The Dimensions of Ecological Sciences

Ecology is the scientific study of organisms `at home' which is called as the 'environment'. The term 'environment' refers to those parts of the world or the total set of circumstances, which surround an organism, or a group of organisms. These two terms are inseparable. The earth as a whole can be considered as a single ecological unit. The useful global model called 'Gaia' was developed by Lovelock (1979) helps to explain the earth's remarkable biological stability. The biosphere includes the atmosphere, the surface of the earth, the oceans and the ocean floors which support communities of living organisms.

Because of these, the science of Ecology involves,
1. The study of the relation of organisms or a group of organisms to their environment,
2. The study of the totality of man and his environment and
3. The application of other disciplines like Palaeoecology, Oceanography, Hydrology, Limnology, Climatology, zoogeography, Geomorphology, Physics and Chemistry.

The interrelation of organisms and the environment may be between
a. an organism & its place of living,
b. an organism & its neighbour,
c. an organism & its own community,
d. an organism & other communities,
e. a group of organisms & an organism and f. a community to a community.
(Or) due to
a. the effect of environment over an organism,
b. the effect of environment over a group of organisms,
c. the change of environment over life and
d. the change of environment over a change of environment.

Ecology was first described as a separate discipline in 1886 by the German Zoologist Ernst Haeckel. It is a multidisciplinary science aimed to deal with many environmental problems.

The study of Ecology deals with
1. the spatial distribution of an abundance of organisms,
2. the temporal changes in the occurrence, abundance and activities of organisms,
3. the interrelations between organisms, communities and populations,
4. the structural adaptation and functional adjustments of organisms to the change in environment,
5. the behaviour of organisms under natural environment,
6. the productivity of organisms and energy to mankind and
7. the development of interactive models for predictive purposes.

Subdivisions
In general, ecology is classified into a. animal ecology and b. plant ecology.

Animal ecology:
This branch deals with the animal population, changes in population, their behaviour, and their relationships with the environment.

Plant ecology: This branch deals with the relationships of plants to other plants and their environment. Many branches of ecology got evolved like Insect ecology and Microbial

Ecology. The subject Insect ecology deals with the study of how insects interact with the surrounding environment. The subject Microbial ecology deals with t– Study of the relationship of microorganisms with their environment.

However, animals mostly depend on plants for both food and shelter. Hence, animal ecology deals with both animal and plant communities. The science of ecology is also divided into
a) synecology and b) autecology, based on the organism and habitats.

A. Synecology

This branch deals with the study of groups of organisms or the community. This is a habitat-based study. A habitat is a place where an organism or species population or a community thrives. There are two major habitats as 1. terrestrial habitats and 2. aquatic habitats. Aquatic habitats include Marine, Fresh water and Estuarine ecosystems. Terrestrial habitats include Forests, Grasslands, Deserts, and cave ecosystems.

Synecology is further divisible into population ecology and community ecology. A population emerges when individuals of the same species aggregate themselves to function as a single unit. Much interactions occur when such populations inhabit an area. A community inturn represents a group of populations. It denotes the Co-habitation of different species in a geographical region. Synecology refers to ecological studies revealing the interrelationships between the species constituting a community.

The study includes
1. Population characteristics,
2. Position of an individual in a population and. its relationship (intraspecific),
3. Regulation of population,
4. Impact of population on the environment,
5. Community characteristics and their interrelationships (Interspecific),
6. Successional changes and
7. The impact of communities over an environment.

B. Autecology

This branch deals with the study of species or the relationship of an organism to one or more environmental conditions. This is also called as species ecology. It deals with the nutrition, growth, reproduction, development and life history of individual species in an environment.

The following are the approaches in autecology;
1. Describing the type of habitat where in the organisms of a species live in.
2. Physical factors of the environment (air, temperature, light, water, oxygen, chemicals) and their interaction with that particular environment and the organism.
3. The influence of various biotic factors (predation, parasitism, competition, exploitation etc) which have a bearing on the life and environment.
4. The interaction of organisms with other organisms of different species.
5. Life and seasonal changes of the environment.
6. Pattern of reproduction and dispersal of organisms.

The Principles of Ecology

The principles of ecology have developed gradually, closely intertwined with the development of other biological and allied disciplines. They are:

1. Protection of species and species' subdivisions will conserve genetic diversity.
2. Maintaining habitat is fundamental to conserving species.
3. Large areas usually contain more species than smaller areas with similar habitat.
4. All things are connected but the nature and strength of those connections vary.
5. Disturbances shape the characteristics of populations, communities, and ecosystems.
6. Climate influences terrestrial, freshwater and marine ecosystems.

