TYBA

SEMESTER - VI (CBCS)

GEOGRAPHY PAPER - VIII

BIOGEOGRAPHY

SUBJECT CODE : 86642

Program Co-ordinator : **Anil R. Bankar**
Associate Professor of History and
Head, Faculty of Humanities,
IDOL, University of Mumbai.

Course Co-ordinator and Editor : **Mr. Susen Aghav**
Assistant Professor of Geography,
IDOL, University of Mumbai.

Course Writer : **Dr. Hemant M. Pednekar**
Principal,
Arts, Science & Commerce College,
Onde, Vikramgad

: **Dr. Shivram A. Thakur**
H.O.D. of Geography,
S.P.K. Mahavidyalaya, Sawantiwadi

: **Dr. R.B. Patil**
H.O.D. of Geography
Pondaghat Arts & Commerce College.
Kankavli

: **Dr. Moushmi Datta**
Associated Prof, Dept. of Geography,
N.K. College, Malad, Mumbai

April 2023, Print - I

Published by : Director
Institute of Distance and Open Learning ,
University of Mumbai,
Vidyanagari, Mumbai - 400 098.

DTP Composed & Printed by : Mumbai University Press,
Vidyanagari, Santracruz (E), Mumbai

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INTRODUCTION TO BIOGEOGRAPHY

Unit structure:

1.0 OBJECTIVE

1. understand the Concept, definition, nature, and Scope of biogeography
2. know the Historical Development and Branches of Biogeography
3. Learn about Approaches in Biogeography
4. understand the Importance of Biogeographic Studies

1.1 INTRODUCTION

Geography is the scientific study of the earth's surface. As we know there is no informality in the earth's surface in world. Because the climate factor is a prominent factor that makes difference from region to region. Geography is divided into two main branches physical geography and human geography. Physical geography deal with natural phonemical factors. physical geography is divided into other branches that are-Geomorphology, climatology, Environment Geography, Oceanography and Biogeography. We are going to know about biogeography. Biogeography means the study of living things and non-living things in a particular area. The focus of biogeography is how a species origin, develops and disperses to our area. We will learn in this unit about branches of biogeography. An important study of biogeography etc.

1.3 BIOGEOGRAPHY - CONCEPT, DEFINITION, NATURE, AND SCOPE

Biogeography is a branch of geography that studies the past and present distribution of the world's many animal and plant species and is usually considered to be a part of physical geography as it often relates to the examination of the physical environment and how it affected species and shaped their distribution across the world. Alfred Russel Wallace studied the distribution of flora and fauna in the Amazon Basin and the Malay Archipelago in the mid-19th century. His research was essential to the further development of biogeography, and he is considered the "father of Biogeography".

Biogeography is the study of the geographic distribution of plants, animals, and other forms of life. It is concerned not only with habitation patterns but also with the factors responsible for variations in distribution.Strictly speaking, biogeography is a branch of biology, but physical geographers have made important contributions, particularly in the study of flora. Modern advancements in the classification of vegetation and the preparation of maps of vegetation began in the 20th century with the work of American botanists Forrest Shreve, Homer L. Shantz, Hugh M. Raup, and others.Biogeographic studies divide Earth's surface—primarily the continents and islands—into regions exhibiting differences in the average composition of flora and fauna. It is thought that the present-day distribution patterns of plant and animal forms, as reflected in such biogeographic regions, are the result of many historical and current causes. These causes include present climatic and geographic conditions, the geologic history of the landmasses and their climates, and the evolution of the taxon (e.g., genus or species) involved. Investigators have found that rate of dispersal, adaptability to prevailing environmental conditions, and the age of the taxa being studied also have a significant impact on the pattern and extent of distribution.

What is biogeography?

"Biogeography, the study of the geographic distribution of plants, animals, and other forms of life. It is concerned not only with habitation patterns but also with the factors responsible for variations in the distribution"

Buffon proposed a mechanism to explain biogeographic patterns: that species 'improve' or 'degenerate' according to their environment. Given generality and often incorporating multiple facets, a theory may emerge that explains the patterns well (e.g. evolutionary theory)

- by Buffon

Alfred Russel Wallace studied the distribution of flora and fauna in the Amazon Basin and the Malay Archipelago in the mid-19th century. His research was essential to the further development of biogeography, and he was later nicknamed the "father of Biogeography".

by - Alfred Russel Wallace

"Biogeography as the branch of physical geography;geography of organic life, the study of spatial distribution of animate nature, includingboth plants and animals and the processes that produce variations in the patterns ofdistribution".

By - **According to Browne,**

"Biogeography, as the term indicates, is both a biologicaland a geographical science. Its field of study is the biologically inhabited part of thelithosphere, atmosphere and hydrosphere- or, as it has become known- the biosphere".

By **According to J. Tivy,**

Biogeography refers to the distribution of various species and ecosystems geographically and throughout geological time and space. Biogeography is often studied in the context of ecological and historical factors which have shaped the geographical distribution of organisms over time. Specifically, species vary geographically based on latitude, habitat, segregation (e.g., islands), and elevation. The subdisciplines of biogeography include zoogeography and phytogeography, which involve the distribution of animals and plants, respectively.

SCOPE AND NATURE OF BIOGEOGRAPHY

Biogeography is closely related to ecology which is the study of the inter-relationships between organisms and their habitat. The organism home or habitat could vary from a small micro habitat such as under a stone or a leaf to Biomes which could be a tropical rainforest or desert. However, biogeography is a broad discipline but has two main branches

Ecological Biogeography which is the present distributions and geographic variation in diversity, how biotic and abiotic interactions influence species distributions, interactions between species (e.g., predation and competition).

Historical Biogeography which is the second deals with continental drift, glaciation, evolutionary lineages reconstructing the origin, dispersal and speciation and extinction of species.

However, the term biogeography is the study of the geographic patterns of species distribution; it is an aspect of physical geography that examines the physical environment and the way it affects the distributions of various species on the earth surface. The discipline is related to biology, ecology, evolution studies, climatology, and soil sciences as they are relate to animal populations and the factors that allow them to flourish in particular regions of the globe. In that case, we are unable to separate biogeography from its related fields, since biogeography is relying heavily on theory and data from other related subjects.

In the late nineteenth and early twentieth centuries, biogeography was a focus of analysis across disciplines such as geography, anthropology and archaeology, both for those concerned with the development of human societies and for those concerned with the distribution and viability of animal or plant populations.

Biogeography seeks to describe and analyze distributional patterns exhibited by organisms at present and in the past. To enable it to comprehend distributional patterns, biogeography needs to study physical and organic factors as they are now and how they were in time past. To acquire this knowledge, it must use information drawn largely from the natural and earth sciences. It is an interdisciplinary subject within these domains.

1.4 HISTORICAL DEVELOPMENT AND BRANCHES OF BIOGEOGRAPHY

To better understand the current field of biogeography, it is important to explore the foundations and history of the science. Biogeography is a synthetic study, which is based in part on the subjects of community ecology, geology, systematics, evolutionary biology, and palaeontology. The development of the subject of biogeography may be broken into four historical periods.

1600–1850: The Age of Reason

Early studies of organisms' geographic distributions were focused on descriptive studies with historical explorations. These scientists focused on documenting spatial patterns of organisms, emphasizing on the effects of climate, latitude, and altitude. Comte de Buffon (1707–1788), also known as Georges-Louis Leclerc, determined that distant regions with similar climate and similar-appearing vegetation have different animal species. This is now referred to as Buffon's Law. He is also the author of Histoire Naturelle, a 44-volume natural history encyclopedia. Carl Linnaeus (1707–1778) studied the plants and animals spread from Mount Ararat in Turkey to explore the idea of the biblical flood. As a result of documenting elevational zones of Ararat, he came up with the idea of biomes defined as major ecological communities. In addition, Carl Linnaeus is considered the father of the science of taxonomy, which is the science of classification.This time period is also known as a great age for exploration. Johann Reinhold Forster (1729–1798) was the naturalist on James Cook's second Pacific voyage in 1778. He advanced biogeography by creating global biotic regions for plants. Forster noted the higher-species diversity in the tropics, as well as species diversity being correlated with island size. Alexander von Humboldt (1769–1859) created a botanical geography that was foundational to the field of biogeography. He determined that plant vegetation types are strongly correlated with local climate to create latitudinal belts of vegetation. Moreover, he developed elevational vegetation zones for the Andes in South America.

1850–1900: Evolution by Natural Selection

The idea of evolution based on natural selection greatly altered the way species distributions were explained. Charles Darwin (1809–1882) is most famous for publishing The Origin of Species, outlining his idea of evolution through natural selection. Natural selection occurs when individuals in a population either do not survive equally well or do not breed equally well, or both due to inherited differences. Evolution in turn can be thought of in two ways: (1) microevolution and (2) macroevolution. In microevolution, evolution is considered as changes in the genetic composition of a population with the passage of each generation. For macroevolution, evolution is the gradual change of organisms from one form into another, with the origins of species and lineages from ancestral forms. For an example, Darwin studied the variations in mockingbirds on different Galapagos Islands. This divergent evolution is a diversification over evolutionary time of a species into several different species, commonly referred to as adaptive radiation.

Alfred Russel Wallace (1823–1913) is also famous for independently developing the idea of evolution by natural selection, based on his work in Indonesia. He found that the species on Sumatra and Java were very different from nearby New Guinea, even though the climates were similar. Wallace's study of biota in Southeast Asia showed geographic distance is not equal to taxonomic similarity, and the boundary area between these islands is now referred to as Wallace's Line. Wallace is also considered to be the originator of zoogeography, which is the biogeography focused on animals. Wallace integrated geological, fossil, and evolutionary information to consider paleoclimate influences distributions, developing six great biotic regions.

Other notable contributions to biogeography during this period include mapping biotic regions and understanding limiting factors. Philip LutleySclater (1829–1913) advanced the subject of biogeography with his defining terrestrial biotic regions for birds and marine regions for marine mammals. Justus Liebig (1803–1876) changed the way scientists viewed restrictions on organisms away from a focus on total resources available with his law of the minimum. The law of the minimum states that the scarcest resource (or limiting factor) in the environment makes it difficult for a species to live, grow, and reproduce.

1900–1950: Continental Drift and Ecology

Themes in biogeography in the first half of the 20th century focused on links to paleontology, centers of species origins, and the biological species concept. The emphasis in the science of biogeography was on evolution, history, dispersal, and mechanisms of survival. The greatest impact on biogeography in this period was the theory of continental drift in 1912 and 1915 by the German geologist Alfred Wegener (1880–1930). Before the theory of plate tectonics, it was difficult for biogeographers to explain certain patterns of species distributions with the assumption that land masses were fixed in their geographic positions. Wegener's theory was actually not widely accepted until the 1960s when proof of continental drift came from a series of linear magnetic anomalies on either side of the Mid-Atlantic Ridge. With the acceptance of the continental drift theory, biogeographers could now explain the disjunct biogeographic distribution of present-day organisms found on different continents but having similar ancestors.

Species can interact as continents collide. Subsequently, when the continents separate, they take their new species with them. Biogeographers now ponder how plate tectonics may have affected the evolution of life. In turn, biogeographers offer evidence for plate tectonics such as dispersal of species via such corridors as the Bering land bridge or widely separated ("disjunct") species distributions that can't be explained by dispersal; for instance, Nothofagus (southern beech) trees, which only occur in Southern South America and in New Zealand.

In addition to historical explanations of organism distributions, biogeographers also examined ecological reasons for spatial patterns. Theories on ecological succession were formally developed in the late 1800s and early 1900s to show predictable and orderly changes in the composition or structure of ecological communities. In 1899, Henry Cowles published his study of stages of vegetation development on dunes along Lake Michigan. In 1916, Frederic Clements published his famous theory of vegetation development focusing on gradual changes over time to best fit the local conditions. His climax theory of vegetation-dominated plant ecology was later largely replaced by other models, notably by Henry Gleason's 1926 concept of distribution of plants depending on the individual species rather than Clements's idea of plant associations. In 1934, Christen Raunkiaer (1860–1938) helped change the way biogeographers classified species with life forms based on ecological rather than taxonomic classification. In 1935, Sir Arthur Tansley (1871–1955) refined the term ecosystem to mean the whole complex natural unit in a system consisting of all plants, animals, and microorganisms (biotic factors) in an area functioning together with all the nonliving physical (abiotic) factors of the environment.

1950–Present: Ecological and Historical Theories Since 1950, the field of biogeography has been revitalized with advances in ecological and historical theories focused on phylogenetic classification to related different species, mechanisms limiting geographic distribution, and distances and size influencing number of species in an area.

During this period, the concept of new species arising due to geographic isolation was developed by Ernst Mayr (1904–2004). Mayr is also well-known for defining the "biological species concept" as potentially interbreeding to produce fertile offspring. In addition, Mayr helped define the term cladistics to refer to classifications, which only take into account geneology, based on evolutionary ancestry. Cladistics, or phylogenetic classification, views a species as a group of lineage-connected individuals, compared with the traditional Linnaean taxonomy, which focused on the similarities between species. Cladograms are created based on the order in which different groups branched off from their common ancestors, arranged with the most closely related species on adjacent branches of the phylogenetic tree.

