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Ecological Succession and Its Types: Dynamics of Eco-system

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ABSTRACT:
Ecological succession is a natural process in which species composition and community structure gradually change over time in ecosystems. This summary gives a general review of ecological succession and its several kinds, emphasizing its importance and major research discoveries. Ecological succession is the term used to describe the predictable and orderly changes that occur in an ecosystem as a result of a disturbance or the colonization of a new region. It includes the long-term establishment, expansion, and replacement of many plant and animal species. The interaction of the organisms with their surroundings, including elements like soil composition, climate, and species interactions, is what propels the process. Primary succession and secondary succession are the two fundamental categories of ecological succession. Primary succession occurs when there was no prior plant or soil, such as bare rock surfaces or freshly created volcanic islands. Beginning with the colonization of pioneer species, which progressively alters the environment and forges the way for the development of more complex species, is the first stage.

KEYWORDS:

Community, Development, Environment, Process, Succession, Species.

I. INTRODUCTION

Communities of living things are dynamic. Instead, they develop through time. There are several ways to understand this development. The development, interaction, and death of individual creatures as they go through their life cycles, influenced by the seasonal cycles and other natural occurrences, constitute the basic degree of complexity. Other types of community transformation take place over longer time periods and are responsible for considerably more significant changes in the structure and makeup of the community. These include community evolution and ecological succession [1]. It is clear from the above that the word succession refers to a series of changes in a community's species composition, which are often accompanied by a series of changes in its structural and functional characteristics. The word is often used to describe the temporal sequence of vegetation on a location (measured in years, decades, or centuries); however, only short-term changes may be directly seen, while long-term ones are deduced from spatial patterns [2], [3]. Changes brought about by succession are often directed or progressive. This information makes it possible to anticipate which species would most likely displace others throughout a succession. Until the species combinations that are most adapted to the local climate and the specific location are established, succession usually continues [4], [5].

Historical Background

Anon Kerner (1863) first introduced the fundamental concept of succession in his book Plant Life of the Danube Basin when describing the regrowth of a swamp forest. Hult (1885) used the phrase ecological succession in his study of communities in Southern Sweden. According to H.C. Cowles, communities are dynamic rather than static. This new knowledge may be seen as a systematic, predictable, and directed phenomenon. Additionally, it was mentioned that biotic interactions within the community control succession, which is autogenic. The fundamental tenet of the classical idea was that early communities changed the environment in a way that favored later successional groups and hurt early societies to their disadvantage. Later investigations showed that callogenesis, which is defined as the

regulation of community dynamics by variables originating beyond the community limits, was likely more prevalent and prominent than autogenesis. Shelford (1913) researched the animal succession on these dunes. Later, Olson (1958) updated his research on the evolution of the ecology on these dunes and provided us with the results. The ideas and philosophy of succession are elaborated by Federick Clements (1907–1936). He put out the successional monoclimax hypothesis. For example, the polyclimx hypothesis by Braun-Blanquet (1932) and Tansley (1939), the climax pattern hypothesis by Whittaker (1953), MacIntosh (1958), and Sellack (1960), and the stored energy theory of information theory by Fosberg (1965, 1967), and Odum (1969) were all hypotheses that were put forth by ecologists in later years to explain the nature of climax communities. Odum (1969) defined succession using three criteria:

1. Succession is an orderly process of reasonable directional and fairly predictable community development;
2. Succession results from a community's alteration of the physical environment, i.e. succession is largely community controlled.
3. The end result of succession is a stabilised ecosystem that maintains the highest biomass and symbiotic function between species per unit of available energy flow. According to Whittaker (1975), there is often an increase in community productivity, height and mass, species variety, relative stability, soil depth, and soil differentiation during the period of succession. The culmination of succession is a climax community with a steady-state function and generally constant species composition that is suited to its environment. If it is not disturbed, it will remain in its environment forever.

II. DISCUSSION

Illustrations

The following examples may be used to demonstrate ecological succession:

1. Lake

A lake progressively transforms as it accumulates silt, going from a deep to a shallow lake or pond, then to a marsh, and perhaps beyond this to a dry-land forest.