The underlying concepts of ecology include the following:

i. All living organisms and the environment they live in are mutually reactive, affecting each other in various ways.

ii. The environment plays a significant role at all stages of the life cycle of the coexisting species.

iii. The species react to the environmental changes and adjusts itself structurally and physiologically.

iv. The environment also changes according to certain species- specific activities like growth, dispersal, reproduction, death, decay, etc.

v. All plants and animals are related to each other by their coexistance and interaction with the environment.

vi. Under similar climatic conditions, there may simultaneously develop more than one community, some reaching the climax stage, and others under different stages of succession.

Ecology has practical applications in various areas like 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).

Today, the topics of interest, in this science, include the biodiversity, distribution, biomass, and populations of organisms, as well as cooperation and competition within and between species. Ecosystems are dynamically interacting systems of organisms, the communities they make up, and the non-living components of their environment. Ecosystem processes, such as primary production, pedogenesis, nutrient cycling, and niche construction, regulate the flux of energy and matter through an environment. These processes are sustained by organisms with specific life history traits.

Ecology is not synonymous with environmentalism, natural history, or environmental science. It overlaps with the closely related sciences of evolutionary biology, genetics, and ethology. An important focus for ecologists is to improve the understanding of how biodiversity affects ecological function. Ecologists seek to explain the life processes, interactions, and adaptations, the movement of materials and energy through living

communities, the successional development of ecosystems and the abundance and distribution of organisms and biodiversity in the context of the environment.

Two Basic Concepts of Ecology

Based on the essential components and their relationships, ecology and ecosystem can be explained in two ways: structural concepts and functional concepts.

1. Structural Concepts:

The different types of organisms living in a particular environment are not only independent and mutually reactive but also react with the environment. Though organisms of a species maintain uniformity in their structure and functions through having a common gene pool, they have sufficient plasticity to modify themselves according to changing environment by modifications in somatic characters (ecads) or genetic characters (ecotypes).

Due to their activities, organisms modify the environment to make it more congenial for their growth, development, reproduction and dispersal. The modified environment may become less suitable for the community already living in it. This invites another community that also changes the environment may become less suitable for the community already living in it.

This invites another community that also changes the environment further beyond its most favorable limit. The development of different communities over a period of time at the same site is called succession. The process of succession and change in environment would continue till an equilibrium is established between the changed environment and a community called climax community.
Under similar climatic conditions, different types of communities grow. Some of them have reached their climax stage while others occur in different stages of succession. The complex of many communities growing in a particular area and sharing a common climate is called biome.

2. Functional Concepts:

The biological community consists of a number of organisms and/or populations. Each population occupies a specific volume of the habitat circumscribed by the interaction of various environmental factors and trophic level of the organisms. It is called ecological niche. The degree of success of a particular population in an area is determined by the parameters of both abiotic factors as well as interaction with other types of populations. The interactions amongst the populations can be positive, negative or neutral.

The flow of energy in the ecosystem is unidirectional or non-cyclic. Radiant energy is trapped by autotrophic plants or primarily producers. From there the energy is transferred to consumers and decomposers. Energy is lost during its transfer from one trophic level to the next. Organisms use the energy in respiration.

A number of inorganic substances are taken by the living beings for their metabolism and body building. They are called biogenetic nutrients. The biogenetic nutrients keep on circulating between the biotic and abiotic components of the ecosystem.

The phenomenon is called biogeochemical cycling. Human beings exploit the ecosphere for their own benefits. As a result, only the economically important plants are allowed to grow in an ecosystem. Species diversity and natural interactions amongst the various components are reduced. When neglected, such an ecosystem deteriorates.

A disturbed or deteriorated ecosystem shows changes due to interactions inside, the assemblage of living being and their abiotic environment, modifying and changing both abiotic and biotic components. The change continues till a stable climax community develops. Where a disturbance continues, the deteriorated ecosystem changes the environment completely.

Why it is Important to Study Ecology?

Existence in the world is made up of living and non living things. The two groups have to coexist in order to share the resources that are available within the environmental ecosystem. To understand about this mutual co relationship we need to study and understand ecology. Survival of all organisms is actualized due to ecological balance. Various species survive because favourable ecosystems were created. One core goal of ecology is to understand the distribution and abundance of living things in the physical environment. Attainment of this goal requires the integration of scientific disciplines inside and outside of biology, such as biochemistry, physiology, evolution, biodiversity, molecular biology, geology, and climatology. Some ecological research also applies many aspects of biology, geology, chemistry and physics, and it frequently uses mathematical models. Ecologists 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 plant, animal, 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.