CONCEPT OF ECOLOGY AND ECOSYSTEM

The term Ecology was coined by Earnst Haeckel in 1869. It is derived from the Greek words *Oikos*- home + *logos*- study. So **ecology deals with the study of organisms in their natural home interacting with their surroundings.** The surroundings or environment consists of other living organisms (biotic) and physical (abiotic) components. Modern ecologists believe that an adequate definition of ecology must specify some unit of study and one such basic unit described by Tansley (1935) was ecosystem. **An ecosystem is a self-regulating group of biotic communities of species interacting with one another and with their non-living environment exchanging energy and matter.** Now **ecology** is often defined as **''the study of ecosystems''.**

The ecosystem is a unit or a system which is composed of a number of sub-units, that are all directly or indirectly linked with each other. They may be freely exchanging energy and matter from outside—an *open ecosystem* or may be isolated from outside in term of exchange of matter—a *closed ecosystem.*

BIOTIC AND ABIOTIC COMPONENTS

Ecosystems have basically two types of components, the biotic and abiotic, as described below:

(*a*) **BIOTIC COMPONENTS:** Different living organisms constitute the biotic component of an ecosystem and belong to the following categories:

(*i*) **Producers:** These are mainly producing food themselves *e.g.*, Green plants produce food by photosynthesis in the presence of sunlight from raw materials like water and carbon dioxide.
They are known as *photo-autotrophs* (auto = self, photo = light, troph = food). There are some *chemo-autotrophs*, which are a group of bacteria, producing their food from oxidation of certain chemicals. *e.g.* sulphur bacteria.
(*ii*) **Consumers:** These organisms get their food by feeding on other organisms. They are of the following types:

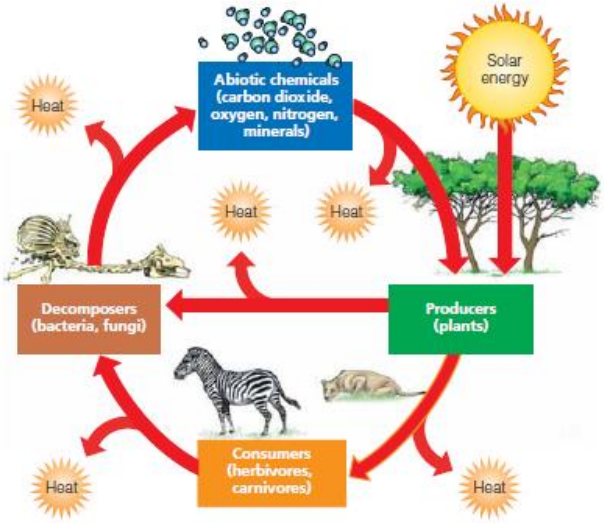
- Herbivores—which feed on plants *e.g.* rabbit, insect.
- Carnivores—which feed on herbivores as secondary carnivores (*e.g.*, frog, small fish) or tertiary carnivores (*e.g.*, snake, big fish), which feed on other consumers.
- Omnivores—which feed on both plants and animals *e.g.*, humans, rats, many birds.
- Detritivores—which feed on dead organisms *e.g.*, earth worm, crab, ants.

(*iii*) **Decomposers:** These are micro-organisms which break down organic matter into inorganic compounds and in this process they derive their nutrition. They play a very important role in converting the essential nutrients from unavailable organic form to free inorganic form that is available for use by plants *e.g.*, bacteria, fungi.

(*b*) **ABIOTIC COMPONENTS:** Various physico-chemical components of the ecosystem constitute the abiotic structure:

(*i*) Physical components include sunlight, solar intensity, rainfall, temperature, wind speed and direction, water availability, soil texture etc.
(*ii*) Chemical components include major essential nutrients like C, N, P, K, H2, O2, S etc. and micronutrients like Fe, Mo, Zn, Cu etc., salts and toxic substances like pesticides.

These physico-chemical factors of water, air and soil play an important role in ecosystem functioning.



Every ecosystem performs the following important functions:

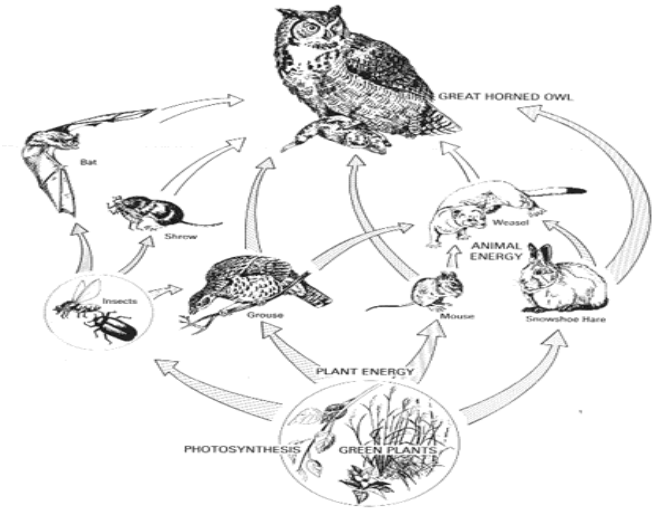
- **There is uni-directional flow of energy in an ecosystem.** It flows from sun and then after being captured by primary producers (green plants), flows through the food chain or food web, following the laws of thermodynamics. At every successive step in the food-chain, there is huge loss of about 90% of the energy in different processes (respiration, excretion, locomotion etc.) and only 10% moves to next level (**Lindemann's Ten per cent law of energy flow**).

- **Nutrients (Materials) in an ecosystem move in a cyclic manner.** The cycling of nutrients takes place between the biotic and abiotic components, hence known as biogeochemical cycles (bio = living, geo = earth, chemical = nutrients).

- **Every ecosystem functions to produce and sustain some primary production (plant biomass) and secondary production (animal biomass).**

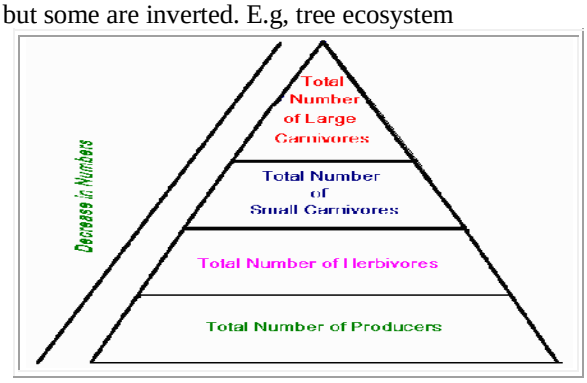
Every ecosystem regulates and maintains itself and resists any stresses or disturbances up to a certain limit. This self regulation or control system is known as **cybernetic system**.

1. **FOOD CHAIN**: A food chain is a sequence of populations or organisms of an ecosystem through which food and its contained energy passes.
   Most food chains have no more than four or five links. There cannot be too many links in a single food chain because the animals at the end of the chain would not get enough food (and hence energy) to stay alive.
2. **FOOD WEB**: It is a network of food chain which becomes interconnected at various trophic levels.



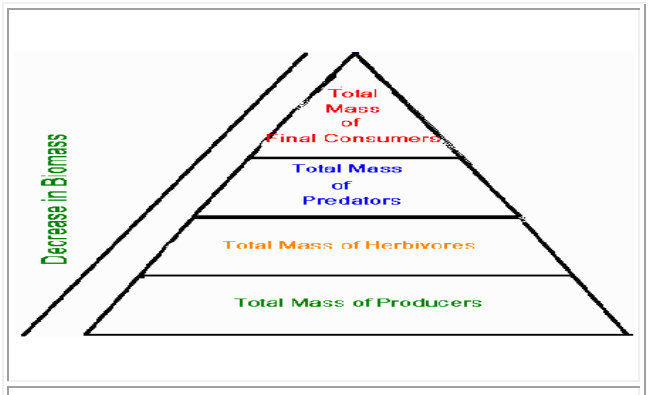
3. **ECOLOGICAL PYRAMIDS** : Trophic levels and the energy flow from one level to the next, can be graphically depicted using an ecological pyramid. Three types of ecological pyramids can usually be distinguished namely:

1. **Number pyramid -** Ecological pyramids are graphical representations of the number of individuals in different nutritional levels . The Number pyramid shows the number of organisms in each trophic level and does not take into consideration the size of the organisms and over-emphasizes the importance of small organisms. In a pyramid of numbers the higher up one moves, so each consecutive layer or level contains fewer organisms than the level below it.
   It is mostly upright but some are inverted. E.g, tree ecosystem



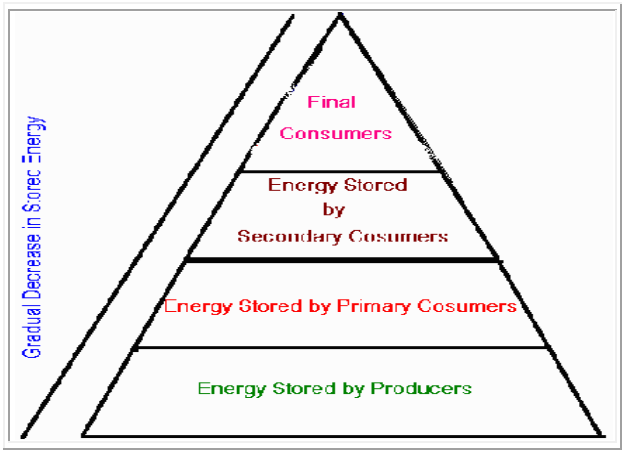
2. **Biomass pyramid.** This pyramid indicates the total mass of the organisms in each trophic level. Thus an enormous mass of grass is required to support a smaller mass of buck, which in turn would support a smaller mass of lions.