2. Crop field

It looks like a piece of empty land after a crop field is abandoned or a forest has been badly burnt; from there, a succession of plant communities emerge and replace one another, starting with annual weeds, moving on to perennial weeds and grasses, shrubs and finally trees, until a forest blocks the development [6], [7]. Ecological succession is therefore the gradual and orderly replacement of one community by another up until a climax community a very stable society takes over the region. In the first illustration, the physical process the silting-up of the lake was the primary factor in the community's transformation. In the second instance, the development of plants on preexisting soil was a major contributing factor.

Development

Ecological succession has the following forms:

1. Pioneers

Pioneers are the first creatures that establish themselves in a succession-in-progress environment, while climax communities are the stable communities that mark the conclusion of the succession.

2. Sere

All of the communities participating in the ecological succession in a particular location. For instance, a sequence that ends in a final stable climax community and transitions from grass to shrub to forest is known as a sere.

3. Seral Stage

Each alteration that occurs is in a different stage of development.

4. Community

Although fleeting, each seral stage is a distinct society with its own traits. It could last for a very little period of time or for many years.

Classification of Series

Seres may sometimes be categorized according on the major force causing them. These influences include geologic, biological, climatic, and physiographic factors. They produce what are known as bioseres, cliseres, eoseres, and geoseres.

Succession Processes

The following two forms of succession are possible.

1. Primary Succession

The process of species colonisation and replacement known as primary succession occurs when the environment is originally essentially devoid of life. To put it another way, the process begins with the base rose, sand dune, river delta, or glacial debris and concludes when the climax is achieved. Presere is the sere engaged in primary succession.

2. Secondary Succession

The process of change that follows an ecosystem's disruption but not complete eradication is known as secondary succession. Because organic material and a few species from the initial community will still be there, the successional process won't need to start again in this case. Therefore, secondary succession occurs more quickly than primary succession. It appears in places that have been scorched by a fire or cleared by farmers for farming. Subsere is the sere engaged in secondary succession.

Types of Succession Processes

There are three different sorts of main and secondary successions. The categorization is based on the amount of moisture present:

(a) Hydrosere Hydrach

The succession is known as a hydrach or hydrosere when it begins in an aquatic environment as ponds, lakes, streams, marshes, bogs, etc.

(b) Mesarch

Mesarch refers to the succession that starts in a region with sufficient rainfall.

(c) Exerosere or Xerach

The term xerach refers to succession that begins in xeric or arid habitats with little to no moisture, such as dry deserts, rocks, etc. The term xerosere refers to a transient colony within an ecological succession on a dry, sterile environment. It may come in the following three forms Iithosere-succession beginning on sand Pasmas’re-succession beginning on sand; and Halosere-succession beginning on salty water or land.

Autogenic Community

An autogenic community is one in which the succession develops only as a consequence of interactions between the organisms and their surroundings the community's driving force take succession on sand dunes, for instance.

Allegonic Community

Allegonic community refers to a succession that is influenced by outside influences, such as fertiliser intake or succession in a tiny pond or bog.

Autotrophic and Heterotrophic Succession

On the basis of community metabolism, succession is sometimes divided into autotrophic and heterotrophic categories:

Autotrophic succession early and persistent dominance of autotrophic species, such as green plants, is a characteristic of autotrophic succession. It starts in a setting that is mostly inorganic. It continuously maintains the energy flow. A kind of ecological succession known as autotrophic succession, commonly referred to as primary succession, takes place in places with no preceding vegetation or soil. It usually starts in arid environments like freshly created volcanic islands, exposed rock, or regions that have been utterly devoid of life as a result of glacial retreat or significant disruption [8], [9]. The colonisation of pioneer species typically durable and adaptable organisms like lichens and mosses begins the process of autotrophic succession. These pioneer species can endure extreme weather conditions with little access to soil and nutrients. Due to their special adaptations, they may attach to soil or rock surfaces and take nutrients from the atmosphere or through mineral weathering.

The pioneer species begin to alter their surroundings as they develop and procreate. They disintegrate rocks, liberate organic debris, gather decomposing biomass, and finally produce a thin layer of soil. Other plant species may thrive in a more hospitable habitat thanks to this freshly produced soil. Herbaceous plants, shrubs, and ultimately trees may colonise the region over time, creating a more complex and diversified population. To establish a mature and stable ecosystem, autotrophic succession is a lengthy and gradual process that might take hundreds or even thousands of years. Changes in environmental factors, such as the buildup of organic matter, soil formation, and the accessibility of water and nutrients, influence species diversity and community structure through time. Each phase of the autotrophic succession lays the groundwork for the next, providing the framework for the emergence and expansion of increasingly sophisticated and demanding species [10], [11].

