BIODIVERSITY

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BIODIVERSITY -CONCEPT

Biodiversity or biological diversity refers to the variability among living organisms from all the sources including terrestrial, marine and other aquatic systems and the ecological complexes of which they are part, this includes diversity within species, between species and of ecosystem. The term biodiversity refers to the totality of genes, species and ecosystem of a region.

BIODIVERSITY -CONCEPT

The term biodiversity was coined by Walter G. Rosen in 1985 for the first planning meeting of the " National Forum on Biodiversity" held in Washington , DC in September , 1986. However, the credit for popularizing this word goes to E. O. Olson who is often called the Father of Biodiversity.

The term Biological Diversity was coined by Raymond F. Dasmann in 1968.

DEFINITION

- Generally , it is defined as the richness in variety and variability of species of all the living organisms in a given region (habitat) .

- A concise definition of biodiversity is " the totality of genes, species and ecosystems in a region" (IUCN UNEP, 1992).

- According to the U. S office of Technology Assessment (1987) , biological diversity is the variety and variability among living organisms and the ecological complexes in which they occur.

DEFINITION

In a broadways, biodiversity or biological diversity is the sum total of species richness (no. of species per unit area) , that is, the number of species of plants , animals , fungi and microorganisms living in a community , ecosystem or the biosphere. It not only encompasses the whole spectrum of life but also the diversity of gene pool or DNA pool

Magnitude of Biodiversity

- Exactly how many species of life exits on earth is not known.

- According to rough estimates , the approximate no. of species of organisms inhabiting the planet is nearly 3 million to 100 million.

Magnitude of Biodiversity

Identified species (0bscure)- 14,13,000 (All over the world)

Insects	7, 51,000
Plants	2,48,000
Other animals	2,81, 000
Fungi	69,000
Protists	30,000
Algae	26,000
Bacteria	4,800
Viruses	1,000

Magnitude of Biodiversity

According to Global Taxonomy Initiative and European Distributed Institute of Taxonomy , the total number of species for some phyla may be much higher than what was known in 2010.

Group	Discovered	To discover
Insects	95,000	89,50,000
Plants	2,70,000	3,80,000
Arachnids	75,000	74,000
Mushrooms	72,000	4,70,000
Mollusca	80,000	2,50,000

Magnitude of Biodiversity

Group	Discovered	To discover
Vertebrates	56,000	61,000
Algae	40.000	4,00,000
Protozoa	30,000	2,10,000
Crustacean	75,000	1,80,000
Other vertebrates	1,20,000	4,00,000

LEVELS OF DIVERSITY

There are three levels of biodiversity.

(a) Genetic diversity

It includes genetic variation (alleles, chromosomes) within the species both among geographically separated populations and within a single population.

It can be view and compared at three levels

1. Genetic variability between individuals within population

2. Genetic variability among population within species

3. Diversity among species

LEVELS OF DIVERSITY

(b) Species Diversity

This denotes the variety of species on earth from acellular viruses to a single celled microorganisms to multicellular plants and animals.

© Ecosystem diversity\ community Diversity

- Variation in biological communities in which the species live, the ecosystems in which communities exist and interactions among these levels.

- It may be various types (5 types)

LEVELS OF DIVERSITY

(1) Alpha diversity – No. of species in a single community or habitat

(2) Beta diversity –

-changes of species composition along an environmental gradient

-Diversity between the two communities

LEVELS OF DIVERSITY

(iii) Gamma Diversity- diversity of habitats over a given geographical area

(iv) Delta diversity

- Changes in species composition and abundance between areas of gamma diversity which occurs within an area of epsilon diversity

- Represents differentiation in diversity over wide geographical area

LEVELS OF DIVERSITY

(v) Epsilon diversity- Total diversity of a group of areas of gamma diversity

Ecosystem diversity describes the niche, trophic levels   and various ecological processes that sustain energy flow, food webs and biogeochemical cycles .