Theories also expanded during this time period on how a species can occur in widely geographically separated areas and the mechanisms that limit these distributions. In 1958, Leon Croizat (1932–1982) published his concept of “vicariance biogeography” to explain disjunction of multiple species due to the growth of barriers instead of via dispersal. Croizat's works include. Manual of Phytogeography (1952), Panbiogeography (1958), and Space, Time, Form (1964). Robert Harding Whittaker (1920–1980) proposed a new method to analyze limits to plant distributions by comparing species abundance with environmental gradients. His gradient analyses approach focuses on abiotic factors such as light, water, temperature, and soil nutrients in plant communities.

Biogeography during this period moved from observational to predictive studies with the theory of island biogeography. In 1963, R. H. MacArthur and E. O. Wilson hypothesized that species richness of an area could be predicted to explain distributions. The theory states that if one knows the rates of colonization and extinction of an island, then it is possible to predict the number of equilibrium species that area could support. They based the species richness prediction on two factors: (1) distance of the island from a mainland source of species for a colonization pool and (2) the size of the island for available habitat and its variety of ecological niches. With these two factors, MacArthur and Wilson predicted the number of species the area could maintain, as well as the turnover rate for the area. According to island biogeography theory, small and distant islands have a lower number of species that can be maintained compared with large and near islands. The theory also states that there would be a turnover of the species as new species colonize and old species go extinct, but the number of species overall should achieve an equilibrium number. This theory has been applied to other non-island areas that act like islands due to habitat fragmentation, such as nature preserves and national parks.

BRANCHES OF BIOGEOGRAPHY:

The main branches of biogeography are

1. Historical Biogeography,
2. Ecological Biogeography, and
3. Conservation Biogeography.

There are three main branches in biogeography

1. Historical Biogeography:

This branch studies the evolutionary history of species and their geographic distribution patterns over time.

It researches that past geological events, such as continental drift, have influenced the distribution of species and their diversity.

2. Ecological Biogeography:

This branch studies the current distribution patterns of species and their relationships with their physical and biotic environments.

3. Conservation Biogeography:

This branch is about the principles of biogeography to conservation biology, focusing on the protection and management of endangered species and ecosystems.

1.5 APPROACHES TO BIOGEOGRAPHY

Historical Biogeography – Reconstruct the origins, dispersal, and extinctions of taxa and biotas

Ecological Biogeography – Accounts for the present distributions in terms of interactions between organisms and their physical and biotic

environments Paleoecology – Bridges the gap between these two fields, investigating the relationships between communities (abundance, distribution, and diversity of species) and abiotic conditions (climate, soils, water quality, etc.).Analytical Biogeographers - Develop general mathematical rules of how geography affects the evolution and distribution of plants and animals

Conservation Biogeography - Work on the protection and restoration of natural environments

1.6 IMPORTANCE OF BIOGEOGRAPHIC STUDIES

1. Through observing the geographic distribution of species, we can see associated variations in sea level, river routes, habitat, and river capture. Additionally, this science considers the geographic constraints of landmass areas and isolation, as well as the available ecosystem energy supplies.

2. Biogeography is one of the Life sciences which deal with the study of distribution of species and ecosystems in geographic area and through geological time. Organisms and biological groups regularly differ in a common fashion along geographic gradients of latitude, elevation, isolation and habitat region. Phytogeography is the department of biogeography that studies the distribution of plants.

3. Zoogeography is the department that studies the distribution of animals. Mycogeography is the department that studies the fungi distribution like mushrooms. Biogeography is an integrative subject of inquiry that unites ideas and facts from ecology, evolutionary biology, taxonomy, geology, physical geography, paleontology, and

climatology. Modern biogeographic studies combine ideas and information from many fields, from the physiological and ecological constraints on organismal dispersal to geological and climatological phenomena running at worldwide spatial scales and evolutionary time frames. The short-period interactions within a habitat and species of organisms describe the ecological application of biogeography.

4. Historical biogeography describes the longtime period, evolutionary durations of time for broader classifications of organisms. Early scientists, starting with Carl Linnaeus, contributed to the development of biogeography as a life science. The scientific principle of biogeography grown out of the work of Alexander von Humboldt (1769–1859), Francisco Jose de Caldas (1768- 1816), Hewett Cottrell Watson (1804–1881), Alphonse de Candolle (1806–1893), Alfred Russel Wallace (1823–1913), Philip LutleySclater (1829–1913) and other biologists and explorers. The patterns of species distribution throughout geographical regions can generally be defined through a mixture of historical elements like: speciation, extinction, continental drift, and glaciation. Through observing the geographic distribution of species, we can see related versions in sea level, river routes, habitat, and river capture. Additionally, this science considers the geographic constraints of landmass regions and isolation, as well as the available ecosystems energy supplies.

5. Modern biogeography regularly employs the usage of Geographic Information Systems (GIS), to recognize the elements affecting organism distribution, and to predict future trends in organism distribution. Often mathematical models and GIS are employed to clear ecological troubles which have a spatial aspect to them. Biogeography is most keenly observed on the world's islands. Islands are best places due to the fact that they enable scientists to observe and study the habitats which are new invasive species that are currently colonized and can be examined how they disperse through the island and modify it. Islands are very diverse in their biomes, starting from the tropical to arctic climates. This diversity in habitat enables for a wide variety of species study in various parts of the world. Biogeography includes many different fields but not only limited to physical geography, geology, botany and plant biology, zoology, general biology, and modelling. Biogeography is being implemented in biodiversity conservation and planning, projecting global environmental modifications on species and biomes, projecting the spread of infectious diseases, invasive species, and for supporting planning for the establishment of crops. Technological evolving and advances have allowed for producing an entire suit of predictor variables for biogeographic analysis.

1.7 SUMMERY

Biogeography is the study of the geographic distribution of plants, animals, and other forms of life. It is concerned not only with habitation patterns but also with the factors responsible for variations in distribution.Strictly speaking, biogeography is a branch of biology, but physical geographers have made important contributions, particularly in the study of flora. Modern advancements in the classification of vegetation and the preparation of maps of vegetation began in the 20th century with the work of American botanists Forrest Shreve, Homer L. Shantz, Hugh M. Raup, and others.Biogeographic studies divide Earth’s surface—primarily the continents and islands—into regions exhibiting differences in the average composition of flora and fauna. It is thought that the present-day distribution patterns of plant and animal forms, as reflected in such biogeographic regions, are the result of many historical and current causes. These causes include present climatic and geographic conditions, the geologic history of the landmasses and their climates, and the evolution of the taxon (e.g., genus or species) involved. Investigators have found that rate of dispersal, adaptability to prevailing environmental conditions, and the age of the taxa being studied also have a significant impact on the pattern and extent of distribution.

1.8 EXERCISE

1. what is Biogeography? explain the nature and scope of Biogeography.
2. discuss the development stages of B Biogeography.
3. explain all branches of Biogeography.
4. explain the importance of Biogeography.

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2

ECOSYSTEM AND BIOSPHERE

Unit structure:

2.0 OBJECTIVE

1. understand the Ecosystem: Concept, meaning and types
2. know the Components of ecosystem and ecosystem productivity
3. Learn about Biosphere: Concept, meaning and components
4. understand the Biogeographic processes

2.1 INTRODUCTION

Down the ages humans have learnt to exist in a variety of locations on the earth. The interaction of humans with the environment (surroundings) in these locations has often brought major changes in that environment. Some changes were good, some were bad. Many times, the bad changes were caused by humans making too much of a change in the environment, by using or abusing the natural resources. Every location where people have lived contained a community of plants, animals, insects, and other natural resources. A community of organisms, other natural resources, and their influence on each other is called an ecosystem. The plants and animals existing in an ecosystem are those most adapted to that environment.

A growing human population presents increasing environmental challenges around the world. The study of Environment and Ecosystem helps in understanding the dynamics of ecology, environmental science, and conservation management of natural resources, wildlife and sustainable ecosystems and landscapes so that applicable solutions can be sought for.

2.2 ECOSYSTEM : CONCEPT, MEANING AND TYPES

Ecosystems can be of different sizes consisting of a community of organisms together with their physical environment. They can be marine, aquatic, or terrestrial. Broad categories of terrestrial ecosystems are called biomes. In ecosystems both matter and energy are conserved. Energy flows through the system usually from light to heat. But matter is recycled. Ecosystems with higher biodiversity tend to be more stable with greater resistance and resilience in the face of disturbances, disruptive events. In an ecosystem each organism plays its own role.

2.2.1 Meaning of Ecosystem :

According to Woodbury, "Ecosystem is a complex in which habitat, plants and animals are considered as one interesting unit, the materials and energy of one passing in and out of the others". An ecosystem includes all the living things such as plants, animals and organisms in a given area, interacting with each other, and also with their non-living environments like weather, earth, sun, soil and climate. Ecosystems are the foundations of the biosphere and they determine the health of the entire earth system. Although a complete self-sufficient ecosystem is rarely found in nature but all the ecosystems of the earth are very well connected to each another such as river ecosystem is connected with the ecosystem of ocean.

The term ecosystem was coined by A.G. Tansley in 1935, who defined it as "the system resulting from the integration of all the living and non-living factors of the environment"

According to R. L. Lindeman (1942), the term ecosystem applies to "any system composed of physical-chemical-biological processes within a space-time unit of magnitude."

According to Monkhouse and Small, "ecosystem is an organic community of plants and animals viewed within its physical environment or habitat".

From the above definitions of ecosystem, the following basic properties emerge:

- Ecosystem of any given spatial- temporal unit represents the sum of all living organisms and physical environment.
- It is a well-defined area.
- It is an open system characterized by continuous input and output of the energy.
- It is mainly powered by solar energy.
- It is a functional unit.
- There is a complex interaction between the biotic and abiotic components.
- Ecosystems are natural system and well organized.

Components and Function of Ecosystem

Components of Ecosystem

An ecosystem is a functional and structural unit of Ecology. This implies that each ecosystem has a definite structure and components where each component part of the system has a definite role to play in the functioning of the ecosystem. Ecosystems have two major components. The living or biotic components like plants and animals; and the nonliving or abiotic components like water, air, nutrients and solar energy. These two parts of the ecosystem continuously interact with one another.

- From the structure point of view all ecosystems consist of the following basic components:

    1. Abiotic components

    2. Biotic components

1. Abiotic Components :

Abiotic component of ecosystem includes all the physical and chemical factors that influence living organisms, like air, water, soil, rocks etc. Thus, it is an assemblage of organic and inorganic substances present in an ecosystem. Basic inorganic elements and compounds are soil, water, oxygen, calcium carbonates, phosphates and a variety of organic compounds such as by-products of organic activities. The physical factors and ingredients like moisture, wind currents and solar radiation are also included in abiotic components. The various climatic factors that affect the ecosystem functioning are also a part of this. Without sunlight, water, air and minerals, life cannot exist. Hence the non-living components are essential for the living world.

2. Biotic Components:

The biotic components include all living organisms present in the environmental system. These can be classified as either producers or consumers, depending on how they get their food. From nutrition point of view, the biotic components can be grouped into two basic components:

a. Autotrophic components- The autotrophic components include all green plants which with the help of the radiant energy of sun manufacture food from inorganic substances.

b. Heterotrophic components-The heterotrophic components include non-green plants and all animals which take food from autotrophs.

- Thus biotic components of an ecosystem can be classified as under:

    I. Producers (Autotrophic components)

    II. Consumers

    III. Decomposers or reducers and transformers

I. Producers (Autotrophic elements) :

Producers can make the organic nutrients they need, using simple inorganic compounds in their environment: for instance, the green plants on land and the small algae in aquatic ecosystems produce their food by the process of photosynthesis. For this the radiant energy of sun is used in photosynthetic process whereby carbon dioxide is assimilated and the light energy is converted into chemical energy. Oxygen is evolved as by-product in the photosynthesis and used in respiration by all living things.

II. Consumers :

Those living members of ecosystem which consume the food synthesized by producers are called consumers. Consumers directly or indirectly depend on food provided by producers. All kinds of animals that are found in an ecosystem are called consumers. Depending on their food habits consumers can be further classified into four types such as:

a. Consumers of the first order or primary consumers

b. Consumers of the second order or secondary consumers

c. Consumers of the third order or tertiary consumers and Parasites, scavengers and saprobes.

d. Decomposers and transformers

a. Primary consumers :

These are purely herbivorous animals that are dependent for their food on producers or green plants. In a food chain, herbivores are referred to as the primary consumers. The herbivores serve as the chief food source for carnivores. Insects, goat, cow, rabbit, deer, buffalo are some of the common herbivores in the terrestrial ecosystem, and small crustaceans, molluscs, etc. in the aquatic habitat.

b. Secondary consumers :

These are carnivores and omnivores. Carnivores are flesh eating animals and they feed on herbivores (primary consumers). Examples of carnivores are lions, tigers. Whereas the omnivores are the animals that eat both plants and herbivores, e.g. pigs, rats, cockroaches and humans.

c. Tertiary consumers :

These are the top carnivores which prey upon other carnivores, omnivores and herbivores. Lions, tigers, hawk, vulture, etc. are considered as tertiary or top consumers.

Besides different classes of consumers, the parasites, scavengers and saprobes are also included in the consumers. The parasitic plants and animals utilize the living tissues of different plants and animals. The scavengers and saprobes utilize dead remains of animals and plants as their food.

d. Decomposers and transformers :

Decomposers digest the complex organic molecules in dead organic matter (detritus) into simpler inorganic compounds. They absorb the soluble nutrients as their food. Some examples are bacteria, fungi, and mites. The decomposers and transformers play very important role in maintaining the dynamic nature of ecosystems.

The most important part of each ecosystem is that it will have certain representative organisms playing each of the above mentioned roles.

