

# ENVIRONMENTAL BIOLOGY

## 1. Introduction

Let us examine first something about the past and present of ecology. Ecology has been usually defined as "the study of reciprocal relationships between organisms and their environment". Though, allusions of ecological ideas may be traced back to prehistoric man who utilised environmental information for food, shelter and medicine in order to survive the hardships of nature, ecology as a science developed mainly since 1900. In Indian writings as Vedic, Epic and Pauranic etc, one may find references to ecological thoughts, and Chakra described the importance of **vayu** (gases and air), **jala** (water), **desha** (topography), and **time** (kaal) in regulation of plant life. In the 18th century, some Greek philosophers and scientists, like Hippocrates, Aristotle, Theophrastus described in their writings on natural history, the habits of plants and animals growing in different areas.

In 1859, Geoffroy Saint Hilaire used the term **ethology** to refer to the study of relationships between organisms and environment. Reiter (1868) introduced the term **oekologie** in literature, and Ernst Haeckel (1869) attempted the first precise definition of ecology.

It was in 19th century that community aspect in ecology was introduced by Lecoq Sendtner and Kerner, S.A.Forbes, Cowles, Warming and Clements. Then came the era of population and community ecology during the first third of 20th century.

Introduction of the term **ecosystem** in literature in 1935 by a British, A.G.Tansley was a turning point in history of ecology. Modern ecology in fact began to develop since this time, when bioenergetic approach was introduced in ecological studies. The ecology was redefined more appropriately as "study of structure and function of ecosystems" or less technically as the "study of structure and function of nature" (Odum, 1969).

Till mid - 20th century or so, the emphasis in ecological studies had been mainly on the environmental factors governing the occurrence and distribution of organisms at different levels of organization. These levels in order of increasing complexity include, individual organisms, population, community and ecosystem. At ecosystem level, as units of study, emphasis was given to

productivity, energy flow and cycles of materials between its living and non-living components.

The whole complexion of ecology virtually changed in 1960s and 1970s when a rethinking was given to the term environment. Before that, the term was used for the "surroundings of an organism" that chiefly included the physical factors like temperature, light etc. The concept of environment was in fact taken in restricted sense limited to non-living physical factors, with less thinking given to living component as a factor of the environment. It was during last three decades or so, i.e. since 1960 onwards that a need was felt to re-define the term environment. The chief reason for this new look to environment has been the rapid industrialisation and agricultural development during this period. Environmental pollution and related problems of environmental degradation, such as toxification, acidification, desertification, deforestation, loss of biodiversity, global warming, depletion of atmospheric ozone layer etc. necessitated a rethinking and new approach to environment. Interests, therefore, shifted to quality of environment, and study of living organisms with an environmental view point. In this context, I would like to elaborate the concept of environment along the following three main lines.

- (1) Dimensions of totality of the environment (factors to systems),
- (2) Shift in the interest, and
- (3) Globality.

Under the changed situations of rapid industrialisation and green revolution, triggering pollution and other environmental problems, the dimensions of total environment were enlarged to include not only the physical, but also living factors as components of the environment. The term "environment", therefore, included the atmosphere, lithosphere, hydrosphere and biosphere on the earth planet. These components reflected the idea of "systems". Thus all systems (and not simply factors as taken earlier) surrounding an organism constitute its environment. The second development was shift in the interest. Main emphasis was on degradation of environment. Since environment includes living organisms (life) also, this was with a view to understand as how deteriorating quality of the environment is deteriorating the quality of life on this planet. As a result of this widening of the dimensions of environment there was also a tremendous enlargement in the scope of environmental studies. There were taken into account not only the non-living (atmosphere, lithosphere and hydrosphere) and living (biosphere) components of the environment, but also social, economic, geographic and even political components that affected the life style of man.

The third and equally important development was the concept of globality. Environment and environmental problems are no more restricted to a region, country, or continent but have become of global concern. The leakage of a toxic gas in the air from an industry in U.S.A. may to some extent also pollute the air over Europe. We Indians were alarmed due to oil flowing in the Arabian sea and Indian ocean during Iraqi invasion of Kuwait (Gulf war). This was the global concern about environment that resulted in the establishment of United Nations Environment Programme (UNEP), Global Environmental Monitoring

System (GEMS), World Commission on Environment and Development (WCED), World Conservation Strategy (WCS), World Wide Fund for Nature (WWF), Scientific Committee on Problems of the Environment (SCOPE) and just concluded United Nations Conference on Environment and Development (UNCED). With this development, environment overshadowed ecology that is now recognised as a field of newly developed multidisciplinary science **Environmental Science**.

## What is Environmental Biology ?

As a result of revised approach to environment, an integrated multidisciplinary science, environmental science developed to tackle the environmental problems. Since environment includes all systems, environmental science can be defined as "the study of all systems of air, land, water, energy and life surrounding the man". Man occupies the central position in this giant system of integrated systems due to that (i) environmental problems are studied in relation to man in particular and (ii) man himself is responsible for the environmental problems he faces. In other words we can look at Man's interaction with natural systems from two viewpoints, corresponding to the two faces of a single coin. One face displays the impact of natural environmental forces upon Man (e.g. floods, earthquakes, fires, landslides, epidemics). The other face displays the impact of Man upon the environment (e.g. air and water pollution, species extinction, accelerated degradation of environment). Primarily our concern is with the environment of Man. But Man cannot exist or be understood in isolation from other forms of life, animal and plant life. Therefore we must deal with the environment of all life forms within the life-bearing layer, or **biosphere** of planet earth. This shallow life layer lies at or close to vital interfaces between the basic earth realms : the atmosphere, the hydrosphere, and the lithosphere.

