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Paper - II

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• 1.2. STRUCTURE OF ECOSYSTEM

The structure of an ecosystem is basically a description of different abiotic and biotic components that constitute the ecosystem :

(A) Abiotic Components

The term abiotic refers to all kinds of non-living elements of the ecosystem which are essential to the dynamics and stability of the ecosystem. These are of the following kinds :

Table 1. Different components of an ecosystem

Main Components	Parts of Main Components
(1) Abiotic components	(a) Inorganic substances (b) Organic substances (c) Climatic factors

(2) Biotic components	(a) Autotrophic components (producers) (b) Heterotrophic components (consumers) (i) Macroconsumers (ii) Microconsumers

(1) Inorganic substances : Some inorganic elements are vital for the synthesis of organic compounds and play an important role in the dynamicity of the ecosystem. These are S, C, H, N, P, O elements. They keep on circulating in the ecosystem in the form of biogeochemical cycles. In these cycles, they are first utilized by the producers, then passed on to the consumers and from consumers, they are released back in the environment. The amount of these inorganic substances, present at any given time in an ecosystem is designated as the standing state or standing quality.

(2) Organic substances : Important organic substances include amino acids proteins, lipids, carbohydrates and highly organized molecules like DNA, RNA and A.T.P. molecules. These organic components are basic structural and functional components of all living organisms of the ecosystem. They circulate in the ecosystem along different chains and come back to the environment in the form of organic detritus.

(3) Climatic factors : They are also called physical factors of the ecosystem. Rainfall, temperature, wind, water, soil, light, moisture, pH etc. constitute these physical factors. They play an important role in the dynamicity and stability of the ecosystem. They are interconnected with each other and form a complex system.

(B) Biotic Components

Biotic components refer to the living organisms of the ecosystem and constitute its trophic structure. Biotic components are distinguished on the basis of their nutritional relationships, which are discussed below :

(1) Autotrophic components : Autotrophic (auto-self; trough-nourishing) components of ecosystem are commonly called producers or energy transducers. They convert solar energy into chmical energy in the form of complex organic substances (carbohydrates, lipids, proteins etc.) with the help of some inorganic substances (H_2O, CO_2 etc.). Autotrophics fall into following two groups :

(i) Photoautotrophs which contain green photosynthetic pigment chlorophyll to transduct the solar or light energy of sun, *e.g.*, trees, grasses, algae, other tiny phyloplanktons and photosynthetic bacteria.

(ii) Chemoautotrophs which use energy generated in oxidation-reduction process, but their significance in the ecosystem as producers is minimal *e.g.*, sulphur bacteria.

(2) Heterotrophic components : Heterotrophic (Hetero-other; tropic-nourishing) organisms are called consumers as they depend for their food on the producers (autotrophs). The activities of utilization, rearrangement and decomposition of complex organic materials predominates in this component of the ecosystem. The consumers are of following two main types :

(a) Macroconsumers : These are also called phagotrophs (phago- to eat) and include mainly animals which ingest other organisms or chunks of organic matter. Depending on their food habits, consumers may either be herbivores or carnivores.

(b) Microconsumers : These are also called decomposers, reducers, saprotrophs, osmotrophs and scavengers. Microconsumers include microorganisms such as bacteria, actinomycetes and fungi. They breakdown complex organic compounds of dead or living protoplasm, absorb some of the products and release inorganic nutrients in the environment, making them available again to autotrophs or producers.

The disintegrating dead organic matter is also known as organic detritus. By the action of detritivores (= decomposers), the disintegrating detritus result into particulate organic matter (POM) and dissolved organic matter (DOM) whcih play important role in the maintenance of the edaphic environment.

- Energy at autotrophic level, first trophic level and carnivores trophic levels.

ECOLOGICAL SUCCESSION

• 2.1. INTRODUCTION

Ecosystem is a complex system which consists of abiotic and biotic components. The community structure (living organisms) and physical environment of an ecosystem are never stable, but dynamic, changing, more or less, regularly over time and space. Environment is always changing over a period of time due to (i) variation in climatic and physiographic factors (ii) the activities of the species of the community themselves. These influences and interaction of the communities and physical environment bring about marked changes in the environment and the dominance of the existing community. The communities sooner or later are replaced by other communities best suited to prevailing environmental conditions at the same place in any ecosystem. The overall process is called dynamicity of the ecosystem and can be discussed in detail under the heading of ecological succession.

Odum (1971) preferred the term `ecosystem development, rather than the 'ecological succession' for this dynamic process and defined it as follows :

(1) This process takes place in a direction and in an order, therefore predictable.

(2) It results from modification of the physical environment by the community, that is succession is community controlled even though the physical environment determines the pattern, the rate of change and often sets limits as to how far development can go.

(3) it culiminates in a stabilized ecosystem.

• 2.2. CAUSES OF ECOSYSTEM DEVELOPMENT (SUCCESSION)

Ecosystem development is a complex dynamic process and there are several causes for this as discussed below :

Initial or Initiating Causes : The climatic factors such as erosion and deposits, wind, fire etc. are the initiating cuases of succession. The various activities of organisms also contribute to initiate the ecological development. The initial causes produce the base areas on destroy the existing populations in an area.

Ecesis or Continuing Causes : These are the processes as migration ecesis, aggregation, competition reaction etc. which cause successive waves of population as a result of changes, chiefly in the edaphic features of the area.

Stabilizing Causes : This is climate that established any one of the species of the community into the ecosystem.

