GCOE, JAMMU

CLASS : *B. Ed Sem.2nd*

SUBJECT : *Pedagogy of Bio-Science*

INCHARGE: *Dr. JYOTI PARIHAR*

UNIT: 5

SUB UNIT: 5.3

Concept of Bio-diversity, Importance of Biodiversity, Loss of biodiversity and biodiversity conservation

What is biodiversity?

Biodiversity is the degree of variation of life forms within a given species, ecosystem, biome, or an entire planet. Biodiversity is a measure of the health of ecosystems. Biodiversity is in part a function of climate. In terrestrial habitats, tropical regions are typically rich whereas Polar Regions support fewer species.

"Biodiversity" is most commonly used to replace the more clearly defined and long established terms, species diversity and species richness. Biologists most often define biodiversity as the "totality of genes, species, and ecosystems of a region". An advantage of this definition is that it seems to describe most circumstances and presents a unified view of the traditional three levels at which biological variety has been identified.

Types of biodiversity

In biodiversity on the basis of variation and distribution, four types are evolved which deals with living species separately. The types of biodiversity vary from place to place. These types are as follows

1. Genetic Diversity
2. Species Diversity
3. Ecological Diversity
4. Functional Diversity

The genetic diversity: It is a type of biodiversity which deals with the living organisms genetically i.e. variation in the genes of the species and the genetic make up of species differ from each other to produce a new generation is categorized as genetic diversity.

Every individual in a species differs widely from other individuals in its genetic makeup due to large number of combinations possible in the genes. This genetic variability is essential for healthy breeding population of a species. The reduction of genetic diversity will result in in-breeding in species. This leads to genetic anomalies and eventually extinction of that particular species. The variety of nature's bounty can be exploited if we breed domestic plant and animal varieties with their wild varieties to make them more productive and disease – resistant. Modem biotechnology also manipulates genes to develop better types of seeds, medicines and other industrial raw materials.

Examples: 5,000 recorded varieties of mango
88,000 recorded varieties of *Oryza sativa*

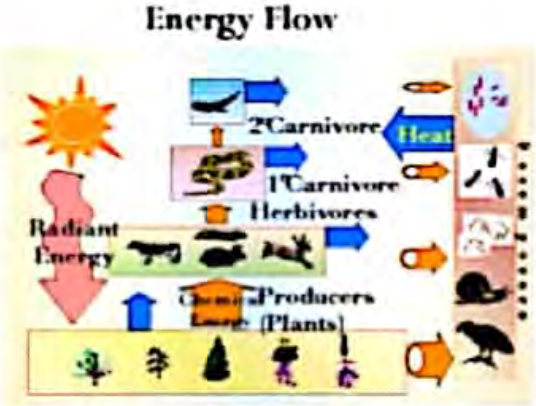


Grassland

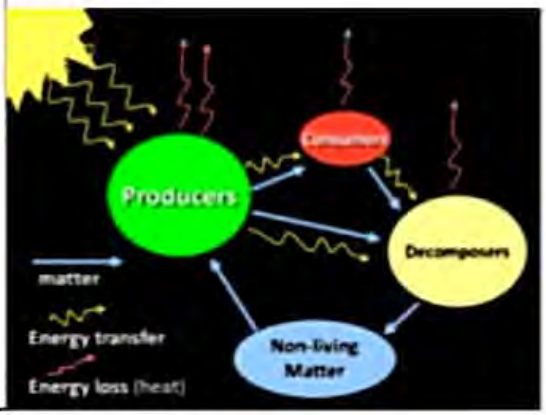
shola forest

The functional diversity: Functional diversity is that type of biodiversity which is the study of different types of chemical processes of species fir their survival on the land. These processes include such as energy flow and cycling of matter etc.

There are a large variety of functions being performed by nature for the diversity. Each function has its own importance and the decline of any of these functions can lead to the imbalance of the biodiversity as well as the ecosystem.