Function of Ecosystem

Functions of Ecosystem

An ecosystem is a functional and life sustaining environmental system. The technical term 'Ecosystem function' is generally used to define the biological, geochemical and physical processes and components that take place or occur within an ecosystem. In other words it relate to the structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within ecosystems and across ecosystems. Sometimes, ecosystem functions are called ecological processes. An ecosystem is a functional and life sustaining environmental system.

- In an ecosystem there are three functional components.
  1. Inorganic constituents
  2. Organism
  3. Energy input

These three components interact with each other to form an environmental system. The primary producers convert inorganic constituents into organic components by photosynthesis using the energy from the solar radiations. The herbivores make use of the energy from the producers and they themselves serve as a food for the carnivores. Animals of different types accumulate organic matter in their body which is taken as food. They are known as secondary producers. The dead organic matters of plants and animals are decomposed by bacteria and fungi which break the complex molecules and liberate inorganic components. These are known as decomposers. During this process some amount of energy is released in the form of heat. The ecosystem of different habitats is interrelated with one another.

Maintaining ecosystem function is important to maintaining the capacity of the region to supply ecosystem services. Those areas with high ecosystem function have the potential to contribute to a wide range of ecosystem services. But those areas showing few ecosystem functions are also important as they may provide important contributions to specific ecosystem services, or they may be important areas for rehabilitation.

2.3 COMPONENTS OF ECOSYSTEM AND ECOSYSTEM PRODUCTIVITY

Ecological Pyramid Definition

An ecological pyramid is a graphical representation of the relationship between different organisms in an ecosystem. Each of the bars that make up the pyramid represents a different trophic level, and their order, which is based on who eats whom, represents the flow of energy. Energy moves up the pyramid, starting with the primary producers, or autotrophs, such as plants and algae at the very bottom, followed by the primary consumers, which feed on these plants, then secondary consumers, which feed on the primary consumers, and so on. The height of the bars should all be the same, but the width of each bar is based on the quantity of the aspect being measured.

Types of Ecological Pyramids

Pyramid of numbers :

This shows the number of organisms in each trophic level without any consideration for their size. This type of pyramid can be convenient, as counting is often a simple task and can be done over the years to observe the changes in a particular ecosystem. However, some types of organisms are difficult to count, especially when it comes to some juvenile forms. Unit: number of organisms.

Pyramid of biomass :

This indicates the total mass of organisms at each trophic level. Usually, this type of pyramid is largest at the bottom and gets smaller going up, but exceptions do exist. The biomass of one trophic level is calculated by multiplying the number of individuals in the trophic level by the average mass of one individual in a particular area. This type of ecological pyramid solves some problems of the pyramid of numbers, as it shows a more accurate representation of the amount of energy contained in each trophic level, but it has its own limitations. For example, the time of year when the data are gathered is very important, since different species have different breeding seasons. Also, since it's usually impossible to measure the mass of every single organism, only a sample is taken, possibly leading to inaccuracies. Unit: g m-2 or Kg m-2.

Pyramid of productivity :

The pyramid of productivity looks at the total amount of energy present at each trophic level, as well as the loss of energy between trophic levels. Since this type of representation takes into account the fact that the majority of the energy present at one trophic level will not be available for the next one, it is more accurate than the other two pyramids. This idea is based on Lindeman's Ten Percent Law, which states that only about 10%

of the energy in a trophic level will go towards creating biomass. In other words, only about 10% of the energy will go into making tissue, such as stems, leaves, muscles, etc. in the next trophic level. The rest is used in respiration, hunting, and other activities, or is lost to the surroundings as heat. What's interesting, however, is that toxins are passed up the pyramid very efficiently, which means that as we go up the ecological pyramid, the amount of harmful chemicals is more and more concentrated in the organisms' bodies. This is what we call biomagnification.

The pyramid of productivity is the most widely used type of ecological pyramid, and, unlike the two other types, can never be largest at the apex and smallest at the bottom. It's an important type of ecological pyramid because it examines the flow of energy in an ecosystem over time. Unit: J m-2 yr-1, where Joule is the unit for energy, which can be interchanged by other units of energy such as Kilojoule, Kilocalorie, and calorie.

While a productivity pyramid always takes an upright pyramid shape, number pyramids are sometimes inverted, or don't take the shape of an actual pyramid at all. To demonstrate, let's take an oak tree, which can feed millions of oakworms. If we consider this ecosystem as our focus, then the producers' level (one tree) will end up much smaller than the primary consumers' level (millions of insects). This is less likely to occur in biomass pyramids, but is not impossible. The pyramids below show the different types of pyramids and the shapes they can have in different ecosystems.

Ecological Pyramid Examples :

The diagram below is an example of a productivity pyramid, otherwise called an energy pyramid. The sun has been included in this diagram, as it's the main source of all energy, as well the decomposers, like bacteria and fungi, which can acquire nutrients and energy from all trophic levels by breaking down dead or decaying organisms. As shown, the nutrients then go back into the soil and are taken up by plants.

The loss of energy to the surroundings is also shown in this diagram, and the total energy transfer has been calculated. We start off with the total amount of energy that the primary producers contain, which is indicated by 100%. As we go up one level, 90% of that energy is used in ways other than to create flesh. What the primary consumers end up with is just 10% of the starting energy, and, 10% of that 10% is lost in the transfer to the next level. That's 1%, and so on. The predators at the apex, then, will only receive 0.01% of the starting energy! This inefficiency in the system is the reason why productivity pyramids are always upright.

FUNCTION OF ECOSYSTEM: FOOD CHAIN & WEB, ENERGY TRANSFER

Food Chains :

All living organisms (plants and animals) must eat some type of food for survival. Plants make their own food through a process called photosynthesis. Using the energy from the sun, water and carbon dioxide from the atmosphere and nutrients, they chemically make their own food. Since they make or produce their own food they are called producers. Organisms which do not create their own food must eat either plants or animals. They are called consumers. Some animals get their energy from eating plants while other animals get energy indirectly from plants by eating other animals that already ate the plants. Animals that eat only plants are called herbivores. Animals that eat both plants and other animals are called omnivores. Animals that eat only other animals are called carnivores. Some animals eat only dead or decaying materials and are called decomposers. In the marine food web, special producers are found. They are tiny microscopic plants called phytoplankton. Since the water is the home for these special tiny plants; it is also the home for tiny microscopic animals called zooplankton. And of course, zooplankton eat phytoplankton. Sometimes zooplankton and phytoplankton are collectively referred to as plankton. Food chains show the relationships between producers, consumers, and decomposers, showing who eats whom with arrows. The arrows show the movement of energy through the food chain. For example, in the food chain shown below, the small fish (silverside) gets its energy by eating the plankton and the large fish (bluefish) gets its energy by eating the small fish. Finally, the bacteria eats the fish after it dies, getting its energy from the large fish. The bacteria also returns nutrients back to the environment for use by the phytoplankton.

Thus the food chain becomes a complete circle. Animals may eat more than one type of food. They may eat many different types of plants or many different animals. This makes everything more complicated and the food chain becomes a food web.

Food Webs :

A food web is made up of interconnected food chains. Most communities include various populations of producer organisms which are eaten by any number of consumer populations. The green crab, for example, is a consumer as well as a decomposer. The crab will eat dead things or living things if it can catch them. A secondary consumer may also eat any number of primary consumers or producers. This non-linear set of interactions which shows the complex flow of energy in nature is more easily visualized in the following diagram. In a food web nutrients are recycled in the end by decomposers. Animals like shrimp and crabs can break the materials down to detritus. Then bacteria reduce the detritus to nutrients. Decomposers work at every level, setting free nutrients that form an essential part of the total food web.

ENERGY LOSS IN THE FOOD CHAIN AND FOOD WEB

In a food chain, energy is lost in each step of the chain in two forms: first by the organism producing heat and doing work, and second, by the food that is not completely digested or absorbed. Therefore, the food web depends on a constant supply of energy from producers and nutrients that are recycled by the decomposition of organisms. As food is passed along the food chain, only about 10% of the energy is transferred to the next level. For example, 10% of the energy phytoplankton received from the sun can be used by zooplankton at the next level. From one level to the next about 90% of the energy used by the previous level is lost. This means that there has to be a lot more organisms at the lower levels than at the upper levels. The number of organisms at each level makes a pyramid shape and is called a food pyramid. To better understand this energy loss, it is helpful to look at a food pyramid.

Energy Transfer :

Energy is transferred between organisms in food webs from producers to consumers. The energy is used by organisms to carry out complex tasks. The vast majority of energy that exists in food webs originates from the sun and is converted (transformed) into chemical energy by the process of photosynthesis in plants.

TYPES OF ECOSYSTEM :

There are many types of ecosystems and it is not possible to classify all of them. There are essentially two kinds of ecosystems; Aquatic and Terrestrial. Any other sub-ecosystem falls under one of these two headings.

2.3.1 Forest Ecosystem

Large group of trees shrubs, the leaf mulch on the floor and the plants that live in tandem with the trees belong to the forest ecosystem. It also includes the animals that live in the forest. For example, birds nest in the trees of a forest, members of the fungus kingdom grow on the forest floor, and a variety of insects and mammals also take up their homes in a forest. Thus a forest ecosystem is a community of organisms that lives within a forest. Forest ecosystems are very important as they are the lungs of the world. The forests release oxygen. Forest ecosystems are very rich and diverse.

There are various types of forest ecosystem throughout the world. Types of forest ecosystem are as follows:

i. Rainforests:

Rainforests is one of the most biodiverse ecosystems on the planet. Rainforests are often based around rivers. Amazon is an important example. The north-eastern part of India is rich in rainforests.

ii. Mangroves:

Mangroves are a unique mix of trees and tidal swamps.

iii. Inland forests:

Innumerable mainland animals and birds like foxes and owls are found in Inland forests which may be vast and ancient, or smaller like copses.

iv. The Taiga:

The taiga is the name for the sparse forest right towards the polar regions of the world.

v. Lakeside forests:

Lakeside forest ecosystems are very humid. Water birds and other water wildlife can be found here.

vi. Mountain forests:

The forests that grow on mountains like mountain pines create Mountain forests ecosystems like the Himalayan mountain forests in India.

- Characteristics of forest ecosystem are discussed below.

    a. Seasonality: In countries that have seasonal climates, forest ecosystems will change with the seasons.

    b. Deciduous or evergreen: A forest may be deciduous or evergreen, or it may be a mix of both deciduous and evergreen trees.

    c. Different levels: Some forest ecosystems feature several distinct levels – such as the forest floor, the lower canopy, the upper canopy and the tree tops, such as rain forests.

    d. Attractive to birds and insects: as they make their homes in forests.

    e. Homes for humans.

    f. Protect the Earth from desertification by providing a shield against winds.

2.3.2 Grassland ecosystems

The grassland ecosystems are composed largely of wide swathes of grass rather than trees or shrubs. A grassland ecosystem is a community of creatures such as various types of grasses, insects, and animals, etc. living together within a grassy space. Grassland ecosystems are extremely bio-diverse and are home to thriving communities of plants, animals, insects and mammals. Grassland ecosystems are present in every single continent on this planet with the sole exception of Antarctica, which is too cold to sustain a grassland ecosystem.

- Grassland ecosystems can be found throughout the world, for example:

a. In the tropics near to the equator.

b. In the temperate zones of the earth, between the equator and the polar Regions.

Grassland ecosystems are found in many shapes and sizes. However, climate change, intensive farming and urban sprawl are all threatening our beautiful grassland ecosystems.

2.3.3 Desert ecosystem

A desert is a place that is difficult to inhabit. A desert ecosystem is a community of organisms that live together in an environment that seems to be deserted wasteland. Desert ecosystems can be hot as found in the sandy Sahara or cold as on the peaks of mountains. Both in hot and cold deserts it is difficult for organisms to inhabit. A desert ecosystem generally witnesses little rainfall, resulting in less vegetation.

- In a desert ecosystem following things may be observed.

i. Numerous insects living in communities.

ii. An abundance of plant life.

iii. Mammals and birds.

iv. Micro organisms such as bacteria are also present in this ecosystem.

- There are so many different types of desert ecosystems. Types of desert ecosystems are stated under.

1. Hot deserts :

Hot deserts, for example Sahara, are found close to the equator. The plants and animals that live here have evolved in order to adapt to very hot conditions present over there.

2. Cold deserts :

When desertification exists at high altitudes the desert will be cold. A cold desert may be sandy or rocky. Here organisms have adapted the harsh environment to survive.

3. Ice deserts :

Ice deserts are another type of cold desert. This is an uninhabited region that is composed of ice. Ice deserts can be found towards the north and south poles of the planet.

2.3.4. Freshwater Ecosystems

Freshwater ecosystems are a subset of Earth's aquatic ecosystems. They include lakes and ponds, rivers, streams, springs, and wetlands.

- Freshwater ecosystems include:

a. sluggish waters of lakes and ponds

b. moving waters of rivers and streams

c. Wetlands which are the areas of land periodically covered by water.

a. Ponds and Lakes Ecosystems – Lakes are large bodies of freshwater surrounded by land, while ponds are smaller bodies of water surrounded by land. Lake Baikal is the biggest lake on Earth and contains about one fifth of the Earth's freshwater. Most of the time they include various types of plants, amphibians and insects and fishes.

b. River Ecosystems – Rivers always link to the sea so they are more likely to contain fish alongside the usual plants, amphibians and insects. These sorts of ecosystems can also include birds because birds often hunt in and around water for small fish or insects.

