecology seeks to understand life process, adaptation and biodiversity. Environment, on the other hand, aims to identify the internal and external factors that affect population.

### **Environment**

- Environment refers to the interaction between the physical, chemical and biological components.
- The environmental issues include pollution, deforestation, global warming, and other broader issues.
- Studies the internal and external factors affecting the environment.

### **Ecology**

- Ecology is the study of relationship between organisms and their environment
- The ecological issues include population size, diversity, distribution of organisms, and also the competition between them.
- Aims to understand life process, distribution, adaptation and biodiversity.

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