Energy flow



Cycling of matter

Hotspots

- **Endemism** - (0.5% or 1500 species of the world's 3 Lakh Plant species as endemics should be present)

- Degree of Threat Hotspots of India – Four

  1. Western Ghats
  2. Eastern Himalayas
  3. Indo-Burma region
  4. Sunderland (Indonesia, Malaysia, parts of India especially Nicobar Islands).

- **Extinct** - A species not definitely located in the wild and never sighted even once in the last 50 years

- **Threatened species** - The term is used in conservation context for species which are in one of the categories –

i) Endangered
ii) Vulnerable
iii) Rare
iv) Indeterminate

Biodiversity and balance of nature

- **Tropical level:** elimination of species from tropical level can cause destruction of ecosystem as well as biodiversity.
- **Complex ecosystem:** in a complicated ecosystem, having loss of one or more species do not cause any serious problem because there alternative is available.
- **Keystone species:** loss or addition of species causes detectable changes in biodiversity rates i.e. species make unique contribution to ecosystem functioning.
- **Niche complementary:** difference among species in their environment for different resources will cause complimentary interactions so that a species could obtain more resources.
- **Facilitation and mutualism:** plants may also benefit from their neighbors through amelioration of the physical and biotic environment.
- **Portfolio effect:** species richness increases the temporal stability of the entire community while the biomass is stabilized.
- **Insurance hypothesis:** biodiversity buffer

10

Importance of biodiversity

i) It represents the almost infinite variety of plant and animal life, and the variety of the types of Earth's ecosystems that support life as we know it.

ii) It enables humans to survive in what would otherwise result in adverse conditions.

iii) Biodiversity is the very stuff that supports the evolution and differentiation among the varying species. It's why cats are cats and horses are horses and humans are humans.

iv) And, further, it is responsible for the differences among groups within the larger species.

v) Energy from wind, water, sunlight, and coal heats our homes and power all our appliances Decaying animal matter has, over the centuries created the fossil fuels we use on a daily basis to power the vehicles that make transportation relatively easy and convenient.

vi) Without biodiversity we would be (if we existed at all) a homogeneous population, with each of us having the same vulnerabilities. This would mean that in case of an epidemic, we would all be killed since there would be no biologic differences that would enable some of us to survive and adapt.

vii) Much of our modern medicine is based on combinations of biologically diverse substances isolated from various plants (which we, therefore, label medicinal). Even before the rise of modern medicine, ayurveda and unani systems of medicine used various plants to achieve various results. Without those plants, and the great variety of insects that pollinate and cross-pollinate them, humans would be much more vulnerable to disease.

viii) The biodiversity contained in the ecosystem provides forest dwellers with all their daily needs- food, building material, fodder, medicines and a variety of other products.

ix) Biodiversity also provides us with lumber, granite, and marble – to name a few of the building materials much human habitation depends upon – we would largely be without shelter.

x) Biodiversity provides a literal treasure trove of foods, from things as common as wheat or corn to things as exotic as some of the seafood used in sushi. Biodiversity sustains the bodies we live in, and affects the lives we lead, and the societies we form.

xi) Many traditional societies have played an important role in preserving their biodiversity. They value biodiversity as a part of their livelihood as well as through cultural and religious sentiments. Traditional agricultural societies have been growing a great variety of crops which acts as an insurance against the failure of one crop.

xii) Modern agricultural practices on the other hand depend largely on monoculture with lot of importance given to cash crops for national and international markets. This has resulted in local food shortages, unemployment, landlessness and increased vulnerability to drought.

xiii) Apart from the economic importance of conserving biodiversity, there are several cultural, moral and ethical values which are associated with the sanctity of all forms of life.

xiv) Biodiversity also makes irreplaceable contribution to our aesthetics, imagination and creativity. It forms an integral part of tourism in the world. People all over the world visit national parks, sanctuaries and resorts to recreate themselves. It not only helps them to de-stress but also helps them to feel one with nature.