- There are 3 main groups of organisms in the freshwater ecosystem:

i. Plankton - organisms that float near the surface of the water

ii. Nekton – free-swimming organisms

iii. Benthos – bottom-dwelling organisms

Freshwater ecosystems are the smallest of the three major classes of ecosystems, accounting for just 1.8% of the total of the Earth's surface. The smallest living part of the food web of these sorts of ecosystems is plankton, a small organism that is often eaten by fish and other small creatures.

Marine Ecosystem

Earth's largest aquatic ecosystems are the Marine ecosystems. Salt marshes, intertidal zones, estuaries, lagoons, mangroves, coral reefs, the deep sea, and the sea floor are included in the Marine ecosystems. They can be contrasted with freshwater ecosystems, which have a lower salt content. Marine waters cover two-thirds of the surface of the Earth and it is the complex of living organisms in the ocean environment. Moreover such places are considered ecosystems because the plant life supports the animal life and vice versa. Marine organisms are not distributed evenly throughout the oceans. The availability of light, water depth, proximity to land, and topographic complexity all affect marine habitats.

2.4 BIOSPHERE : CONCEPT, MEANING AND COMPONENTS

What is Biosphere?

The Biosphere includes all the living components of the Earth. It consists of all plants and animals, including all the micro Organisms that live on Earth and their interactions with the surrounding environment.

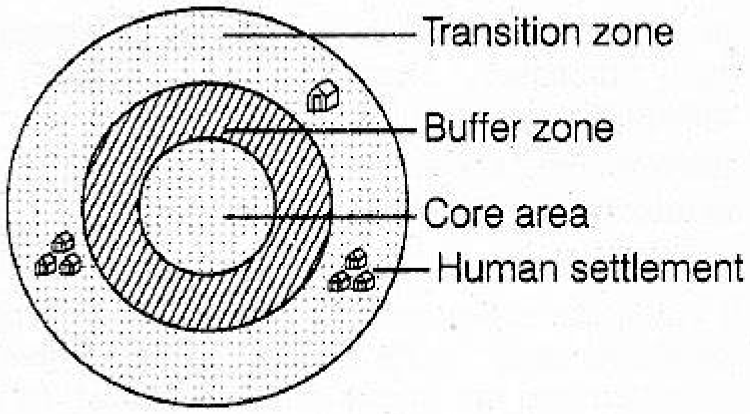
Most of the organisms exist in the lithosphere, the hydrosphere, and the atmosphere. Many organisms move freely from one realm to the other. All these together constitute the Biosphere.

What is Biosphere Conservation?

Since 1986, the Government of India has been implementing a programme known as Biosphere Reserve, which provides financial assistance in the proportions of 90:10 to the Northeastern Region States and three Himalayan states and 60:40 to other states for the upkeep, improvement, and advancement of certain components. The Central MAB Committee reviews and approves the Management Action Plan drafted by the State Government.

Zoning Schemes of Biosphere:

The zonation of each biosphere reserve in India or any other Biosphere reserve should include:



Zonation in terrestrial biosphere

Core area

Human interference in the core area is restricted.

The core area of Biosphere Reserves generally consists of national parks and sanctuaries protected under the wildlife protection act 1972.

Core areas of the biosphere reserve are securely protected sites for conserving biological diversity. Monitoring these minimally disturbed ecosystems and undertaking non-destructive research and other low-impact uses such as education.

In addition to its conservation function, the core area of the reserves contributes to a range of ecosystem services, e.g. carbon sequestration, supply of clean water and air, soil stabilization.

Buffer zone

Buffer zone generally surrounds or adjoins the core regions and can be used for activities compatible with sound environmental practices, such as environmental education, recreation, Ecotourism applied and basic research.

The buffer zone of the biosphere reserve also has a critical connectivity function in a larger spatial context as they connect biodiversity components within core areas with those in transition areas.

Buffer zones also have intrinsic functions of maintaining anthropogenic, biological, and cultural diversity in the biosphere reserves.

Transition area

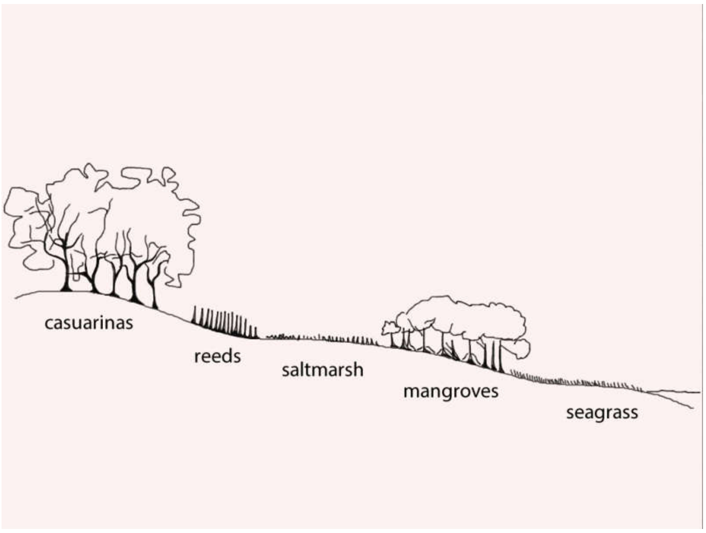
It is the outermost area of the Biosphere Reserves.

Transition Area plays a central function in sustainable development. Transition Areas may contain a variety of agricultural activities, settlements, and other uses.

Local communities, management agencies, scientists, NGOs, cultural groups, and other stakeholders work together to manage and sustainably develop the area's resources.

2.5 BIOGEOGRAPHIC PROCESSES

Biologists and geographers come to biogeography from a broad range of fi elds, naturally bringing with them discipline-specifi c methods, assumptions, and goals, plus language, usually in the form of jargon. Systematists have applied cladistics, one method used to discover phy-logenetic relationships among organisms, to analyses of area relation-ships using an array of methods, called by a variety of names: vicariance biogeography, cladistic biogeography, historical biogeography, phyloge-netic biogeography, phylogeography, and comparative phylogeography, among others. Other systematists, in contrast, document and interpret distribution patterns without relying necessarily on cladistic hypotheses, particularly in panbiogeography, although these systematists rely.



(BIOGEOGRAPHIC PROCESSES)

invasion: when a species establishes itself in area that it was not found previously.

modification: the change which takes place to an ecosystem as a result of the decline and increase of species and the introduction of new species.

succession: the change of species structure of an ecosystem over time.

A stable ecosystem that is functioning effectively and has a high level of biodiversity could be said to be a climax community. This is an ecosystem in its ideal state. The ecosystem is in stable equilibrium. This might mean that even if there are small changes in the composition and number of species, the ecosystem will continue to function more or less the same. When ecosystems are disturbed or disrupted they are said to be in disequilibrium. This means that the ecosystem will change in an attempt to achieve the most ideal functioning. This process of change involves the process of invasion, modification and succession.

Intertidal wetlands provide an excellent example of invasion, modification and succession.

Succession is a cumulative (build up of) change in the types of plants that occupy in a particular place over time. Succession is a process of change. There are a series of associated processes: colonisation, establishments and extinction.

Colonisation is when a species spreads into new areas. It is also called immigration.

Establishment refers to when a species becomes part of an ecosystem on a permanent basis.

Extinction refers to the end of an organism or a group of organism. When a species "dies out".

For succession to occur there usually has to be some kind of disturbance in the environment. This disturbance will wipe out the majority of vegetation in an area. A typical disturbance could be fire, logging or disease (these may be relevant for mangroves) or severe flooding, pest infestation, or climate change (these might be relevant for sea grasses). The disturbance is a catalyst for change (this means it causes the change).

2.6 SUMMARY

The environment is the source of life on the earth and determines the existence, growth and development of mankind and all its activities. The interaction of humans with the environment (surroundings) in these locations has often brought major changes in that environment. Some changes were good, some were bad. The environment is a complex of many variables which surrounds man as well as all living organisms. The environment is complex, dynamic and systematic in nature. The biotic components and abiotic components together make up the environments. There exists man made environment that is helping man to lead a smooth life.

Environmental geography is broadly experiential so students have more of a diverse learning experience. It will also help the students to understand human behaviour and the extent to which this behaviour differs in regards to the environment. Thus they will develop cultural awareness. No matter how modern and manufactured world we live in mankind will forever rely on the environment.

The term ecosystem was coined by A.G. Tansley in 1935, who defined it as "the system resulting from the integration of all the living and non-living factors of the environment". Ecosystems maintain themselves by cycling energy and nutrients obtained from external sources. There are different trophic levels that exist in an ecosystem. The ecosystem of different habitats is interrelated with one another. Important differences among the various components that make up an ecosystem like of Forest, grasslands, Desert, Fresh water and Marine tell us that ecosystems are not just habitats for animals. Many human communities live in there all over the world.

2.7 EXERCISE

1. Explain the types of ecosystems.
2. Discuss the concept of the Biosphere and explain the zones of the Biosphere.
3. Discuss in detail the process of Biogeographic.
4. Explain the components of the Ecosystem.

❖❖❖❖

3

PLANT COMMUNITY

Unit Structure :

5.0 OBJECTIVE

1. Understand the Concept of plant community and Classification of Plants.
2. know the Biotic succession and climax vegetation.
3. Learn about the Major plant formation and biomes- Tropical.
4. Understand the Major plant formation and biomes- Temperate.

5.1 INTRODUCTION

The association or group of plant communities of any region is called vegetation. In other words, 'all the plants which grow together in any area form its vegetation, the character of which depends not just on the different species present but on the relative propor-tions in which their members are represented'. For example, two habitats may have similar floras but their vegetation may vary from one another and two habitats having different floras may have similar vegetation.

For instance, if there are two simi-lar habitats wherein both have grasses and sal trees but there is overwhelming dominance of grasses and sparse distribution of sal trees in the first habitat whereas the second habitat is characterized by dense sal trees and sparse distribution of grasses, the vegetation of the first habitat will be grasses whereas the vegetation of the second habitat will be sal forest.

3.2 CONCEPT OF PLANT COMMUNITY AND CLASSIFICATION OF PLANTS

Meaning and concept of plant community:

The group or association of plants growing together in a particular habitat is called plant commu-nity. In other words, 'those plants which grow together in a particular habitat are referred to as a plant commu-nity, by which something more than a mere collection or assemblage is implied'.

'A group of populations of different species living in the same local areas and interacting with one another is called ecologi-cal community Plants play very dominant role in the biosphere because these are primary producers in the biosphere and provide directly or indirectly food to all terrestrial and aquatic animals including man. The social group-ings of plant species are called plant community of which plant is the fundamental basic unit. Plants directly receive and trap solar energy (light energy) and prepare their own food with the help of sunlight through the process of photosynthesis.

Thus, solar energy converted into the food or chemical energy is transferred to differ-ent animals and micro-organisms through different trophic levels of food chain. Thus, plants are intermediary between biotic and abiotic components of the environment/ecosystems/biosphere. On the basis of importance and dominant role of plants in the biosphere the study of plants is given more significance.The study of plants has been developed as an important branch of geography which is called as plant geography which includes the study of classification of plants, their spa-tial distribution, origin and development, dispersal and extinction and functions.

The main functions of plants are to trap solar energy and prepare their food with the help of photosynthesis and to circulate and transfer energy and nutrients among the organisms of different trophic levels of the food chain.

CLASSIFICATION OFPLANTS

Annuals :

Annuals are plants that complete their life cycle in one year. They germinate, grow, bear fruits and die off within an year. Generally, all herbs and plants belonging to the grass family exhibit this type of life cycle. Mustard, watermelon, corn, lettuce wheat, are a few examples of annual plants.

Lifespan of Rice Plant :

Rice is a type of grass and is the staple food for millions of people across the world. It is an annual crop with an average lifespan of 4 – 8 months. It goes through three main stages before it is harvested – vegetative stage, reproductive stage and ripening stage.

Biennials :

Biennials are plants that complete their life cycle in two years. They germinate, develop a root system, stem and leaves in the first year. Later in their second year, they yield flowers and bear fruit. A few herbs are also classified as biennials, including spinach. Along with spinach and other herbs, biennials also include carrot, cabbage, petunias radish, onions, etc.

Perennials :

Perennials are plants which complete their life cycle in more than two years. Once they grow, they start to bear flowers, produce fruits, seeds and the cycle continues for a longer period of time. They do not die after bearing fruits but renew their parts, season after season. Along with a few shrubs, trees are all classified into perennials. For Eg., tomatoes, ginger, banana, mango, coconut, palm, banyan, etc.

3.3 BIOTIC SUCCESSION AND CLIMAX VEGETATION

1. Primary Biotic Succession:

Primary succession refers to developmental se-quence of vegetation in those bare areas where there were no vegetation and animals earlier. Such areas or sites may be newly emerged sea floor, cooled and solidified basaltic surfaces due to recent lava flows, exposed lake bed due to drying of water, newly formed sand dunes, flood plains formed by recent alluvia, heaps of debris accumulated by man, the areas of exposed rocks due to melting of ice from the glacial areas, etc.

The initial sites for the primary successional development of vegetation may be of various types having varying environmental conditions as referred to above but for convenience such site is being selected which is of bare rock surface and does not have any earlier vegetation for the explanation of primary suc-cession of vegetation.