• 2.3. TRENDS OF SUCCESSION

An ecological succession proceeds along the following four lines :

(1) A continuous change in the kinds of plants and animals.

(2) A tending increase in the diversity of species.

(3) An increase in the organic matter and biomass supported by the available energy flow.

(4) Decrease in net community production or annual yield.

Basic Types of Succession

(1) Primary succession : It starts from the primitive substratum, where there was no previously any sort of living matter. The first group of organisms establishing there are known as the pioneers primary community or primary colonisers.

(2) Secondary succession : It starts from previously built up substrata with already existing living matter. The action of any external force, as a sudden change in climatic factors, biotic intervention, fire etc. causes the existing community to disappear. Thus area becomes devoid of living matter but its substratum is built up, instead of primitive.

(3) Autotrophic succession : It is characterised by early and continued dominance of autotrophic organisms like green plants. It begins in a predominantly inorganic environment and the energy flow is maintained indefinitely. There is gradual increase in the organic matter content supported by energy flow.

(4) Heterotrophic succession : It is characterised by early dominance of heterotrophs, such as bacteria, actinomycetes, fungi and animals. It begins in a predominantly organic envionment and there is a progressive decline in the energy content.

General Process of Succession : In a primary autotrophic succession, the following steps would occur in a sequence.

(1) Nudation : This is the primitive stage of an ecosystem in which the substratum happens to be a bare area without any form of life. The area may develop due to several causes such as landslide, erosion, deposition or other catastrophic agencies. Man is also responsible for nudation due to his developmental activities.

(2) Invasion : This is the successful establishment of a species in a bare area. The species actually reaches this new site from any other area. It involves the following steps :

(i) Migration(dispersal) : In this process, seeds, spores or other propagules of the species reach the bare area through air, water, birds, and other animals.

(ii) Ecesis (Establishment) : After migration, the process of successful establishment of the species as a result of adjustment with the prevailing environmental conditions is known as ecesis. In plants, after migration seeds or propagules germinate, seedlings grow into adults and start to reproduce. Only a few of them are capable of doing this under primitive harsh conditions and thus most of them become dead. Thus, as a result of ecesis, the individuals of species become established in the area.

(3) Aggregation : After establishment the individuals of the species increase their population by reproduction with a course of time. They come to each other and this process is called aggreagation.

(4) Competition and coaction : In an aggregation, the individuals of the species compete with each other for space and mutation. This is called competition. In this close association, individuals of a species affect each other's life in various ways and this is called coaction. The species, if unable to compete with other species, if present would be discarded. To withstand competition, reproductive capacity, wide ecological amplitude etc. are of much help to the species.

(5) Reaction : This is the most important stage in succession. Environmental conditions change or modify by the influence of established living organism which is called reaction. As a result of reactions, changes take place in soil, water, light conditions, temperature etc. of the environment. Due to all these, the environment is modified, becoming unsuitable for the existing community which sooner or later is replaced by another community (seral community). The whole sequence of communities that replaces one another in the given area is called 'sere', and various communities constituting the sere, as seral communities, seral stages or developmental stages.

(6) Stabilization (Climax) : Finally, there occurs a stage in the process, when the final terminal community becomes more or lss stabilised for a longer period of time and maintains itself in equilibrium with the climate of the area. This final community is not replaced and is known as climax community and the stage as climax stage.

Sometimes due to changes in local conditions as soil characteristics or microclimate the process of succession becomes deflected in different directions from that presumed under climatic conditions of the area. Thus the climax communities are likely to be different from the presumed climatic climax community. This type of succession is called deflected succession.

• 2.4. SUCCESSION IN A POND

In a pond, primary autotrophic succession takes place through the general steps of succession in a sequence. Successive changes take place in plants as well as animal life. But as the changes are more obvious in plants than animals, it looks as it is a succession of plants only. Changes in plants are so obvious that we designate the different stages of succession on the basis of dominant plant types or species, which are as follows (Fig. 1).

(1) Phytoplankton stage : They are the pioneer communities such as blue-green algae, green algae, diotoms and bacteria etc. They are the primitive organisms which start development of the pond ecosystem.

(2) Rooted submerged stage : After some time, the dead matter of phytoplanktons and silt brought from the surrounding land by rain water and by wave action of pond water, become mixed and form a soft mud at the bottom of the pond. This new surface (bottom) becomes suitable for the growth of rooted submerged hydrophytes like Myriophyllum, Elodea, Hydrilla Potamogeton, Vallisneria, Utricularia etc. These plants bring about further build up of the substratum as a result of their death and decay. The water level also decreases making the pond shallower. This modified habitat provides the surface for growth of other types of plant community.

(3) Rooted floating stage : The new community of plants is rooted hydrophytes with their large leaves floating on the water surface. They colonise the habitat with their rhizomes. These are species of Nelumbo, Nymphaea, Limnanthemum, Apomogelon, Trapa, Monochoria etc. Some free floating species as Azolla, Lemna, Wolffia, Pistia, Spirodella, Salvinia etc. also become associated with the rooted plants due to availability of salts and other minerals in abundance. The water level further decreases with more build up substratum make floating species sooner or later disappear from the area.

(4) Reed-swamp stage : This sage is also known as amphibious stage as the plants are rooted in the pond but most part of their shoots remains exposed to air. Species of scirpus, Typha, Sagittaria and phragmites etc. are the main plants of this stage. The water level is by now very much reduced and finally becomes unsuitable for the growth of these amphibians species.