Part-two

Chapter one- Ecology

Introduction

- The term Ecology was coined by Earnest 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.**

Introduction

- 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 Tensely (1935) was ecosystem.

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’’.

Ecosystem

- An ecosystem is an integrated unit consisting of interacting plants, animals and micro-organisms whose survival depends upon the maintenance and regulation of their biotic and abiotic structures and functions.
- They may be freely exchanging energy and matter from outside—an *open ecosystem or*
- *They may be isolated from outside in term of exchange of matter—a closed ecosystem.*

Ecosystem

- Ecosystems show large variations in their size, structure, composition etc.
- However, all the ecosystems are characterized by certain basic structural and functional features which are common.
- Composition and organization of biological communities and abiotic components constitute the structure of an ecosystem.
- Thus, ecosystems have basically two types of components, the biotic and abiotic, as described below:

Ecosystem

(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).*

Ecosystem

- There are some *chemo-autotrophs, which are a group of bacteria, producing their food from* oxidation of certain chemicals. *e.g. sulphur bacteria.*

Ecosystem

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.*

Ecosystem

- Omnivores—which feed on both plants and animals *e.g., humans, rats, many birds.*
- Detritivores—which feed on dead organisms *e.g., earth worm, ants.*

Ecosystem

(*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.*

Ecosystem

(*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.

Ecosystem

- These physico-chemical factors of water, air and soil play an important role in ecosystem functioning.
- Every ecosystem performs the following important functions:
- It has different food chains and food webs. Food chain is the sequence of eating and being eaten. *e.g.,* Grass → Grasshopper → Frog → Snake → Hawk , Phytoplanktons (water-algae) → water fleas → small fish → large fish (Tuna)

Ecosystem

- These are known as grazing food chain—which start with green plants and culminate with carnivores.
- Another type is detritus food chain—which starts with dead organic matter. *e.g.,* Leaf litter in a forest → Fungi → bacteria

Ecosystem

- Food chains are generally found to be interlinked and inter-woven as a network and known as **Food Web.**
- There are several options of eating and being eaten in a food web. Hence these are more stable.

Ecosystem

(*ii) 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.

iii) 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 (Ten per cent law of energy flow).

Ecosystem

iii) 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).

Ecosystem

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

(*v) 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.

Balanced ecosystem

- Ecosystems have a unique property of self-regulation.
- The ecosystem comprising various sub-components of biotic and abiotic nature, which are inter-linked and inter-dependent, have an inherent property to resist change.

Balanced ecosystem

- That means, the ecosystems have a property to tolerate external disturbance or stress.
- This property is known as **homeostasis.**
- The ecosystems have a definite structure comprised of certain
- Types of living organisms, which have a definite place and role in the ecosystem, as defined by their position in the food-web.

Balanced ecosystem

- Together, in interaction with the abiotic components, these ecosystems perform the functions of energy flow and material cycling, and finally give a desired output in the form of productivity.
- Every ecosystem can operate within a range of conditions, depending upon its **homeostasis** (capacity to resist change).

Balanced ecosystem

- Within its homeostatic plateau, the ecosystem has the potential to trigger certain feedback mechanisms which help in maintaining the ecosystem functioning by countering the disturbances.
- Such **deviation-counteracting feedbacks are known as negative feedback mechanisms.**
- Such feedback loops help in maintaining the ecological balance of the ecosystem.

Balanced ecosystem

- A balanced ecosystem has basic biotic components which have evolved with time to suit the environmental conditions. The flow of energy and cycling of nutrients take place in a definite pattern in such an ecosystem, under a set of physical environment.

Balanced ecosystem

- However, as the outside disturbance or stress increases beyond a certain limit (exceeding the homeostatic plateau of the ecosystem), the balance of the ecosystem is disrupted.
- This is because now another type of feedback mechanisms, which are **deviation accelerating mechanisms start operating.**

Balanced ecosystem

- Such feedbacks are called **positive feedback mechanisms, which further increase the disturbances caused** by the external stress and thus take the ecosystem away from its optimal conditions, finally leading to collapse of the system.

Climax community

- A community which would mature to a characteristic set of organisms, each performing its optimal functions, if left undisturbed.