Thus, primary succession of vegetation on a bare rock surface having no prior vegetation and animals starts and is completed through the following stages:

(i) The initial plant-free site has relatively dry environment. It does not mean that the climate of this site is dry because the rocks of the concerned site are bare and are devoid of any plant and therefore the environment becomes relatively dry due to excessive evaporation though the climate may be even humid.

    The pioneer plants are established upon the bare rocks of the initial plant-free site. The initial pioneer plants include mainly algae and lichens because they easily stick to the bare rocks and can easily adapt to the environmental conditions of the initial sites whether these may be hot, dry or cold.

(ii) Dust particles blown by wind settle down in the concerned habitat. These dust particles are gradu-ally deposited around algae and lichens. Some of the lichens secrete acids which react with the minerals of the rocks of that habitat resulting into dissolution of some minerals. This process starts the process of pedogenesis (soil-forming processes) and thin veneer of soil is formed in due course of time. The soil zone, though very thin in the beginning, is colonized by micro-organisms.

(iii) The formation of soils through rock weath-ering and soil-organisms continues and the thickness of soils continues to increase with time. Consequently, a few soil-living animals like mites, ants, spiders etc. are evolved. This 'sere' of successional development of plant community is characterized by more soil-living organisms, sporadic plants and wide open areas devoid of any plant. This type of plant community is called open community or pioneer community.

(iv) Secondary community of mosses replaces the pioneer community of algae and lichens in due course of time. The mosses spread over the soils like thin sheets and thus soils are covered by the mosses. Consequently, the moisture content of the soils is increased because the moss-cover retards evaporation.

New dense matting of mosses also provides organic matter to the soils and thus the soils are enriched by the addition of organic nutrients. Gradually and gradually seasonal and perennial grasses are developed along with new groups of animals like nematodes, spring-tails etc. which are able to obtain their food from the seasonal and perennial grasses.

The gradual develop-ment of grasses covers the whole area of the concerned habitat and thus is developed a dense vegetation cover which changes and modifies the micro-climates of the concerned habitat. The dense vegetation cover de-creases ground temperature and sunlight at the ground surface but increases moisture content of the soils because evaporation of moisture from the soil surface is effectively decreased due to shade provided by dense vegetation cover.

The open community is now changed to closed community (which means that no part of the concerned habitat remains without vegetation, in other words, whole area of the habitat is covered with vegetation). This is possible only when the environ-ment of the concerned habitat is wet but if the environ-ment of the concerned habitat is dry and the surface is of sandy desert, much area is still open and devoid of vegetation.

(v) After the development of sere of closed community there begins the competition among the plants for space, sunlight, water and nutrients.

There may be two alternative routes of competition among the plants e.g.:

(a) If the plants of the concerned habitat are of the same species, there is competition for the aforesaid elements among the different members of the same species and only the fittest plants survive during the competition. Thus, the principle of survival of the fittest becomes effective in the community develop-ment of plants. Such competition is called intraspecific competition which means survival of the strongest plants and elimination of weaker plants but the preser-vation of species is maintained.

(b) If there are more than one species in the concerned habitat, competition for getting space, sunlight, water and nutrients takes place among the individuals of different species wherein the strongest and most aggressive species establish dominance over the entire vegetation community.

But if all the species of the concerned habitat are equally powerful, there is maintained a balance of power among different species inspite of competition and the result is that all species are preserved and maintained. Such competition is called interspecific competition. This phase (sere) of community development is domi-nated by herbaceous plants and thus by herb commu-nity.

(vi) With the march of time there is developed large shrubs in the concerned habitat and the herb community is dominated and replaced by scrub com-munity. At this stage a very significant development takes place in that the seeds of flowering plants (phanerogams) are brought from the neighbouring areas to the concerned habitat by winds and given birth to trees in the otherwise shrub-dominated habitat.

The canopy of these scattered trees is much higher than the stratum of shrubs. Thus, the vegetation community upto this stage (sere) is mixed with lichens, mosses, grasses, shrubs and trees. This is called forest commu-nity and the sere of this successional development of vegetation community is called preclimax.

(vii) The final stage or 'sere' of the successional development of vegetation community is character-ized by the development of giant and very tall trees; the density of which increases rapidly and the whole of the concerned habitat is covered with dense and tall trees.

The roots of such tall trees penetrate far deeper in the ground. The soil zone attains its maximum depth and different horizons of the soil profiles are well devel-oped. The soil zones are colonized by various micro-organisms which decompose the organic matter and help in the process of energy transfer.

The vertical stratification of plant community is well developed. This final phase or 'sere' of the successional develop-ment of vegetation community is called climax commu-nity, climax succession, climatic climax vegetation etc. which represents mature ecosystem.

2. Secondary Biotic Succession :

Secondary succession refers to the develop-mental sequences of vegetation in those areas which had vegetation cover earlier but now have been ren-dered nude or bare due to destruction of vegetation (either partly or completely) either by natural proc-esses (like lava flow, prolonged drought, glaciation, natural widespread forest fires through lightning, se-vere storms, catastrophic floods etc.) or by human interferences (like intentional burning of vegetation, massive land use changes, mass felling of tress and overgrazing etc.).

It may be pointed out that such disturbed ecosystems or habitats still contain mature soils and some original vegetation and therefore the initial stage or sere of secondary succession of plant community is quite different from the initial stage or 'sere' of primary succession which starts on a bare rocky surface, having no earlier plants and animals.

The total time required for the development of climax vegetation or climax succession in the secondary succes-sion is much less than the time taken for the develop-ment of primary succession.

An example of secondary succession may be given from the hill areas of north-east India where jhuming or shifting cultivation is a common practice. Under this cultivation, first forest is cleared from small areas through burning and then the soil is cultivated for agricultural crops for a few years. When the soil loses its fertility, that area is left out and new areas are cleared of vegetation for cultivation.

The abandoned area or the old clearance is again colonized by vegeta-tion through various stages and it attains climax veg-etation or climax succession in a short period of time (a few years), because the sequence of secondary succes-sion is more rapid than the primary succession due to availability of mature soils.

When the vegetation community of any region is disturbed before reaching its climax sere by human interferences (through slow but long-term activities like deforestation or burning of vegetation etc.), the resultant vegetation is called sub-climax vegetation.

When the disturbances in the successional develop-ment of vegetation continue for long time, stages of normal sere of the development of vegetation do not take place but these 'sere' are deflected by those factors which bring in disturbances in the successional development of vegetation. The vegetation developed during the deflected sere persists so long as the factors responsible for the disturbance remain active. Such deflected climax is called plagioclimax and its various stages are called plagio sere.

After some time if the factors causing disturbances in the successional devel-opment of vegetation community cease to operate or become ineffective, then the environmental conditions of the concerned site or habitat are changed, with the result new environmental conditions of the habitat are unable to support and preserve the plagioclimax veg-etation. Thus, new vegetation develops under new changed environmental conditions in place of plagioclimax vegetation and the successional develop-ment of vegetation community takes place under nor-mal sere.

3.4 MAJOR PLANT FORMATION AND BIOMES - TROPICAL

What is Biome?

The definition of a biome is best explained as a collection of all the plants and animals living in an environment that shares common characteristics. Biomes, however, not only include only plants and animals. They can also be defined in terms of microorganisms as well. The term used for microorganisms is the microbiome. For microorganisms, the area considered need not be as large as that considered for plants and animals. They can be defined on a much lesser scale. For example, the term 'human microbiome' refers to all bacteria, viruses, parasites, fungi, and other microorganisms living inside the human body.

A biota is defined as the complete collection of all the organisms living in a geographical region or a defined time scale. The scale of the region or the time considered can be as small as a local region or instantaneous time scales. It can also be as large as the whole planet or complete span of life on earth. All the biotas living on the earth build up the earth's biosphere.

Tropical Rain Biomes/ Forest:

Tropical rain forests are home to more species than all other land biomes combined. The leafy tops of tall trees – extending up to 70 meters above the forest floor – form a dense covering called a canopy. In the shade below the canopy, a second layer of shorter trees and vines forms an understory. Organic matter that falls to the forest floor quickly decomposes and the nutrients are recycled.

- **Abiotic factors:** hot and wet year-round; thin, nutrient-poor soils
- **Dominant plants:** broad-leaved evergreen trees; ferns; large woody vines and climbing plants; orchids and bromeliads
- **Dominant wildlife**: herbivores such as sloths, tapirs, and capybaras; predators such as jaguars; anteaters; monkeys; birds such as toucans, parrots, and parakeets; insects such as butterflies, ants, and beetles; piranhas and other freshwater fishes; reptiles such as frogs, Caymans, boa constrictors, and anacondas
- Geographic distribution: parts of South and Central America, Southeast Asia, parts of Africa, southern India, and northeaster Australia

Tropical Dry Biomes / Forest:

Tropical dry forests grow in places where rainfall is highly seasonal rather than year-round. During the dry season, nearly all the trees drop their leaves to conserve water. A tree that sheds its leaves during a particular season each year is called deciduous.

- **Abiotic factors:** generally warm year-round; alternating wet and dry seasons; rich soils subject to erosion • Dominant plants: tall, deciduous trees that form a dense canopy during the wet season; drought-tolerant orchids and bromeliads; aloes and other succulents
- **Dominant wildlife:** tigers; monkeys; herbivores such as elephants, Indian rhinoceros, hog deer; birds such as great pied hornbill, pied harrier, and spot-billed pelican; insects such as termites; reptiles such as snakes and monitor lizards
- **Geographic distribution:** parts of Africa, South and Central America, Mexico, India, Australia, and tropical islands.

Tropical Savanna Biomes :

Receives more seasonal rainfall than deserts but less than tropical dry forests, tropical savannas, or grasslands, are characterized by a cover of grasses. Savannas are spotted with isolated trees and small groves of trees and shrubs. Compact soils, fairly frequent fires, and the action of large animals such as rhinoceros prevent some savanna areas from turning into dry forests

- **Abiotic factors:** warm temperatures; seasonal rainfall; compact soil; frequent fires set by lightning • Dominant plants: tall, perennial grasses; sometimes drought-tolerant and fireresistant trees or shrubs
- **Dominant wildlife**: predators such as lions, leopards, cheetahs, hyenas, and jackals; aardvarks; herbivores such as elephants, giraffes, antelopes, and zebras; baboons; birds such as eagles, ostriches, weaver birds, and storks; insects such as termites
- **Geographic distribution:** large parts of eastern Africa, southern Brazil, northern Australia

Desert Biomes :

All deserts are dry –- in fact, a desert biome is defined as having annual precipitation of less than 25 centimetres. Beyond that, deserts vary greatly, depending on elevation and latitude. Many undergo extreme temperature changes during the course of a day, alternating between hot and cold. The organisms in this biome can tolerate extreme conditions.

- **Abiotic factors:** low precipitation, variable temperatures; soils rich in minerals but poor in organic material

- **Dominant plants:** cacti and other succulents; creosote bush and other plants with short growth cycles
- **Dominant wildlife:** predators such as mountain lions, grey foxes, and bobcats; herbivores such as mule deer, pronghorn antelope, desert bighorn sheep, and kangaroo rats; bats; birds such as owls, hawks, and roadrunners; insects such as ants, beetles, butterflies, flies, and wasps; reptiles such as tortoises, rattlesnakes, and lizards
- **Geographic distribution:** Africa, Asia, the Middle East, the United States, Mexico, South America, and Australia

3.5 MAJOR PLANT FORMATION AND BIOMES - TEMPERATE

The term Biome was first used by Frederic E. Clements to represent plants and animals of a given region or habitat.

Over time, scientists expanded and refined the definition of biomes and related different concepts in new areas of ecology, and in 1963 Shelford characterized the following biomes: tundra, coniferous forest, Deciduous forests, grasslands, deserts. Later, ecologist Arthur Tansley created another definition of the ecosystem, including biological processes, rather than the definition of biome.

Common to all biome definitions is that biomes are distinguishable according to the organisms and climate in which they live and that the organisms within the biome share an adaptation to this particular environment. Climate is one of the important factors that determines which organisms can be found in which biome, and the factors that affect climate are Latitude, geographic features, and atmospheric processes that diffuse heat and humidity.

Temperate Grassland Biomes:

Characterized by a rich mix of grasses and underlaid by some of the world's most fertile soils, temperate grasslands – such as plains and prairies – once covered vast areas of the midwestern United States. Since the development of the steel plough, however, most have been converted to agricultural fields. Periodic fires and heavy grazing by large herbivores maintain the characteristic plant community.

- **Abiotic factors:** warm to hot summers; cold winters; moderate, seasonal precipitation; fertile soils; occasional fires
- **Dominant plants:** lush, perennial grasses and herbs; most are resistant to drought, fire, and cold • Dominant wildlife: predators such as coyotes and badgers -- historically included wolves and grizzly bears; herbivores such as mule deer, pronghorn antelope, rabbits, prairie dogs, and introduced cattle -- historically included bison; birds such as hawks, owls, bobwhite, prairie chicken, mountain plover; reptiles such as snakes; insects such as ants and grasshoppers.

- **Geographic distribution:** central Asia, North America, Australia, central Europe, and upland plateaus of South America.

Temperate Woodland and Shrubland Biomes:

This biome is characterized by a semiarid climate and a mix of shrub communities and open woodlands. In the open woodlands, large areas of grasses and wildflowers such as poppies are interspersed with oak trees. Communities that are dominated by shrubs are also known as chaparral. The growth of dense, low plants that contain flammable oils makes fires a constant threat.