Importance of Biodiversity

Biodiversity has-

1. Socioeconomic Significance

2. Monetary Significance

3. Ecological Significance

Importance of Biodiversity

- **Direct Values-** Use in agriculture, medicine & Industry. ⇒

- **Indirect Values-** Ecological process , Ecosystem's ability to absorb pollution, maintain soli fertility and microclimates.

Importance of Biodiversity

Importance of biodiversity may be summarized in the following ways:

1. **Source of food and improved varieties**

   a. In modern agriculture:

      - As a source of new crops

      - As a source of material for breeding improved varieties

      - As a source for biodegradable pesticides.

b. To improve traits of varieties-

Ex. Rice grown in Asia is protected from the four main diseases by gene received form a single wild rice species *Oryza nivara* from India.

2. **Drugs and medicines-**

Biodiversity provides substances derived from plants for the therapeutic uses.

• Quinine to treat malaria obtained from *Cinchona ladgerina*.

- Morphine used as an analgesic obtained from *Papaver sominiferum.*

- Taxal used as anticancer drug obtained from *Taxus brevifalia & T. baccata.*

- Plants and plant products for the manufacture of many synthetic phytochemicals products.

3. Aesthetic and Cultural Importance-

- Ecosystems, bird watching, wild life, pet keeping, gardening etc.

- Aesthetic value of diversity.

- In majority of Indian villages and town, following plants are considered sacred and worshiped by the people.

  Ocimum sanctum (Tulsi), *Ficus religiosa* (Pipal), *Eregrostis cynasuroides* (Kusa grass), *Dolomiaea cynasuroides* (Dhup), *Sesmum indicum* (til) etc.

- Several birds and even snakes considered sacred.

- Since longtime, we recognize plants and animals as symbols of national pride and culture.

4. <u>Ecosystem Services-</u>

Biodiversity:

- Essential for the maintenance of food chains and energy flow.

- In forest & ocean system, it helps to maintain the gaseous composition of the atmosphere & climate.

- Controls natural pests, regulates pollination of plant by insects and birds.

- Protects soils.

- Conserves and purifies water continents.

LOSS OF BIODIVERSITY

The earth's biological wealth or biological activity diversity is the entire complement of life that has survived nearby 4 billion years of evolution. However, in recent times, the ever increasing loss of this biological wealth has posed serious threat to the very existence of mankind. Some of the factors responsible for the degeneration of biodiversity are-

Factors responsible for the degeneration of biodiversity

i.   Prevailing illiteracy

ii. Poverty

iii. Lack of scientific development

iv. Burgeoning population

But primary factors for loss of biodiversity are:

i.   Destruction of habitat and habitat fragmentation leading to species movement to other habitat where they find it difficult to adopt.

ii. Extensive hunting of wild animals and over exploitation of plants and trees in the wild.

According to the Global Biodiversity strategy (WRI/IUCN/UNEP, 1992), there are six fundamental causes of biodiversity degeneration:

i.   Unsustainable rules of human population growth and natural resource consumption.

ii. Steadily narrowing spectrum of traded products from agriculture and forestry and introduction of exotic species associated with agriculture, forestry and fisheries.

iii. Economic systems and policies that fail to value the environment and its resources.

iv. Inequity of ownership and access to natural resources, including the benefits from use and conservation of biodiversity.

v.   Inadequate knowledge and inefficient use of information.

vi. Legal and institutional systems that promote unsustainable exploitation.

There are five great episodes of extinction of biodiversity including the mammoth dinosaurs.

1st – Ordovician period (448 million years ago)

2nd - Devonian period (356 million years ago)

3rd - Permian period (286 million years ago)

4th - Triassic period (210 million years ago)

5th – Cretaceous period (66 million years ago)

Diversity loss due to climate change

Facing today due to human activities

- Topical forest cover is being lost at the rate of about 0.16 billion hectare per decade.

- Of the 25 hot spots of biodiversity, two of them belong to India- 1. The Eastern Himalayas, 2. Western Ghats.

- India is referred as a "Mega diversity" nation due to its rich floral and faunal wealth.