   Pyramid of biomass is upright for terrestrial habitats. Inverted pyramids are obtained in aquatic habitats.



The Biomass Pyramid

3. **Energy pyramid.** The Energy pyramid indicates the total amount of energy present in each trophic level. It also shows the loss of energy from one trophic level to the next. **The pyramid of energy is always upright.**



Biological diversity, or **biodiversity,** is the variety of the earth's species, the genes they contain, the ecosystems in which they live, and the ecosystem processes such as energy flow and nutrient cycling that sustain all life.

International Union for Conservation of Nature and Natural Resources (IUCN) and Red Data List:

- IUCN Red list Categories and Criteria for classifying species at high risk of global extinction
- Red list focus attention on taxa at the highest risk setting priorities for conservation measures for their protection
- Provide a global index of the state of degeneration of biodiversity
- Identify and document those species most in need of conservation attention if global extinction rate are to be reduced

OBJECTIVES OF IUCN REDLIST

- To assess in the long term the status of a selected set of species
- To establish a baseline from which to monitor the status of species
- To provide a global context for the establishment of conservation priorities at the local level

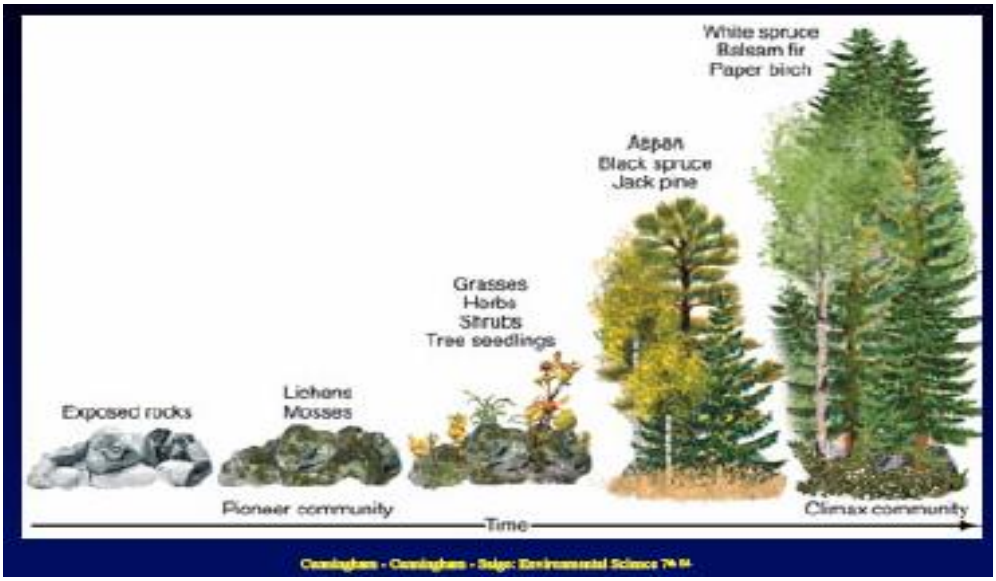
To monitor on a continuing basis, the status of a representative selection of species (as biodiversity indicators) that cover all the major ecosystems of the world

ECOLOGICAL SUCCESSION :

Ecological succession is the changing sequence of communities that live in an ecosystem during a given time period.

PRIMARY SUCCESSION Primary ecological succession is the changing sequence of communities from the first biological occupation of a place where previously there were no living beings. For example, the colonization and the following succession of communities on a bare rock.

- Change in community composition on a site which previously has had no living organisms



Pioneer Species - First plants to colonize: mosses, lichens & herbs

- Rapid dispersal & colonizers
- Rapid growth (opportunistic)
- Relatively poor competitors in stable environments
- Generalists (r-selected species)

Climax Community

- May take 100's or 1000's of years to reach this stage
- Stage at which system has reached steady-state equilibrium
- Most permanent of all the stages
- Determined by climatic or edaphic (soil) factors unless intervened
- Humans maintain an equilibrium at sub-climax (e.g. poor soil quality, grazing, preventing forest fires, selective logging)

Secondary Succession Secondary ecological succession is the changing sequence of communities from the substitution of a community by a new one in a given place. For example, the ecologicalsuccession of the invasion of plants and animals in an abandoned crop or land.