- **Abiotic factors:** hot, dry summers; cool, moist winters; thin, nutrient-poor soils; periodic fires
- **Dominant plants:** woody evergreen shrubs with small, leathery leaves; fragrant, oily herbs that grow during winter and die in summer
- **Dominant wildlife:** predators such as coyotes, foxes, bobcats, and mountain lions; herbivores such as blacktailed deer, rabbits, squirrels, and mice; birds such as hawks, California quail, western scrub jay, warblers and other songbirds; reptiles such as lizards and snakes; butterflies; spiders
- **Geographic distribution:** western coasts of North and South America, areas around the Mediterranean Sea, South Africa, and Australia

Temperate Forest biomes

Temperate forests contain a mixture of deciduous and coniferous trees. Coniferous trees, or conifers, produce seed-bearing cones and most have leaves shaped like needles. These forests have cold winters that halt plant growth for several months. In autumn, the deciduous trees shed their leaves. In the spring, small plants burst out of the ground and flower. Soils of temperate forests are often rich in humus , a material formed from decaying leaves and other organic matter that makes stheoil fertile.

- **Abiotic factors:** cold to moderate winters; warm summers; year-round precipitation; fertile soils
- **Dominant plants**: broadleaf deciduous trees; some conifers; flowering shrubs; herbs; a ground layer of mosses and ferns
- **Dominant wildlife:** Deer; black bears; bobcats; nut and acorn feeders, such as squirrels; omnivores such as raccoons and skunks; numerous songbirds; turkeys
- **Geographic distribution:** eastern United States; southeaster Canada; most of Europe; and parts of Japan, China, and Australia

Tundra Biomes

The tundra is characterized by permafrost, a layer of permanently frozen subsoil. During the short, cool summer, the ground thaws to a depth of a few centimetres and becomes soggy and wet. In winter, the topsoil freezes again. This cycle of thawing and freezing, which rips and crushes plant roots, is one reason that tundra plants are small and stunted. Cold temperatures, high winds; the short growing season, and humus-poor soils also limit plant height

- **Abiotic factors:** strong winds; low precipitation; short and soggy summers; long, cold, and dark winters;. poorly developed soils; permafrost
- **Dominant plants:** ground-hugging plants such as mosses, lichens, sedges, and short grasses • **Dominant wildlife:** a few resident birds and mammals that can withstand the harsh conditions; migratory waterfowl, shore birds, musk ox, Arctic foxes, and caribou; lemmings and other small rodents
- **Geographic distribution**: northern North America, Asia, and Europe

3.6 SUMMARY

The main functions of plants are to trap solar energy and prepare their food with the help of photosynthesis and to circulate and transfer energy and nutrients among the organisms of different trophic levels of the food chain.Over time, scientists expanded and refined the definition of biomes and related different concepts in new areas of ecology, and in 1963 Shelford characterized the following biomes: tundra, coniferous forest, Deciduous forests, grasslands, deserts. Later, ecologist Arthur Tansley created another definition of the ecosystem, including biological processes, rather than the definition of biome.A biota is defined as the complete collection of all the organisms living in a geographical region or a defined time scale. The scale of the region or the time considered can be as small as a local region or instantaneous time scales. It can also be as large as the whole planet or complete span of life on earth. All the biotas living on the earth build up the earth's biosphere.human interferences (through slow but long-term activities like deforestation or burning of vegetation etc.), the resultant vegetation is called sub-climax vegetation.

When the disturbances in the successional develop-ment of vegetation continue for long time, stages of normal sere of the development of vegetation do not take place but these ‘sere’ are deflected by those factors which bring in disturbances in the successional development of vegetation. The vegetation developed during the deflected sere persists so long as the factors responsible for the disturbance remain active. Such deflected climax is called plagioclimax and its various stages are called plagio sere.

3.7 EXERCISE

1. Discuss in details of classification of plant community.
2. Explain the Biotic succession and climax vegetation.
3. What are the Biomes? Explain the Tropical Biomes.
4. What are the Biomes? Explain the Temperate Biomes.

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4

MARINE BIOGEOGRAPHY

Unit Structure :

4.0 OBJECTIVE

1. Understand the Marine Biogeography Meaning and concept

2. know the Types of ocean habitats

3. Learn about the Biogeography of estuaries

4. Understand the Island biogeography

4.1 INTRUDUCTION

Biogeographic provinces, based on distinct floras and faunas, have been recognized for over 150 years (Forbes,1859). These provinces represent parts of the world that host unique biotas, both areas of recent evolutionary innovation and refuges of ancient lineages that persist today. Although impenetrable barriers are relatively uncommon in the sea, boundaries between these provinces are frequently associated with continents, sharp ecological gradients, or vast expanses of open ocean. Three observations by Forbes (1859) still guide the field of marine biogeography today: (1) each zoo-geographic province is an area where new lineages arise and tend to mix with emigrants from other provinces; (2) each species is created only once and individuals tend to expand their range from their place of origin; and (3) to be under-stood, provinces, like species, must be traced back to their origin in the past. The first global characterization of marine biogeographic provinces was compiled in the pioneering volume Stereography des Meres (Ekman, 1935), later updated and translated into Zoogeography of the Sea (Ekman, 1953).Therein, Sven Ekman described a series of large regions and subregions, in-clouding the continental shelf, tropical, temperate, and polar waters, their separation by zoogeographic barriers, and their endemism. Briggs (1974) divided the continental shelves into series of large biogeographic regions that, in turn, contained smaller biogeographic provinces, each defined on the basis of endemism. This work established the now-accepted practice oldening biogeographic provinces on the basis of 10% endemism at the species level within published species inventories, most frequently fishes or well-known invertebrate groups such as molluscs. A central theme was that the greater the proportion of endemic biota, the greater the evolutionarysignificance of the province (Briggs, 1974).Marine biogeography has seen a recent revaluationin the face of considerable research over the past few decades.

4.2 MARINE BIOGEOGRAPHY MEANING AND CONCEPT

Marine biogeography is the study of marine species, the geographic distribution of their habitats, and the relationships between living organisms and the environment. Creating a habitat ecosystem map of the seafloor—a key component of marine biogeography—is a tricky process.

Marine biogeography is a subfield of the biogeography aimed at understanding the patterns and processes governing the distribution of marine taxa at geographic scales. Marine biogeography is related to several disciplines and subdisciplines, including marine biology and ecology, physical and biological oceanography, ecophysiology, genetics, geography, geology, paleontology, and macroecology. Several subdisciplines have been proposed from the intersection with these branches, alluding to the subject of study (e.g., phytogeography and zoogeography), the temporal scale of driving processes (e.g., ecological biogeography and historical biogeography), the use of phylogenetic and phylogeographic tools (e.g., comparative phylogeography), paleontological data (paleobiogeography), or the combined use of multiple approaches (e.g., integrative biogeography). Progress in marine biogeography has historically been well behind terrestrial biogeography, owing to the large logistical limitations involved in obtaining information in remote areas, including the open ocean and the deep sea. However, marine systems offer unique biophysical, environmental, and biotic features, creating a mosaic of phenomena and challenges unseen in terrestrial biogeography. First, despite the fact that species richness seems to be much lower in marine compared to terrestrial realms, phyletic diversity is much higher in the sea. There are thirty-five marine phyla, compared to only eleven terrestrial phyla. Second, many marine organisms possess complex life cycles, creating unique challenges to understanding their biogeographic patterns and underlying processes. The possession or lack of a planktonic larval phase seems to be an important (yet not the unique) factor controlling the scale of dispersal, gene flow, size of the geographic range, and duration in the fossil record. Third, seawater has different biophysical properties than air, forcing different adaptations by marine organisms. Finally, the marine fossil record is comparatively much superior in preservation than that of terrestrial taxa, opening avenues for robust comparative paleobiogeographic studies across the Phanerozoic, and for testing the importance of evolutionary/historical factors shaping present-day biogeographic patterns.

4.3 TYPES OF OCEAN HABITATS

Coral Reef Habitat :

From coral reefs to salt marshes, there are many different types of ocean habitats to explore. Some of these are incredibly lively and filled with thousands of well-known species, while others are dark, rarely explored, and populated by some of the strangest creatures on Earth.Coral reefs are incredible, diverse ecosystems found around the world. They are at immediate threat from changing ocean temperatures and are often subject to a process known as coral bleaching. They play host to diverse inhabitants, including:

1. Hammerhead sharks
2. Tiger sharks
3. Sea turtles
4. Butterfly fish
5. Parrot fish
6. Rabbit fish
7. Moray eels

scientists believe that coral reefs contain around 25% of all marine species. Corals are, despite their appearance, living functioning marine creatures themselves. They are soft-bodied organisms that attach to the ocean floor and can live on their own or form large communities.

Estuaries Habitat:

Estuaries are partially enclosed bodies of water where fresh and saltwater meet. They are regarding as transitory areas and are filled with marine animals, as well as elements of the habitats described below. They play host to many different bird species like the great blue heron, Canada goose, American wigeon, and more. Crabs, small fish, oysters, otters, and seashores can even be found in these areas.

Kelp forests

Kelp forests are highly diverse ocean habitats that provide a home and source of food for thousands of marine species. The kelp forests are giant algae that grow into sheltered, underwater forests. They grow at incredible rates, around eighteen inches a day, and are spread out along the west coast of North America. Common animals found in and around kelp forests include:

1. Great blue herons
2. Sea otters
3. Sea lions
4. Leopard sharks
5. Giant sea bass

6. Sea urchins
7. Horn shark
8. California moray
9. California spiny lobster

Mangrove forests Habitat:

Mangrove forests are groups of trees that live and grow in intertidal zones. The majority of mangrove forests are in Asia, with the rest spread out around the world. There are around 80 different species of mangrove all of which require low-oxygen soil. They include the black and red mangrove as well as the loop-root and green buttonwood. It's common to find jellyfish, tunicates, molluscs, worms, barnacles, snails, crabs, shrimp, and more in mangrove forests.

Mudflats Habitat:

Mudflats form in areas where the sea brings in silt and mud. They are exposed during low tide and filled with invertebrates and other small organisms. Also common to this ocean habitat are oysters, snails, and worms. Many species of fish also frequent mudflats. They are found near bays, lagoons, and more, around the world.

These meadows are underwater ecosystems that include flowering plants that seed, have roots, and are anchored to the sea floor. The plants form large meadows that are home to a diverse array of marine life. Endangered species, like sea turtles and dugongs, feed there. They also provide homes for shrimp, fish, and scallops, among many species of fish. Scientists believe that the destruction of these habitats is incredibly detrimental to the overall health of the Earth's oceans.

4.4 BIOGEOGRAPHY OF ESTUARIES

Salt-wedge Estuaries

Salt-wedge estuaries are the most stratified, or least mixed, of all estuaries (Molles, 2002; Ross, 1995). They are also called highly stratified estuaries. Salt-wedge estuaries occur when a rapidly flowing river discharges into the ocean where tidal currents are weak. The force of the river pushing fresh water out to sea rather than tidal currents transporting seawater upstream determines the water circulation in these estuaries. As fresh water is less dense than saltwater, it floats above the seawater. A sharp boundary is created between the water masses, with fresh water floating on top and a wedge of saltwater on the bottom. Some mixing does occur at the boundary between the two water masses, but it is generally slight. The location of the wedge varies with the weather and tidal conditions.

Fjord-type Estuaries

Fjords (pronounced fee-YORDS) are typically long, narrow valleys with steep sides that were created by advancing glaciers. As the glaciers receded they left deep channels carved into the Earth with a shallow barrier, or narrow sill, near the ocean. The sill restricts water circulation with the open ocean and dense seawater seldom flows up over the sill into the estuary. Typically, only the less dense fresh water near the surface flows over the sill and out toward the ocean. These factors cause fjords to experience very little tidal mixing; thus, the water remains highly stratified. Fjords are found along glaciated coastlines such as those of British Columbia, Alaska, Chile, New Zealand, and Norway.

Slightly Stratified Estuaries

In slightly stratified or partially mixed estuaries, saltwater and freshwater mix at all depths; however, the lower layers of water typically remain saltier than the upper layers. Salinity is greatest at the mouth of the estuary and decreases as one moves upstream. Very deep estuaries, such as Puget Sound in Washington State and San Francisco Bay in California, are examples of slightly stratified estuaries. Even though Puget Sound is classified as a fjord in terms of its geology, it does not exhibit the characteristics of a fjord when classified by water circulation.

Vertically Mixed Estuary

A vertically-mixed or well-mixed estuary occurs when river flow is low and tidally generated currents are moderate-to-strong. The salinity of water in a vertically-mixed estuaries is the same from waters surface to the bottom of the estuary. Strong tidal currents eliminate the vertical layering of freshwater floating above denser seawater, and salinity is determined by the daily tidal stage. An estuary's salinity is highest nearest the ocean and decreases as it moves up the river. This type of water circulation might be found in large, shallow estuaries, such as Delaware Bay.

Freshwater Estuaries

We normally think of estuaries as places where rivers meet the sea, but this is not always the case. Freshwater or Great Lakes-type estuaries do not fit the definition of a brackish water estuary where freshwater and seawater mix.

Freshwater estuaries are semi-enclosed areas of the Great Lakes in which the waters become mixed with waters from rivers or streams. Although these freshwater estuaries do not contain saltwater, they are unique combinations of river and lake water, which are chemically distinct. Unlike brackish estuaries that are tidally driven, freshwater estuaries are storm-driven. In freshwater estuaries the composition of the water is often regulated by storm surges and subsequent seiches (vertical oscillations, or sloshing, of lake water). While the Great Lakes do exhibit tides, they are extremely small. Most changes in the water level are due to seiches, which act like tides, exchanging water between the river and the lake.