- Tropical deforestation will be the single greatest cause of species extinction in the next half century.

- All over the world, about 60,000 species of plants and 2000 species of animals are on the verge of extinction.

- About 343 fishes, 50 amphibians, 170 reptiles, 1355 invertebrates, 1037 birds and 497 mammals are threatened.

- The disappearance of species also means a reduction of genes from the gene pool. This reduction in the genetic resources of the Earth is known as genetic erosion.

Genetic erosion is a matter of great concern.

BIODIVERSITY CONSERVATION

Now-a-day need of biodiversity conservation is indispensable for the sustenance of living organisms including human beings.

Whenever, we talk about the conservation of biodiversity, all the species, which play a very important role, may be divided in 4 categories:

Species specific conservation

1. Endemic species   2. High-impact species   3. Conservation focus species   4. Indicator species
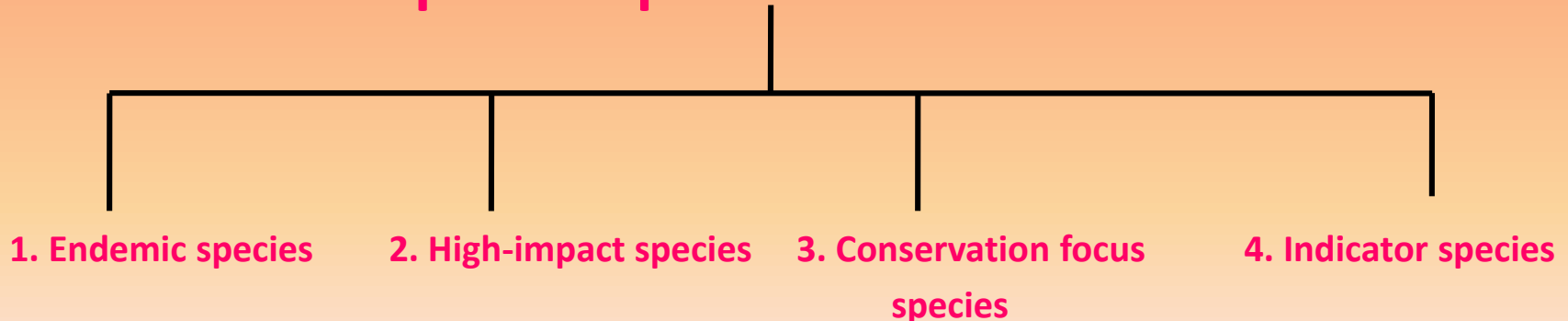
1. Endemic Species

- Having restricted distributions

- Narrow range species

- Important focus for conservation.

According to (Engler 1982) endemic species are classified following ways on the basis of their spatial distribution, Inferred evolutionary age, and affinities and abundance.

1.Neoendemics- Comprising clusters of closely related species and sub-species that have evolved recently ex. *Cichlid* fish of Lake Malawi.

Endemic Species

2.Palaeoendemics

Comprising phylogenetically highly ranking taxa, usually monotypic sections, sub-genera and genera that may be regarded as evolutionary relics.

Ex. *Welwitschia mirabilis* of the Namib desert.

2. High-Impact species

- Species which have more influence on ecosystems than others.

- Impact and abundance may change over time with other species replacing them in their influential position.

On the basis of relevant to biodiversity conservation, they are (a) Keystone species and (b) Exotic species

(a) Keystone species-

- Species that maintain the structure and organization of the community.

- Allow large no. of other species to persist in the community.

Ex. *Ficus religiosa* (Peepal), *Ficus benghalensis* (Bargad)

Ficus glomerata (Gular), *Ficus carica* (Anjeer), *Ficus racemose* (Pakar)

(b) Exotic Invasive-

- Newly appearing species either in natural or human influenced ecosystems.

- Any type of organism such as pathogen, vector, weed or invasive animals.

3. Conservation-Focus Species

Species that flag conservation efforts. It is of three types:

1. **Threatened species-** Dwindling species of plants and animals.

