

## **Definition of Ecology:**

Life processes of living organisms are affected by the environment in which they live. Similarly organisms also affect their environment and cause changes in it. The scientific study of the interaction between the organism and their environment is called ecology. It is a multi-disciplinary science and includes geology, chemistry, physics along with the biological disciplines like physiology, genetics, morphology, etc.

The word 'ecology' has a greek origin. 'Oikos' means home, 'logos' means to study. Thus ecology is concerned with organisms in their environment. Ernst Haeckel coined the term 'ecology' in 1869. The term 'environment' refers to the surrounding of the organism.

It includes non-living and living components that affect the life and development of the organism in its natural surroundings. The natural surroundings of an organism is called 'habitat'. The non-living components are called abiotic factors; living components are called biotic factors.

The scope of ecology is wide and varied. Ecology is a basic division of biology and forms an integral part of all the taxonomic divisions.

In a simple term ecology may be defined as that science which studies, interrelationships between abiotic and biotic components of the biospheric ecosystem on one hand, and among biotic components on the other hand.

Generally, ecology is divided into autecology and synecology wherein autecology is concerned with the study of ecological relations of individual species in a given ecosystem whereas synecology is the study of plant communities in relation to their habitats of given ecosystem.

## **Classification of Ecology:**

### **1. On the basis of nature of study ecology can be subdivided as:**

#### **a. Autecology:**

Autecology deals with the study of the individual organism or an individual species and its population. Here, the focus on life-histories and behaviour, as means of adaptation to the environment, is made. Autecology is also called "**species ecology.**"

#### **b. Synecology:**

Synecology deals with the study of groups of organisms which are associated together as a unit. In other words it is study of communities, their composition, their behaviour and relation to the environment.

Synecology is also called "**Ecology of communities.**"

**Synecology is further sub divided into:**

#### **(i) Population ecology:**

It relates the organism with various groups of organisms and their inter-relationship.

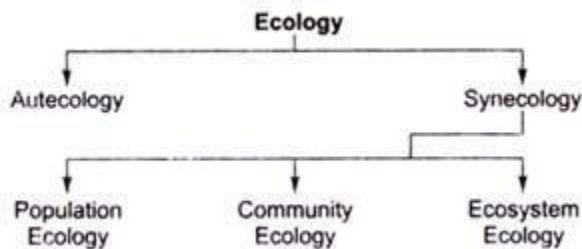
**(ii) Gene ecology:**

It deals with the genetic make-up of species in relation to the environment.

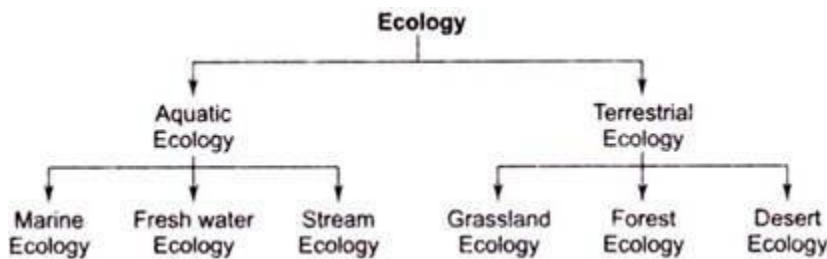
**(iii) Taxonomic ecology:**

It includes ecology of taxonomic groups as microbial ecology. Vertebrate or invertebrate ecology.

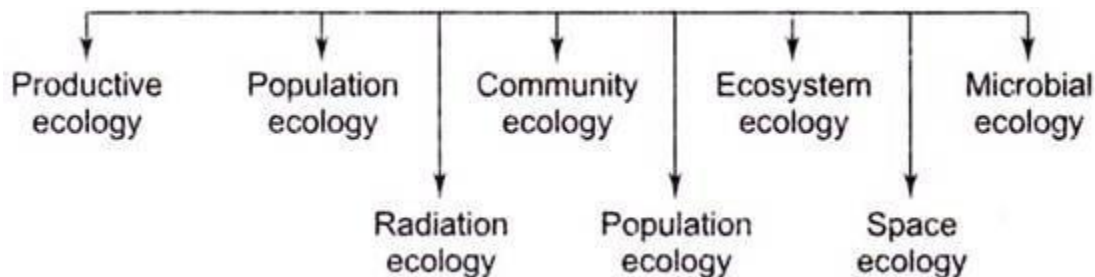
For e.g., if a study is carried out of the relation of a Neem tree with the environment, then the approach is said to be autecological in nature. But if the study is carried out of the forest (of which Neem tree is a part), then the approach is said to be synecological in nature.



**2. On the basis of the kind of environment or habitat, ecology has been sub divided into the following branches:**



**3. With advancing trends in the fields of ecology present day ecologists divide ecology into the following branches:**



<b>Autecology</b>	<b>Synecology</b>
It is the study of individual organism or individual species or a population in relation to their environment	It is the study of group of organisms or many species or communities in relation to their environment
It is also called as population ecology	It is also called as community ecology
The study is at the level of an individual, a population or an entire species	Synecology is concerned with study of the highest level of biological organization; many populations in an area (called as community) interacting with

	each other and also with the environment. It can even be the study of an ecosystem
Autecology is comparatively simple experimental and inductive.	Synecology is complex, philosophical and deductive. (Refer: Inductive vs Deductive)
Autecology studies can be accommodated in a laboratory setup and data is interpreted using conventional mathematical tools**	Synecology studies refers to the interaction of a whole system and that cannot be accommodated in a laboratory setup as the system is naturally formed after interactions of hundreds of years such as a forest ecosystem
Example: Study of Zebra population in relation to its environment (may be factors like rainfall, hunting, lion population etc in a grassland ecosystem) see the figure (in dotted black lines)	Example: Study of entire grassland ecosystem (including all the species or communities) see the figure (in green thick border)

## Levels of Ecology:

Ecology can also be considered in terms of the concept of levels of organisation. In ascending order of complexity, the hierarchy of organisation includes cells, organs, organisms, population, community, ecosystem, landscape, biome and the biosphere.