13

Impact of loss of biodiversity

The loss of biodiversity has many consequences that we understand, and many that we do not. It is apparent that mankind is willing to sustain a great deal of biodiversity loss if there are concomitant benefits to society; we hope they are net benefits. In many cases, the benefits seem to accrue to a few individuals only, with net societal loss. However, as noted below, it is extremely difficult to estimate the future costs of losses in biodiversity, or of environmental damage. As stated by Tilman (2000), "The Earth will retain its most striking feature, its biodiversity, only if humans have the prescience to do so. This will occur, it seems, only if we realize the extent to which we use biodiversity."

Losses in biodiversity in rainforests cause significant changes in ecosystem functioning. About ecosystem functioning in tropical rain forests we know very little, but we do know that ecosystems are affected by changes in the number and kinds of species which they contain, an idea originally conceived by Charles Darwin and Alfred Russel Wallace. Intact ecosystems function best, since the organisms composing them are specialized to function in that ecosystem to capture, transfer, utilize and, ultimately, lose both energy and nutrients. The particular species making up an ecosystem determine its productivity, they affect nutrient cycles and soil contents, and they influence environmental conditions such as water cycles, weather patterns, climate and other no-biotic aspects.

evolution, so that at various times they will be composed of different organisms. According to pollen data and information gathered from fossil bones, few modern ecosystems are the same as they were 10,000 years ago. They originate bit by bit as the environment changes, and as species become extinct or shift their geographical range or their anatomy or behavior.

As we continue to lose species at a rapid rate, we must discover which losses will have the most deleterious consequences on ecosystems. At present, we know little, and what we do have is information on short-term, small-scale experimental plots. We need to know more, much more. It is vital to realize, then, that biodiversity does not mean simply the number and kinds of living organisms present.

a. *Species richness*: Most of the research into the interrelationships between biodiversity and ecosystem functions has been done on plants, which affect soil processes, decomposition, water retention and many other ecosystem functions. Higher plant diversity does not appear to have any great effect on soil processes such as decomposition rates, but does affect productivity and enhances the stability of ecosystem processes. productivity. Plots with greater numbers of species had a greater above- and below-ground plant biomass, higher rates of There are suggestions that loss of species richness may affect many ecosystem processes (nutrient cycling, increased uptake of carbon, and

others) in addition to productivity. However, we have little evidence for this as yet, and there seems to be no straightforward relationship between species diversity and many other ecosystem functions

b. *Species composition*: The array of species in an ecosystem (species composition) must also be important to its function. Certain species will have a greater influence than others, particularly if they are among those groups which capture and transfer energy or nutrients, or which affect environmental conditions regulating these processes. Hawaiian forests have been disrupted by the introduction of a nitrogen-fixing tree, *Myrica faya*, which has led to a great increase in nitrogen supply and altered greatly the properties of these forests. In another case in Hawaii, nonnative grasses were introduced to improve cattle grazing, but since these grasses are flammable, they have caused a 300-fold increase in fires in the forests into which they spread. Most woody plants are damaged or destroyed by fires, while grasses generally

are not, since their deep root systems are maintained even when the superficial portions of the plant are lost. This in turn reduces evapotranspiration and rainfall. If tropical forest trees are removed and their place is taken by savannah grasses, the evapotranspiration which is so conspicuous a feature of tropical rainforests would be severely curtailed, decreasing rainfall (and eliminating the possibility of forest regeneration or even survival of remnants). There is some support for the idea that many species are "redundant"; that is, several species play equivalent roles in an ecosystem. Thus, one or more of these

equivalent species could be lost without irretrievably damaging the ecosystem. But, in general, each loss of species will lead to impoverishment of the system. Davidson (2000) uses the metaphor of threads being pulled from a tapestry, until finally it becomes threadbare, and the grand design is lost.

c. *Species interactions*: Species interactions are perhaps the most important aspect of ecosystem functioning. Species are not just "there," they are interacting at some level with all the other organisms in the system, forming highly complex interlocking systems. They compete, they parasitize, they cooperate, they prey, and they provide food or shelter. In these interactions they also modify the nonbiological aspects of the ecosystem: the availability of nutrients, energy sources (such as sunlight), water, nitrogen (nitrogen-fixing organisms) and the like.