2. **Umbrella species-** Whose occupancy area (plant) or home range(animals) are large enough and whose habitat fragments are wide enough such that if they are given a sufficiently large area for their protection, they will also bring other species under the protection.

3. Flagship species-

Popular charismatic species that serve as symbols and rallying points to stimulate conservation awareness and action.

Ex. Condors, pandes, rhines, large cats, large primates, orchid, cacti, large butterflies stick insects.

1. Threatened species

➢ **Endangered species-** In danger of extinction and whose survival is unlikely if the causal factors continue to be operating. Ex Tiger, Rhinoceros

➢ **Critically endangered species-** Facing extremely high risk. Ex. Hawksbill sea turtle

➢ **Vulnerable species-** Likely to move into the endangered category in the near future if the causal factors continues to operate. Ex. Snow leopard

- **Rare species-** At risk because of low number. Ex. Leatherback sea turtle

- **Indeterminate species-** In danger of extinction but the reason is not known.

- **Threatened species-** Often genetically impoverished of low fecundity, dependent on patchy or unpredictable resources, extremely variable in population density, persecuted or otherwise prone to extinction in human dominated landscape. Eg. Sumatran elephant

- **Insufficiently known species-** Probably belong to one of the conservation categories but are not sufficiently known to be assigned to a specific category. Ex. Whale shark

➢ **Extinct species-** No longer known to exist in the wild.

➢ **Extinct species in the wild-** Known only to survive in cultivation, in captivity or as naturalized population well outside the past range. Ex. Dodo

➢ **Conservation dependent species-** Not critically endangered, endangered or vulnerable but are the focus of a continuing species-specific or habitat-specific conservation programme targeted towards the species in question, the cation of which result in the species qualifying for one of the threatened categories above within a period of five years. Flowering plant *Garcinia hermonii*

- **Near threatened species-** Not critically endangered, endangered or vulnerable or conservation dependent but close to qualifying for vulnerable. Ex. Nilgiri tahr

- **Least concern species-** Not critically endangered, endangered or vulnerable or vulnerably and not qualifying for conservation dependent or near threatened. Ex monkey

- **Data deficient species-** Well studied, biology well known, but appropriate data on abundance-or distribution lacking to keep in threatened categories. Ex *Lamprey*

4. Indicator Species

- Monitoring species for change in biotic and abiotic conditions.

- Reflects the quality and change in environmental conditions as well as aspects of community composition.

- Used in environmental assessment and in the preparation of environmental sensitivity maps.

Biologically indicators:

- **Sentinels-** Sensitive species introduced into a typical conditions as early warning devices. Canary bird in coal mine

- **Detectors-** Occurring naturally in the area of interest that may show measurable response to environmental change. Ex Grey long-eared bat

- **Exploiters-** Presence indicates the probability of disturbance or pollution. Ex Common starling

- **Accumulators-** Accumulates chemicals in their tissues. Water hyacinth

- **Bioassay organism-** Selected organisms sometimes use as laboratory reagents to detect the presence and/or concentration of pollutants. Ex *Daphnia magna*

Need of Conservation of Biodiversity

Most biologists accept the estimate of the American evolutionary biologist Edward O. Wilson that the earth is losing approximately 27,000 species per year. This estimate is based primarily on the rate of disappearance of ecosystems, perhaps due to:

1. Population explosion
2. Deforestation
3. Introduction of exotic species
4. Environmental pollution

5. Over-exploitation of selected species
6. Destruction of organisms for commercial purposes
7. Natural calamities
8. Threat of war.

Scientists have discovered and named only about 1.75 million species less than 20% of those estimated to exist. Biodiversity has immense significance such:

i. As a valuable natural resource
ii. For maintenance of the balance of the ecosystem.

iii. As a valuable genetic resource.

iv. Role in the conservation of abiotic resources.

Hence, it causes prime concern for us to take steps to conserve biological diversity.

Thanks

NURTURE THE NATURE FOR OUR FUTURE