Hierarchy includes 'an arrangement into a graded series'. Ecology is concerned with levels beyond an organism (Fig. 1).

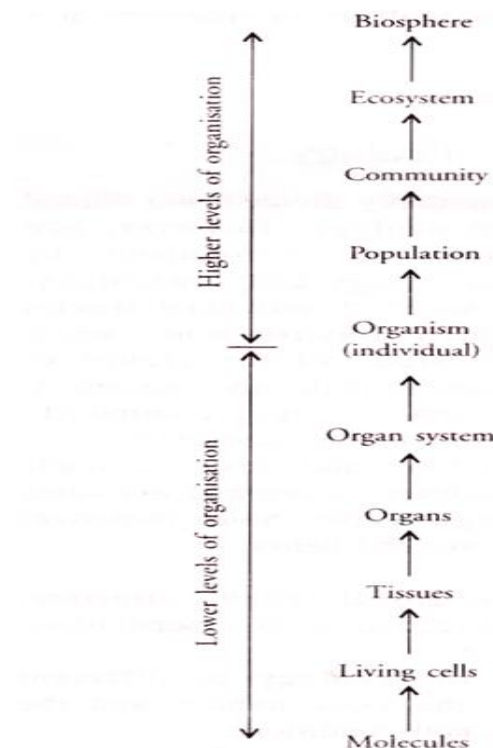


Fig. 1 Levels of organisations.

The different levels are as follows:

### a. Organism:

An organism is the basic unit of study in ecology. At the organism level we are concerned with taxonomic position, morphological characters, reproduction, life cycle, geographical distribution, and

behaviour in relation to specific environmental conditions. Similar organisms that can interbreed and produce fertile offspring form a species.

**b. Population:**

Population denotes a group of individuals of a particular kind capable of interbreeding with one another inhabiting a particular place.

**c. Community:**

A Community includes all the populations occupying a given area.

**d. Ecosystem:**

The community and the non-living environment function together as an ecosystem.

**e. Landscape:**

It is defined as a heterogeneous area composed of a cluster of interacting ecosystems.

**f. Biome:**

Biome is a large regional or subcontinent system of characteristic vegetation type. Similar biomes share similar climatic conditions. For example, the hot deserts in the world exhibit similarity in flora and fauna.

**g. Biosphere or the Ecosphere:**

It is the largest and nearly self-sufficient biological system which includes all the living organisms of the earth interacting with the physical environment. Hierarchies in nature are nested, i.e. each level is made of groups of lower level units. For example, population is made of groups of organisms that can interbreed. In contrast, human organised hierarchies as seen in governments, military, etc., are non-nested.

Organisms interact with the environment at different time and spatial scales. For instance, a bacterium interacts with its environment within a narrow fraction of a cubic cm. A tree on the other hand interacts with its environment at a large time and spatial scale. Organisms, big or small, exchange matter and energy continuously with the environment.

## **Limiting Factors**

- A **limiting factor** is an **abiotic or biotic** factor that restricts the number of individuals in a population.
- Limiting factors can include:
  1. Competitors
  2. Disease and parasites
  3. Weather
  4. Fires
  5. Available habitat
  6. Predators

## **1. Competitors-competition results when organisms struggle to survive in a habitat with limited resources**

Birds of prey: live in forests on the edge of fields. Eat mice and other rodents.

Nest in trees. Live in same habitats, use same resources, so they compete with each other

## **2. Disease and Parasites**

Diseases and parasites can be dependent on population size and habitat

Larger population = more parasites and disease = limit how big population gets.

## **3. Weather**

Storms

Drought

Flooding

Heat/cold

## **4. Fires**

Fires lead to succession which is a predictable change in the community over time.

## **5. Available Habitat**

Human activities play a large role

Development (homes, buildings, parking lots), damming rivers, clear cutting forests, hunting.

Parts of the habitat can also be limiting: amount of food (prey), available nesting sites

## **6. Predators**

Predator-prey relationship can be a delicate balance between the two populations.

As the prey population increases, the predator population increases. As the prey population decreases, then so does the predator population.

# **Law of Limiting Factor**

Limiting factors (nutrients, light, water, space etc) are the factors present in limited supply.

The laws explaining the effect of different factors on organism:

According to **Law of minimum** given by **Leibig** in 1840, the growth of organisms is dependent not on the maximum but on the minimum quantity of nutrients. Smaller quantities of materials limit the growth of individuals. Leibig's law is applicable only under the steady-state condition, that is, when inflow balances the outflow of energy and material in equilibrium state.

According to Shelford in 1913, organisms can tolerate some conditions to the highest degree while in other cases, slight change in conditions affect the organism. Thus, success of an organism depends on the completeness of complex of conditions .The organisms have ecological maximum and minimum with graded changes which represent the boundaries of tolerance. This limiting effect of maximum and minimum factors on the growth of organisms constitute **Shelford's Law of Tolerance** .

### **What is Carrying Capacity?**

- Because of these **limiting factors**, each ecosystem has a finite capacity for growth connected to its **carrying capacity**.
- **Carrying capacity** is the maximum number of individuals of a species that an ecosystem can support.