I) Mutualistic interactions: These interactions are essential in ecosystems. One example is the mycorrhizal associations between fungi and the roots of plants, or the decomposition of organic material in the soil by microorganisms, each species of which may contribute different enzymes to the decay process. The organic compounds thus released are taken up by forest plants, which provide the organic matter for the next cycle.

ii) Trophic interactions: Ecosystem functions depend greatly upon

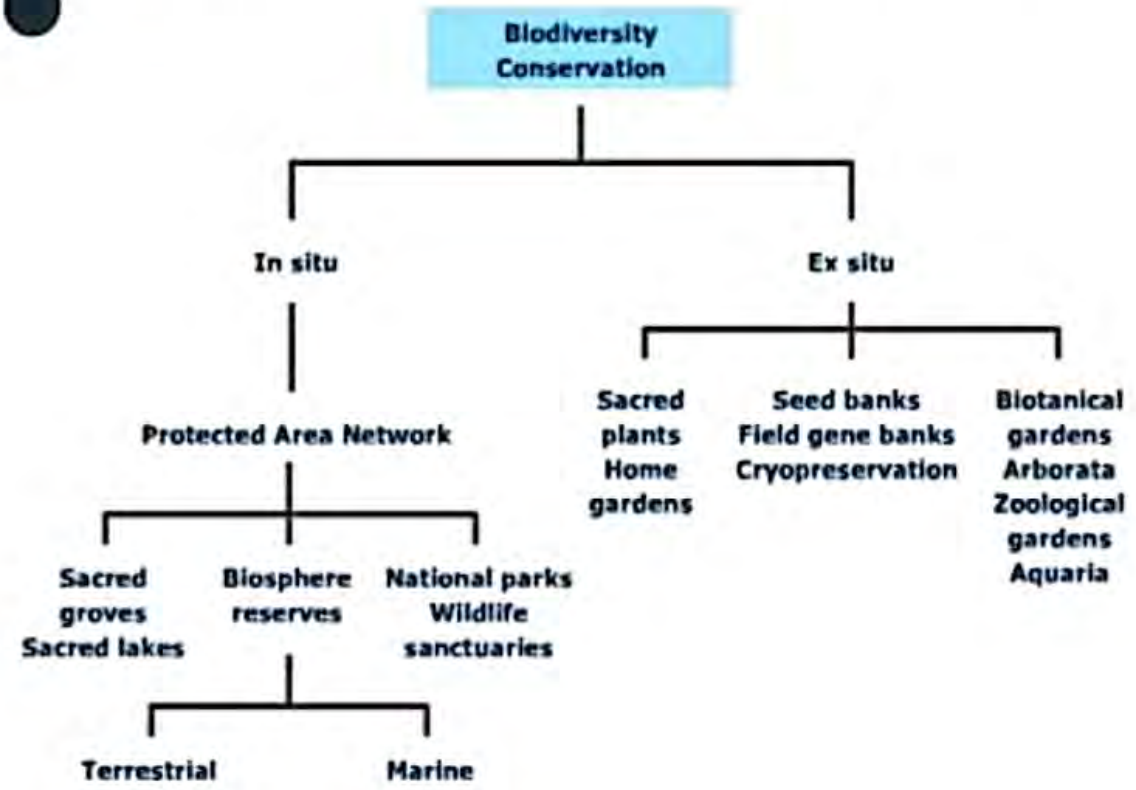
equivalent species could be lost without irretrievably damaging the ecosystem. But, in general, each loss of species will lead to impoverishment of the system. Davidson (2000) uses the metaphor of threads being pulled from a tapestry, until finally it becomes threadbare, and the grand design is lost.

c. *Species interactions*: Species interactions are perhaps the most important aspect of ecosystem functioning. Species are not just "there," they are interacting at some level with all the other organisms in the system, forming highly complex interlocking systems. They compete, they parasitize, they cooperate, they prey, and they provide food or shelter. In these interactions they also modify the nonbiological aspects of the ecosystem: the availability of nutrients, energy sources (such as sunlight), water, nitrogen (nitrogen-fixing organisms) and the like.