Old Woman Creek is a freshwater estuary located on the south-central shore of Lake Erie in Ohio. Tidal changes in water level only average about 3 cm. As a storm-driven estuary system, during periods of low water flow, a barrier sand beach will often close the mouth of the estuary, isolating it from Lake Erie.

4.5 ISLAND BIOGEOGRAPHY

Island Biogeography

Islands are conventionally (and narrowly) referred to as isolated lands in surrounding waters. However, in broad senses and when loosely defined, 'islands' also include insular areas or entities such as mountain tops, lakes (e.g., potholes in northern Great Plains in North America), oasis (in deserts), and springs (especially in deserts) that support unique species assemblages relative to surrounding habitats (e.g., Brown, 1978; Lomolino et al., 2006). Mostly because of the insular nature, habitats on oceanic islands are often different from those on the nearest mainland even when latitudes (climates) and the sizes (areas) are the same. For example, islands often support unique species assemblages with proportionally more rare and endemic species with small population sizes (e.g., reduced body size or the so-called insular dwarfism and dispersal). Partly because of their unique features (e.g., isolation) and conservation values, islands are extremely attractive for intensive efforts in exploration, research, and conservation (e.g., Kalmar and Currie, 2006). Island biogeography studies the biogeography of the isolated units mentioned in the preceding text, especially in the context of species diversity and related patterns and ecological processes. As a major advance and guide in related research arena on islands, MacArthur and Wilson (1967) developed the theory of island biogeography (next section) based on observations of many earlier naturalists made during their explorations around the world. To date, this relatively simple heuristic model has paved the ground and continues to inspire many individuals for further exploration and in some cases has resulted in with much greater effort and investment in such research.Islands as ecological systems have suchsalient features as simple biotas and variability inisolation, shape, and size. These characteristicsand their large numbers facilitate both intensiveand extensive studies with the repeatabilitynecessary for statistical validity. Since Darwin,islands have provided particularly important andfruitful natural experimental laboratories for developing and testing hypotheses on evolution, biogeography and ecology. The theory of island biogeography has been one of the moreimportant products of island studies.Eugene G. Munroe (1948, 1953) firstdeveloped the concept of an island having anequilibrium species number when he examinedspecies-area relationships in his study of the

4.6 SUMMARY

Marine biogeography is a subfield of the biogeography aimed at understanding the patterns and processes governing the distribution of marine taxa at geographic scales. Marine biogeography is related to several disciplines and subdisciplines, including marine biology and ecology, physical and biological oceanography, ecophysiology, genetics, geography, geology, paleontology, and macro ecology. Several subdisciplines have been proposed from the intersection with these branches, alluding to the subject of study (e.g., phytogeography and zoogeography), the temporal scale of driving processes (e.g., ecological biogeography and historical biogeography), the use of phylogenetic and phylogeographic tools (e.g., comparative phylogeography), paleontological data (paleobiogeography), or the combined use of multiple approaches (e.g., integrative biogeography). Progress in marine biogeography has historically been well behind terrestrial biogeography, owing to the large logistical limitations involved in obtaining information in remote areas, including the open ocean and the deep sea.now-accepted practice oldening biogeographic provinces on the basis of 10% endemism at the species level within published species inventories, most frequently fishes or well-known invertebrate groups such as molluscs. A central theme was that the greater the proportion of endemic biota, the greater the evolutionarysignificance of the province (Briggs, 1974).Marine biogeography has seen a recent revaluation in the face of considerable research over the past few decades.

4.7 EXERCISE

1. Explain the concept of Marine Biogeography.
2. Discuss in details of classification of marine habitat.
3. What is the Estuaries Biogeography.
4. Write on Island Biogeography.

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5

BIODIVERSITY

Unit Structure :

5.0 OBJECTIVE

1. Understand the Meaning and Types of Biodiversity
2. know the Importance of Biodiversity
3. Learn about the Causes of Biodiversity Loss
4. Understand the biodiversity conservation

5.1 INTRUDUCTION

The well-being of our society depends on the resources provided by the earth. Typically, resources are materials, energy, services, staff, knowledge, or other assets that are transformed to produce benefit or satisfaction of human beings. This is a neutral stuff until some technical skills are found to extract it from nature. Therefore, in order to become a resource, the thing or substance must possess two properties i.e. functionality and utility. The exploitation of nature and natural resources can be dated back tothe advent of mankind and the very start of civilization. But the present increase in population along with industrial growth has given rise to the unlimited use of resources. Thus, disrupting ecosystems and exhausting resources.

Due to deforestation the world loses more than 23 million acres of forest area every year. Thus, we should try utmost toreverse deforestation and protect the world's remaining forestsintact. The plants and animals in the bits of forest that remain become increasingly vulnerable, sometimes even committed, to extinction. Water resources are playing considerable roles in the socio-economic development of any region. Water issues affect us all as it is estimated that below 900 million people lack reliable access of safe water worldwide. A thriving ecosystem depends on water immensely.

Release of mining waste scanal so affect habitats. Therefore, we should take a conscious effort for the conservation and sustainable use of resources. From a human perspective proper utilization of natural resources will lead to the increase ofwealth and meet our needs. Froma broader biologicalor ecological perspective, a resource satisfies the needs of a living organism.

5.2 MEANING AND TYPES OF BIO DIVERSITY

Concept of biodiversity :

Our ecosystems provide uswith food, medicine, clean airand water, recreation, and spiritual and aesthetical inspiration.Hence the human species cannot exist without its surrounding ecosystems. Biodiversity is the sum of all the different species of animals, plants, fungi and microbial organisms living on Earth and the variety of habitats in which they live.

5.2.1 Concept

Biodiversity is the contracted form of biological diversity that means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquaticecosystems. This also includes the ecological complexes of which they are a part as well as diversity within species, between species and of ecosystems. Scientists estimate that more than 10 million different species inhabit Earth.

Biodiversity being a broad term may be measured at a number of organizational levels. Traditionally, ecologists have measured biodiversity by taking into account both the number of species and the number of individuals of each species. This is known as relative abundance. On the other hand, biologists use different measures of biodiversity that includes genetic diversity to preserve the biologically and technologically important elements of biodiversity.

Biodiversity loss refers to the reduction of biodiversity due to displacement or extinction of species.The loss of a particular individual species, especially ifit is not acharismatic specieslike the Bengal tiger, may appear as unimportant to some people. However, the current accelerated extinction rate means the loss of tens of thousands of species within our lifetimes.

Scientists have discovered and named only 1.75 million species which is actually less than 20 percent of those estimated to exist. This estimation states that the greatest value of biodiversity is yet to be known. Most biologists agree that much of Earth's great biodiversity such as species of plants, animals, fungi and microscopic organisms such as bacteria is rapidly disappearing. So scientists are putting stress on their researches and studying global biodiversityaiming at better understanding and slow the rate of loss.

5.3 IMPORTANCE OF BIODIVERSITY

Benefits of biodiversity

The following are some of the benefits of biodiversity:

- Provisioning services such as food, clean water, timber, fibre and genetic resources
- Regulating services such as climate, floods, disease, water quality and pollination
- Cultural services such as recreational, aesthetic and spiritual benefits
- Supporting services such as soil formation and nutrient cycling

5.3.1 Types of biodiversity

- Biodiversity includes three main types:

i. diversity within species orgenetic diversity

ii. between species or species diversity and

iii. between cosystems or ecosystem diversity

Genetic Diversity

Genetic diversity means the total number of genetic characteristics in the genetic makeup of a species. Every species on Earth is related to every other species through genetic connections. Each individual species possesses genes which arethe source of its own unique features. Therefore the more closely related any two species are, the more genetic information they will share, and the more similar they will appear. For example in human beings the huge variety of people's faces reflects each person's genetic individuality. While all species have descended from asingle, common ancestor, species diverge and develop their own peculiar attributes with time, thus making their own contribution to biodiversity.

- The two reasons for differences between individual organisms are:

a. The variation in thegene which all organisms possess and is passed from one to its off spring’s

b. The influence of environmentneach individual organism.

Species Diversity

The diversity of creatures roaming in our Earth is absolutely astonishing. Species diversity is defined as the number of species and abundance of each species living with in a particular habitator a region. Species are the basic units of biological classification. Hence are the normal measures of biological diversity. The number of different species in a given area is called species richness. So when we measure the species richness of a forest, we will find 20 bird species, 50 plant species, and 10 mammal species. Species endemism is another term that is used to measure biodiversity by way of assessing the magnitude of differences between species.

Abundance is the number of individuals of each species. Species diversity may be of small scale such as a forest or ofalarge scale such as the total diversity of species living on Earth

Ecological Diversity

Ecological diversity refers to the number of species in a community of organisms and the dynamic interplay between them. It is the variation in the ecosystems found inaregion or the variation in ecosystems over the whole planet. An ecosystem consists of organisms from many different speciesliving together in

a region and their connections through the flow of energy, nutrients and matter. Those connections occur as the organisms of different species interact with one another. Measuring ecological diversity is difficult because each of Earth's ecosystems merges into the ecosystems around it.

5.3.2 Hotspots of Bio-diversity

There are places on Earth that are biologically rich but deeply threatened, so we must take some effort to protect them. Hotspots of bio-diversity are large regions that contain exceptional concentrations of plant endemism and experience high rates of habitat loss. By the method Biodiversity hotspots those regions of the world are identified where attention is needed to address biodiversity loss. It also guides investments in conservation. Theidea was first developed by Norman Myers in 1988 to identifytropical forest 'hotspots' characterized both by exceptional levels of plant endemism and serious habitat loss. To trunk this crisis, we must protect those places where biodiversity lives. It is observedthat species are unevenly distributed around the planet. Certain areas have large numbers of endemic species which are not found anywhere else. Many of the search eavily threatened by habitat loss and other human activities. These areas are the biodiversity hotspots. Currently, 35 biodiversity hotspots have been identified. Most of them occur in tropical forests and represent just 2.3% of Earth's land surface. Among them they contain around 50% of the world's endemic plant species and 42% of all terrestrial vertebrates.

5.3.3. Biodiversity in India with emphasison Western Ghat

India is one of the12 megabiodiversity centres of the world.

The country is divided into 10 biogeographic regions such as:

1. Trans Himalay as
2. Himalayan
3. Indian desert
4. Semi-aridzone
5. Western Ghats

6. Deccan peninsula
7. Gangetic plains
8. North-East India
9. islands
10. coasts

The hill chain of the Western Ghats constitutes the Malabar province. It runs parallel to the west coast of India. Biogeographically, the Western Ghats represents 4% of India's land region that experiences high torrential rainfall as well as monsoon and tropical climate and high variation in wind speed.All these features have marked this region as one of the ten bio-geographic zones in India.

The Western Ghats is considered to be one among the hotspots in the world. This bioregion is highly species rich. But it is constantly facing severe threats because nearly 40% of the total number of species is endemic. In a in a 17,000 sq. km strip of forest along the seaward side of the Western Ghats in Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala there are 15,000 plant species with5, 000 endemics (33%), 4,050 plants with 1,600 endemics (40%).

The rain forests of the Western Ghats exist in an environment where there is considerable seasonality in distribution of the rainfall. The high altitudinal zone also gives rise to a kind of forest which has primarily Lauraceous vegetation. Moreover the parent rocks in these areas have given rise to soils which are rich in nutrients and have a very high moisture holding capacity. All these elements have given rise to the tropical rain forests of the Western Ghats which has diversity in vegetation types.

Vegetation types such as Wet evergreen, Dry evergreen, Moist deciduous and Dry deciduous are classified based on mean annual rainfall. Forest tracts up to 500 m in elevation are mostly evergreen. This comprises one fifth of the entire forest expanse of the Western Ghats. The forest regions in the 500-1500 m range are semi-evergreen. Whereas, low, medium and high elevation wet evergreen forest types are distinguished by low minimum temperature with increasing altitude. Among these there are two major centres of diversity, the Agasthyamalai Hills and the Silent Valley or New Amarambalam Reserve basin.

Flora and Fauna of the Western Ghats

The area has an estimated 3,00,000 hectare (37%) under forest cover and is characterised by a rich diversity of flora and fauna.

- **Flowering plants** : 7402 species off lowering plantsare known from the Western Ghats. Recent studies have suggested that there could be 2300 species of flowering plants endemic to the Western Ghats.
- **Amphibians**: Over 117 species belonging to 21 genera are recorded in the forests and coastal areas of this region, of which76% are endemic to the region.

- **Invertebrates**: A large variety of insects including some ofthe spectacular butterflies and moths occur in the dense evergreen highland and lowland forests. It is estimated that India has over 1,400 species of which the Western Ghats harbour nearly 320 species including 37 endemics and 23 others shared with Sri Lanka. The area is host to a large variety of fresh water mollusca, some of which are specific to the region.

- **Fish**: There is a wide variety of fish available from freshwater montane, lowland river streams and water bodies as well as coastal lagoonsand backwaters. Around218 species of primaryand secondary freshwater fishes in the Western Ghats are found. About 53% of all fish species (116 species in 51 genera) in the Western Ghats are endemic. Sixteen out of 20species of Caecilians known in India occur in the Western Ghats; all 16 being endemic.

