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Energy and cycles of energy

Environmental studies and Disaster management

Energy flow in Ecosystem & Ecological Succession

(Celsius degrees above absolute zero). It transmits energy to earth as electromagnetic radiation. The maximum energy flux of the incoming solar energy is at a wavelength of about 500 nanometers, which is in the visible region of the spectrum. A 1 square meter area perpendicular to the line of solar flux at the top of the atmosphere receives energy at a rate of 1,340 watts, sufficient, for example, to power an electric iron. This is called solar flux. Energy in natural systems is transferred by heat, which is the form of energy that flows between two bodies as a result of their difference in temperature, or by work, which is transfer of energy that does not depend upon a Energy Flow and Photosynthesis

Whereas materials are recycled through ecosystems, the flow of useful energy may be viewed as essentially a one-way process. Incoming solar energy can be regarded as high-grade energy because it can cause useful reactions to occur, the most important of which in living systems is photosynthesis. Solar energy captured by green plants energizes chlorophyll, which in turn powers metabolic processes that produce carbohydrates from water and carbon dioxide. These carbohydrates represent stored chemical energy that can be converted to heat and work by metabolic reactions with oxygen in organisms. Ultimately, most of the energy is converted to low-grade heat, which is eventually reradiated away from Earth by infrared radiation.

Succession

Environment is always kept on changing over a period of time due to (1) variations in climatic and physiographic factors, (2) the activities of the species of the communities themselves. These

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influences bring about marked changes in the dominants of the existing community, which is thus sooner or later replaced by another community at the same place. This process continues and successive communities develop one after another over the same area until the terminal final community again becomes more or less stable for a period of time. It occurs in a relatively definite sequence. This orderly change in communities is referred as succession. Odum called this orderly process as ecosystem development/ecological succession. Succession is an orderly process of community development that involves changes in species structure and community processes with time and it is reasonably directional and therefore predictable.

Succession is community controlled even though the physical environment determines the pattern.

Causes of succession

Succession is a series of complex processes, caused by

- (I) Initial/initiating cause: Both climatic as well as biotic.
- (II) Ecesis/continuing process ecesis, aggregation, competition reaction etc.
- (III) Stabilizing cause: Cause the stabilization of the community.

Climate is the chief cause of stabilization and other factors are of secondary value.

Types of succession

Primary succession: 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/primary colonizers. Very slow is the series of community changes that takes place in disturbed areas that have not been totally stripped their soil and vegetation.

- **Secondary succession:** Starts from previously built up substrata with already existing living matter. Action of an 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, instead of primitive is built up. Such successions are comparatively more rapid.
- **Autogenic succession:** Community - result of its reaction with the environment, modified its own environment and thus causing its own replacement by new communities. This course of succession is autogenic succession.

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- **Allogenic succession:** Replacement of the existing community is caused largely by any other external condition and not by the existing organisms.
- **Autotrophic succession:** Characterized by early and continued dominance of autotrophic organisms like green plants. Gradual increase in organic matter content supported by energy flow.
- **Heterotrophic succession:** Characterized by early dominance of heterotrophs, such as bacteria, actinomyces, fungi and animals. There is a progressive decline in the energy content.

General Process of succession

(i) Nudation: Development of barren area without any form of life.

Cause of nudation: It may be

(a) Topographic soil erosion by wind (b)

Climatic - storm, frost etc.

(c) Biotic - man, disease and epidemics.

(ii) Invasion: Successful establishment of a species in a barren area. This species actually reaches this new site from any other area by (i) Migration, (ii) Ecesis and (iii) Aggregation. **Slow soil development by weathering, activities of tolerant species**

Pioneer Species

Retrogressive succession:

Continuous biotic influences have some degenerating influence on the process. Due to destructive effects of organisms, the development of disturbed communities does not occur. Process of succession, instead of progressive, it becomes retrogressive. (Eg.) Forest may change to shrubby or grassland community.

Deflected succession:

Sometimes due to changes in local conditions as soil character or microclimate the process of succession becomes deflected in a different direction than that presumed under climatic conditions

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of the area. Thus the climax communities are likely to be different from the presumed climatic climax community. In India, with a monsoon type of climate, in some habitats like temporary ponds, Pools etc. It is common to observe each year, the development of different kinds of communities in different seasons of the year - seasonal succession. But such changes are simply recurrent and not developmental and should not be designated as successful. Species do not remain unchanged indefinitely. In course of time many species become extinct and disappeared forever. Or a species may form one or more new species that differ from the original one. All these changes are result of evolution (ie) by the process of evolution organism arise by modification from ancestral forms of life.

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Food Chain

A **food chain** shows how each living thing gets its food. Some animals eat plants and some animals eat other animals. For example, a simple food chain links the trees & shrubs, the giraffes (that eat trees & shrubs), and the lions (that eat the giraffes). Each link in this chain is food for the next link. A food chain always starts with plant life and ends with an animal

1. Plants are called **producers** because they are able to use light energy from the Sun to produce food (sugar) from carbon dioxide and water.
2. Animals cannot make their own food so they must eat plants and/or other animals. They are called **consumers**. There are three groups of consumers.
 - a. Animals that eat ONLY PLANTS are called **herbivores** (or primary consumers).
 - b. Animals that eat OTHER ANIMALS are called **carnivores**.
 - Carnivores that eat herbivores are called secondary consumers
 - Carnivores that eat other carnivores are called tertiary consumers

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e.g., killer whales in an ocean food web ... phytoplankton → small fishes