Heterotrophic succession early dominance of heterotrophs, such as bacteria, actinomycetes, fungi, and animals, is a characteristic of heterotrophic succession. This kind of succession starts in an environment that is mostly organic, and the energy content gradually decreases. Heterotrophic succession, sometimes referred to as secondary succession, is the ecological succession process that takes place in previously populated regions after a disturbance. Heterotrophic succession takes place in places where a community has previously been formed but has been disturbed or eliminated, in contrast to autotrophic or primary succession, which begins in bare regions without prior vegetation.

Different disturbances, like wildfires, logging, or human endeavours like agriculture or urban expansion, may cause heterotrophic succession. These disruptions change or completely eliminate the current vegetation, which upsets the ecosystem's biological equilibrium. After a disturbance, opportunistic, quickly-growing plant species known as pioneer species recolonize the region, starting the process of heterotrophic succession. These species often have strong reproductive rates and quick development, and they are generally equipped to colonies disturbed settings. They contribute to soil stabilization, stop soil erosion, and provide an ideal setting for other plant species to flourish. The pioneer plants change the environment as they develop and interact with it, enhancing soil fertility, boosting organic matter, and establishing microhabitats for other creatures. As a result, more diversified plant species, such as trees and shrubs, begin to emerge. The makeup of the community is evolving over time, moving towards a more sophisticated and complicated ecology.

Serule

Serule is the term for the tiny succession of microorganisms and other fungus found on fallen logs of rotting wood, tree bark, etc. Drury and Nisbet (1973) distinguished three categories of succession:

(a) Category I consists of numerous traditional secondary succession types as well as certain main successions. It includes temporal sequences occurring at a single location while the physiography and environment are mostly unchanging.

(b) Category II consists of a large number of primary successions (particularly those in ponds and lakes) and a small number of secondary successions. Temporal sequences are shown here, together with local environmental changes influenced by outside forces like the climate, erosion, drainage, fertiliser inputs, etc.

(c) Changes in Category III encompass spatial sequences on nearby sites and occur over lengthy (geological) time scales.

Success: General Process and Climax

General Method

The succession process involves a naked region or nudation that is created for a variety of causes, including volcanic eruption, landslip, and subsequent phases.

1. Nudation

A naked region or nudation is where the succession process starts. This area may have been created by a volcanic eruption, a land slide, floods, erosion, a deposit, a fire, a disease, or another calamitous event. Man may also be responsible for the development of new dead, barren places, such as those caused by walls, stone quarries, fires, excavation, drowning vast land tracts under reservoirs, etc.

2. The invasion

The term invasion refers to the spread of certain species' reproductive bodies or propagules into uninhabited or newly created areas. In every location where animals rely on plants for sustenance, plants are the first invaders. The following three steps make up the invasion:

Migration or Dispersal: The species' seeds, spores, or other progeny travel by air, water, or animals to the barren region.

(a) Ecesis: The effective establishment of migratory plant species in a new environment. It involves the germination of seeds or propagules, the development of seedlings, and the beginning of mature plants' reproductive processes.

(b) Aggregation: During this phase, a species' successful immigrants multiply, increasing their numbers and forming a sizable population in the region. Individuals of the species therefore approach one another.

III. CONCLUSION

Ecological succession is a natural process that through time influences how ecosystems alter and grow. It starts new species colonization in an environment. It turns regions that have been devastated by various biotic and abiotic sources into spaces where live organisms may flourish. Changes in the barren or devastated region promote the growth of taller plants such as shrubs and grass. Secondary succession develops in previously populated regions following a disturbance, while primary succession occurs in places with no past vegetation. Both kinds of succession are necessary for an ecosystem to operate and be resilient. We can learn a lot about ecosystem dynamics, species interactions, and the restoration of damaged habitats by studying ecological succession. Effective ecosystem management and conservation efforts depend on this knowledge.

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