I) Mutualistic interactions: These interactions are essential in ecosystems. One example is the mycorrhizal associations between fungi and the roots of plants, or the decomposition of organic material in the soil by microorganisms, each species of which may contribute different enzymes to the decay process. The organic compounds thus released are taken up by forest plants, which provide the organic matter for the next cycle.

ii) Trophic interactions: Ecosystem functions depend greatly upon trophic interactions among species within that system. For instance, if [illegible] prey species populations may grow

Conservation of biodiversity



The following two strategies are used for conservation of biodiversity as well as wildlife:

(a) In-situ conservation,
(b) Ex-situ conservation.

10

In-situ conservation:

The in-situ conservation, emphasis protection of the ecosystem of the original habitats or natural environment. The in-situ approach includes protection of a group of typical ecosystem through a network of protected areas on land or sea. These are managed through state r other effective agencies. India has 381 protected areas, covering about 4.7% of land surface. The biosphere reserves, national parks and wildlife sanctuaries are included in the protected areas.

(a) **National park**: a national park is an area which is strictly reserved for the betterment of wildlife and where human activities like forestry, grazing or cultivation are not permitted.

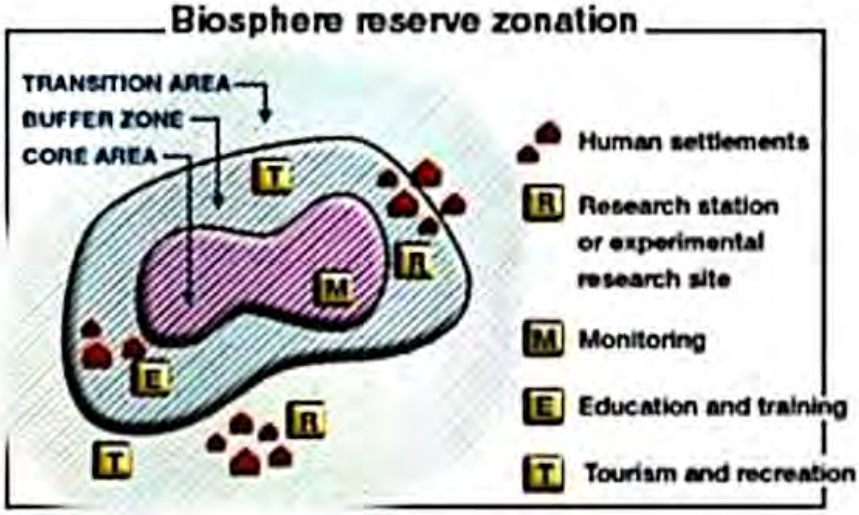
Examples: 1. Jim Corbett (Uttarakhand)
2. Sunderbans (west Bengal)
3. Dudhva (Uttar Pradesh)
4. Tadoba (Maharashtra)

(b) **Wildlife sanctuaries:** a wildlife sanctuary is a protected area that is reserved for the conservation of the only of wildlife animals and plant species. Human activities like harvesting of timber, collection of minor forest products and private ownership rights are allowed.

Examples: 1. Periyar (Kerala)
2. Ranipur (Uttar Pradesh)
3. Chilka lake (Orissa)
4. Sariska (Rajasthan)

21

Biosphere reserves: a biosphere reserve is a special area of land or coastal environment in which multiple use of land is permitted by dividing it into certain zones. The natural or core zone consists of an undisturbed and legally protected ecosystem.



Ex-situ conservation:

Sometimes the population of species may decline or many become extinct due to genetic or environmental factors such as inbreeding, habitat loss, disease and over-exploitation. In such cases in-situ conservation may not prove to be effective and a species can be protected from becoming extinct only through maintaining individuals in artificial conditions under human care. Such measures are included under ex-situ conservation.
Generally, botanical gardens, zoos, aquariums, parks, agricultural research centres, forest research centres, etc., are the artificial habitats for ex-situ conservation.

Beside these measures, gene, pollen, seed, seedling, tissue culture and DNA banks are also included in these strategies. Seed,