- **Reptiles**: 157 species of reptiles are found in the Western Ghats. Majority of the reptile species are snakes. Dense forests of the region are the home of the King Cobra and Rock Python apart from other smaller reptiles. In all 97 species, representing 36 genera (2 genera of turtle/ tortoise, 20 snakes, 14 lizards) are endemic. Among the tortoises the endemic cane turtle, and terrapin are found in the Western Ghats. The marsh crocodile or mugger was once widely distributed in swamps and larger water bodies of the forested areas.

- **Birds**: About 508 species of birds occur in the Western Ghats (590 if sub-species are included). Among them 144 are aquatic or coastal birds. Nineteen species are considered to be endemictothe Western Ghats. Many end emic birds are exclusive to evergreen and Shola forests.

- **Mammals**: 120 species of mammals are reported from the Western Ghats of which, 14 are considered to be endemic to the Western Ghats. The forests of the area have large herbivores such as gaur, spotted deer, sambar, barking deer, elephant, etc. Carnivores are represented by tiger, leopard, jungle cat, leopard cat, fishing cat, Malabar civet, brown palm civet, small Indian civet, two species of mongoose and wild dog.

  With rapid developmental activities, agricultural expansion and uncontrolled human population explosion, there have been significant declining trend in the diversity of both flora and fauna in the Western Ghats. As per recent records, 496 plant species, 91 amphibians, 41 mammals, 22 birds, 8 fishes, 6 reptiles 300 and 3 insect species are considered as threatened, asper IUCN Red Data List, in the Western Ghats. Further, 51 species are critically endangered, 125 are endangered and 127 are in vulnerable category.

5.4 CAUSES OF BIODIVERSITY LOSS

5.4.1 Threat To Biodiversity- Causes

Some of the main threats to biodiversity are:

1. Human Activities and Loss of Habitat,

2. Deforestation,

3. Desertification,

4. Marine Environment,

5. Increasing Wildlife Trade and

6. Climate Change.

1. Human Activities and Loss of Habitat :

Human activities are causing a loss of biological diversity among animals and plants globally estimated at 50 to 100 times the average rate of species loss in the absence of human activities. Two most popular species in rich biomes are tropical forests and coral reefs.

Tropical forests are under threat largely from conversion to other land-uses, while coral reefs are experiencing increasing levels of over exploitation and pollution. If current rate of loss of tropical forests continues for the next 30 years (about 1 percent per year), the projected number of species that the remaining forests could support would be reduced by 5 to 10 percent relative to the forest in the absence of human disturbance.

The rate of decline would represent 1000 to 10,000 times the expected rate of extinction without deforestation by humans. Some studies suggest that, globally, as many as one half of all mammal and bird species may become extinct within 200 to 300 years.

Biodiversity loss can result from a number of activities, including:

(a) Habitat conversion and destruction;

(b) Over-exploitation of species;

(c) Disconnected patches of original vegetation; and

(d) Air and water pollution.

Over the coming decades, human-inducted climate change increasingly become another major factor in reducing biological/biodiversity. These pressures on biodiversity are, to a large extent, driven by economic development and related demands including the increasing demand for biological resources.

Activities that reduce biodiversity, jeopardize economic development and human health through losses of useful materials, genetic stocks, and the services of intact ecosystems. Material losses include food, wood, and medicines, as well as resources important for recreation and tourism. Losing genetic diversity, like losing species diversity, makes it even more likely that further environmental disturbance will result in serious reductions in goods and services that ecosystems can provide.

2. Deforestation :

Forest ecosystems contain as much as 80 percent of the world's terrestrial biodiversity and provide wood fiber and biomass energy as well as critical components of the global cycles of water, energy and nutrient. Forest ecosystems are being cleared and degraded in many parts of the world.

3. Desertification :

Desertification and deforestation are the main causes of biodiversity loss. Both processes are decisively influenced by the extension of agriculture. The direct cost of deforestation is reflected in the loss of valuable plants and animal species. Desertification process is the result of poor land management which can be aggravated by climatic variations. Converting wild lands to agriculture often involves ploughing the soils which leads in temperate regions to an average decline in soil organic matter between 25 and 40 per cent over twenty five years.

4. Marine Environment :

Oceans play a vital role in the global environment. Covering 70 per cent of the earth's surface, they influence global climate, food production and economic activities. Despite these roles, coastal and marine environment are being rapidly degraded in many parts of the globe.

5. Increasing Wildlife Trade :

According to Nick Barnes, "Trade is another cause of biodiversity depletion that gives rise to conflict between North and South." Global trade in wildlife is estimated to be over US $ 20 billion annually. Global trade includes at least 40,000 primates, ivory from at least 90,000 African elephants, 1 million orchids, 4 million live birds, 10 million reptile skins, 15 million furs and over 350 million tropical fish.

6. Climate Change:

As climate warms, species will migrate towards higher latitudes and altitudes in both hemisphere. The increase in the amount of CO_2 in the air affects the physiological functioning of plant and species composition. Moreover, aquatic ecosystems, particularly coral reefs, mangrove swamps, and coastal wetlands, are vulnerable to changes in climate.

In principle, coral reefs, the most biologically diverse marine systems, are potentially vulnerable to changes in both sea level and ocean temperature. While most coral systems should be able to grow at a sufficient pace to survive a 15 to 95 centimeter sea-level rise over the next century, a sustained increase of several degrees centigrade would threaten the long-term viability of many of these systems.

5.5 BIODIVERSITY CONSERVATION

Definition of Biodiversity Conservation

"Protection, restoration, and management of biodiversity in order to derive sustainable benefits for present and future generations.". Or, it can also be defined as, "the totality of genes, species, and ecosystems in a defined area.".

Conservation of Biodiversity

Biodiversity conservation refers to the protection, preservation, and management of ecosystems and natural habitats and ensuring that they are healthy and functional.

- The three main objectives of Biodiversity Conservation are as follows-
- To protect and preserve species diversity.
- To ensure sustainable management of the species and ecosystems.
- Prevention and restoration of ecological processes and life support systems.

Biodiversity Conservation Methods

Two types of methods are employed to conserve biodiversity. They are-

In situ conservation and

Ex-situ conservation.

Following are some of the ways through which Biodiversity can be conserved:

- In-situ Conservation
- Ex-situ Conservation

In Situ Conservation

In Situ Conservation refers to the preservation and protection of the species in their natural habitat. It means the conservation of genetic resources in natural populations of plant or animal species. In situ conservation involves the management of biodiversity in the same area where it is found.

- In situ, biodiversity conservation has many advantages
- It preserves species as well as their natural habitat.
- It ensures protection to a large number of populations.

- It is economic and a convenient method of conservation
- It doesn't require species to adjust to a new habitat.

Different methods of In-situ conservation include biosphere reserves, national parks, wildlife sanctuaries, biodiversity hotspots, gene sanctuary, and sacred groves.

It is defined as the conservation of species within their natural habitat, where the natural ecosystem is protected and maintained.

- In-situ conservation possesses numerous advantages. Some of the important advantages of in-situ conservation are as follows:
- It is a cost-effective and convenient way of biodiversity conservation.
- Various living organisms can be conserved at the same time.
- They can evolve better and can easily get adapted to various environmental conditions.
- In-situ conservation occurs in places like national parks, wildlife sanctuaries, and biosphere reserves.

Biosphere Reserves

These are national governments nominated sites, large areas (often up to 5000 square km) of an ecosystem where the traditional lifestyle and natural habitat of the inhabitants of that ecosystem are protected. They are mostly open to tourists and researchers.

Example- Sundarban, Nanda Devi, Nokrek, and Manas in India.

National Parks

These are limited reserves maintained by the government for the conservation of wildlife as well as the environment. Human activities are prohibited in national parks and they are solely dedicated to the protection of natural fauna of the area. They mostly occupy an area of 100-500 square km. There are a total of 104 national parks in India, right now. The national parks may even be within a biosphere reserve. These are small reserves that are protected and maintained by the government. Its boundaries are well protected, where human activities such as grazing, forestry, habitat, and cultivation are restricted.

Example- Kanha National Park, Gir National Park, Kaziranga National Park, and so on.

Wildlife Sanctuaries

Wildlife Sanctuaries are protected areas meant only for the conservation of wild animals. A few human activities such as cultivation, wood collection, and other forest product collection are allowed here, but they must not interfere with the conservation of the animals. Tourist visits are also allowed in these areas. There are a total of 551 wildlife sanctuaries in India. These are the places where only wild animals can be found. Certain human activities like timber harvesting, cultivation, collection of woods, and other forest products are permitted unless they interfere with the conservation project. Recreation tourism is also permitted.

Example- Ghana Bird Sanctuary, Abohar Wildlife Sanctuary, Mudumalai Wildlife Sanctuary, etc.

Biodiversity Hotspots

A biodiversity hotspot are the areas of conservation where there is strictly a minimum of 1500 species of vascular plants and a habitat that has lost its 70% cover. These are protected areas for various purposes where the wildlife, inhabitant lifestyle, and domesticated plants and animals are conserved. Tourist and research activities are allowed.

Example- The Himalayas, The Western Ghats, The North East, and The Nicobar Islands.

Gene Sanctuary

Gene sanctuary is a conservation area reserved only for plants. India has its only gene sanctuary set up in Garo Hills of Meghalaya for the conservation of wild species of Citrus. Plans to open more such sanctuaries are underway.

Sacred Groves

Sacred Groves are conserved areas for wildlife protected by communities due to religious beliefs. It is mostly a part of the forest where its wildlife is given complete protection.

Ex Situ Conservation

Ex Situ Conservation means conservation of life outside their natural habitat or place of occurrence. It is the method in which part of the population or the entire endangered species is taken from its natural habitat which is threatened and breeding and maintaining of these species take place in artificial ecosystems. These artificial ecosystems could be zoos, nurseries, botanical gardens, etc. The living environments are altered in these conservation sites, so there are fewer survival struggles like scarcity of food, water, or space. Ex-situ conservation of biodiversity consists of breeding and maintenance of endangered species using artificial environments like zoos, nurseries, botanical gardens, gene banks, etc. The competition for food, water, and space among the organisms is low.

Advantages of Ex Situ Conservation Include

Essential life-sustaining conditions like climate, food availability, veterinary care can be altered and are under human control.

Artificial breeding methods can be introduced leading to successful breeding and creating many more offspring of the species.

The species can be protected from poaching and population management can be efficiently done.

Gene techniques can be applied to increase the population of the species and they can again be reintroduced into the wild.

Biodiversity Conservation Strategies

Conservation of Ecosystems- The intent of the conservation of biodiversity is to provide long term viability to the ecosystems. It is to make sure that ecological integrity is intact. The landscapes of the region which have undergone historical or evolutionary deterioration can be reinstated. The threats can be removed and the ecosystems should be able to continue with ecological processes.

Reverse the decline of species- According to this strategy, the aim of conservation is to restore the population of declined species in a particular ecosystem.

Conservation of all biological aspects- This strategy aims at giving cover and conserving food, livestock, microbial population, agricultural stock including plants and animals.

Efficient utilization of natural resources.

Strict laws on deforestation and preventions of deforestation by every means.

Poaching and killing animals in the wild should be prevented.

Creating public awareness about conservation of biodiversity and its importance.

Longer time and breeding activity of the animals are provided.

The breeding of species in captivity is reintroduced in the wild.

Genetic techniques are used to preserve endangered species.

2.6 SUMMARY

We use a variety of materials derived from the environment. Nature has given us abundant resources in form of water, air, soil, wild animals, metals, fossils, fuels etc. and man byhis technical skill and knowledge using resource from the dawn of civilization. Resource is the ability to perform the work of satisfying the needs or wants of human being. Resource can be classified on the basis of their nature, durability, ownership and distribution pattern. All the resources are derived from the environment. Many natural resources are essential for human survival, while others are used for satisfying human desire. Conservation is the protection, improvement, and wise use of natural resource to provide the greatest social and economic value for the present and the future. "Sustainable development is development that meets the needs of thepresentwithoutcompromisingtheabilityoffuturegenerations to meet their own needs". On September 25th 2015, countries adopted a set ofgoals to end poverty, protect the planet, andensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years. For the goals to be reached, everyone needs to do their part : governments, the private sector, civil society and people.

5.7 EXERCISE

1. What is Biodiversity? explain the types of biodiversity.
2. Define the term Biodiversity. What is the importance of biodiversity?
3. What are the causes of Biodiversity loss?
4. Write in details methods of biodiversity conservation.

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QUESTION PAPER PATTERN

Time: 3 hours		Marks : 100
N.B.1.All questions are compulsory and carry equal marks. 2. Use of Map Stencils is permitted. 3. Draw sketches and diagrams wherever necessary.		
Q.1	Long answer question on Unit-I	20 Marks
	OR	
	Long answer question on unit –I for 20 Marks or Two short answer questions each 10Marks	20 Marks
Q.2	Long answer question on Unit-II	20 Marks
	OR	
	Long answer question on unit –II for 20 Marks or Two short answer questions each 10 Marks	20 Marks
Q.3	Long answer question on Unit-III	20 Marks
	OR	
	Long answer question on unit –III for 20 Marks or Two short answer questions each 10Marks	20 Marks
Q.4	Long answer question on Unit-IV	20 Marks
	OR	
	Long answer question on unit –IV for 20 Marks or Two short answer questions each 10Marks	20 Marks
Q.5	Long answer question on Unit-V	20 Marks
	OR	
	Long answer question on unit –V for 20 Marks or Two short answer questions each 10Marks	20 Marks