Environmental biology may thus be defined as "the study of air, land, water and energy systems in relation to life systems" i.e. study of atmosphere, hydrosphere and lithosphere in relation to biosphere. In a concise way we may say that environmental biology is "study of biology with an environmental view point." Thus, ecology grew and matured during post-industrialisation era with much more responsibilities and concerns into a new multidisciplinary field of environmental science, the **environmental biology**.

## Scope of Environmental Biology

Scope of environmental biology enlarged as a result of widening of the dimensions of environment. As a discipline of environmental science, environmental biology embraces upon the other several disciplines. It is a multidisciplinary field borrowing freely from other, often overlapping, fields of environmental science (Fig. 1). Basic principles of ecology are applied to the understanding as how organisms manage to survive under an array of combinations of ecological factors of the environment under natural conditions. Toxicology, and ecotoxicology contribute to our understanding of the sources,

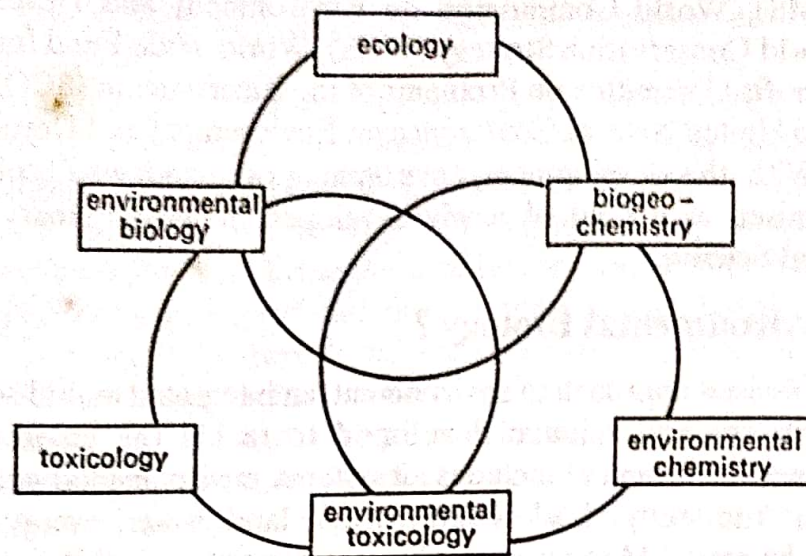


Fig. 1. Interdisciplinary fields of environmental science.

fate and adverse effects of potentially toxic chemicals on biosphere. Environmental toxicology deals with the toxic physical, chemical and biological factors that make up (virtually toxify) our environment. The information on nature of an array of chemicals, regarding classification, speciation, mechanisms of action, released in the environment is provided by environmental chemistry. The physical, chemical and biological features of land in relation with biosphere are studied in biogeochemistry. There are several other related areas that contribute to environmental biology. For instance, there are environmental engineers and environmental geologists who could study the behavior of the interior of earth and advise in matters of construction work.

These can also be included the role of anthropologists, social scientists and economists who contribute to environmental biology in the changed scenario of development.

### Major Areas of Environmental Biology

There may be recognised several major areas of study in environmental biology. These may also be considered as basic sub-divisions of this discipline. Though environmental biologists may differ in their views on boundary limits of each of the subdivisions, following may be recognised as major areas or basic subdivisions of environmental biology.

#### [I] Environmental analysis

This is concerned with the analysis of the environment into its basic four components viz. atmosphere, hydrosphere, lithosphere, and biosphere. Each component is dynamic and changes with time and space. While affecting life (biosphere) this is the integrated whole of three systems that operate upon an organism.

#### [II] Ecosystem analysis

This deals with the structure and function of ecosystems making the biosphere. It is mainly concerned with the productivity and energy relations at various

trophic levels in a food chain and also with the circulation of organic matter and mineral elements between non-living and living components.

**[III] Population biology**

This deals with intra- as well as interspecific interactions of populations. There are studied interactions between individual organisms in a monospecific population, as well as between populations of different species (interspecific) in a community.

**[IV] Community studies**

These are concerned with the composition, structure, distribution and dynamics of communities of ecosystems. The factors responsible for stabilisation of communities are also studied.

**[V] Environmental degradation**

This is the study of various factors responsible for environmental degradation. Studies include pollution, toxic agents, desertification, deforestation etc.

**[VI] Conservation of biodiversity**

This is the study of natural resources and wildlife, and the scientific way of their conservation and management.

**[VII] Environmental monitoring, impact assessment and development**

Studies are designed for repeated and regular observations on status of chemical, physical and biological factors of the environment. There is followed chemical monitoring for various chemicals in the environment as well as biomonitoring for changes in the life forms in different ecosystems with a view to assess risk due to pollution. There are also undertaken studies on risk assessment, safety evaluation and sustainable development.

**[VIII] Environmental legislation and education**

This is concerned with creating an awareness in general public for environmental problems around them through formal and informal education. There may also be made recommendations to the State for any legislation in order to protect the deterioration of quality of life and the environment.

The information on abovesaid basic sub-divisions of environmental biology has been elaborated in the chapters to follow.

**Questions**

1. What is environmental biology? Discuss its scope and major areas of study.
2. Give an account of developmental states of environmental biology.
3. Write notes on :  
(i) Environmental science (ii) Basic concepts of environmental biology.