Biodiversity And its Conservation

Biodiversity → Variety & variability of living organisms on Earth.

or

Variety of life forms, gene pools and habitats found in an area.

Popularised by Sociobiologist Edward wilson

★ Three levels hierarchial levels or interrelated Component of biological organisation

① Genetic Diversity
→ A single species shows high diversity at the Genetic level.
→ Variety in genetic information contained in the organisms.
→ enables population to adapt to its environment.

> 20,000 species of ants,
3,00,000 species of beetles.
28,000 species of fishes
nearly 20,000 species of orchids.

Note → Creates → different Sub-species, Variety, breed, forms etc.

e.g → > 50,000 Genetically different strains of rice and 1,000 Varieties of mango.

Genetic variation medicinal plant Rauwolfia vomitoria growing in different Himalayan ranges
terms of conc. & potency of active chemical reserpine. that produce plant.

② Species Diversity

diversity at species level or measure of variety species & their relative abundance within a region.

western Ghats have more amphibian species diversity than Eastern Ghats.

Two important species diversity

① species richness
→ No. of species per unit area.
→ species richness is higher species
→ diversity increase.

② species evenness
→ relative abundance of species in an area.

③ Ecological Diversity

Diversity at ecosystem level.
→ Presence of more variety of ecosystem & habitats.

i.e- Rainforest, mangroves, coral reefs, desert, wetlands & alpine meadows.

→ India has greater diversity than Scandinavian countries (e.g. Norway).

Magnitude of Biodiversity (India)

According to IUCN (International union for Conservation of Nature) 2004.

→ Total plant & animal species described so far is more than 1.5 Million

→ Assuming large No. species undiscovered in tropics

temprate - tropic statistical comparison ratio of plant & animals.

Gross estimate Total No. of species on Earth 20-50 Million.

- Scientifically Sound estimate by Robert May places Global diversity 7 million.

> 70% species animals

not more than 22% plant comprise

→ Insect species rich taxonomic group. In Animal Kingdom (70% animals are insect) out of every 10 animals 7 are insects on earth.

→ No. of Fungi species in world = total no. of species of fishes, amphibians, reptiles & mammals.

→ Biologist not sure about prokaryotic like → archaea, bacteria, Protists etc.

Reasons

i → taxonomic methods are not sufficient

ii → some Cannot culture under laboratory Conditions.

iii → Molecular & biochemical are adapted for delineating microbial species. this would put their diversity into millions

Indian Biodiversity

→ is one of 12 megadiversity Countries of world.
→ has only 2.4% of world's land.
→ But shares 8.1% of world's species diversity.

45,000 species of plant and twice of animals.

> 1,00,000 species (plant) & 3,00,000 (species animal)

yet to be discovered.

If Apply Robert May's Global estimate than only 22% of species have been recorded.

Patterns OF Biodiversity

→ Biodiversity is not uniform throughout world.
→ Varies with changes in latitude and altitude.

Latitudinal Gradients

→ Equator → Pole → species diversity decreases.

→ Biodiversity more at lower latitude (equator) than higher latitude (poles).

★ Tropics (latitude range of 23.5° N to 23.5° S) more species than temperate or polar area.

★ e.g

Colombia → near equator → 1400 species of birds
New York → at 41°N → 105 species of birds.
Greenland → at 71°N → 56 species of birds.

→ Indian tropical latitude areas has > 1200 species of birds.

→ Forest equal area in tropical region has 10 times more species of vascular plant in temperate region (mid west of USA)

→ Amazonian rainforest in South America has greatest biodiversity on Earth.
- > 40,000 species of plants
- 3,000 of fishes.
- 1,300 of birds
- 427 of mammals and amphibians
- 378 of reptiles
- > 1,25,000 of invertebrates

2 Million species of insects are still waiting to be discovered.

Reason For Greater Biodiversity in Tropics

i) Temperate regions were subjected to frequent Glaciation in past which killed most of species (speciation)
But tropics have remained undisturbed & evolved more species.

ii) T.R. are less seasonal, relatively more constant & predictable than temperate region.
Such region promote niche specialisation (Optimal Environment)
Promote greater species diversity.

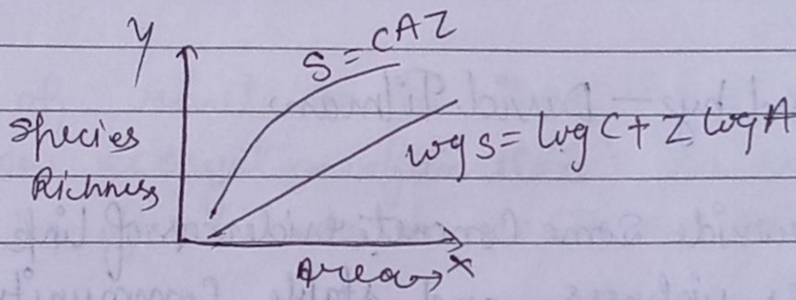
iii) More Solar energy is available in tropics

iv. Resources availability higher & rate of extinction is low in tropics.

Species - Area Relationship

- Alexander Von Humboldt — South America Jungle observed with in a region, the species richness increases when the exposed area increases ~~also~~ (But upto a certain limit)

- When the relationship b/w species richness and area for number of taxa (~~like~~ angiospermic plants, fresh water fishes, birds etc) is plotted. then the curve obtained is Rectangular hyperbola.



Where S = species richness
Z = slope of line
A = Area
C = Y - intercept

* Value of Z

A. In Normal area = Z = 0.1 to 0.2
(interceptive of the taxonomic groups)

B. In very large areas (eg. Entire Continent)

$z = 0.6$ to 1.2

* Here the slope is much steeper
eg Fruit eating birds (Frugivorous birds) and mammals in tropical forest have the value of z equals to 1.15.

Important of Species Diversity to the Ecosystem

→ Ecologist believed that Community with more species tend to be more stable than those with less species.

→ Confirmed by — David Tilman

He provide some Concrete evidences of link ~~for~~ species richness and stable Community By long-term ecosystem experiments using outdoor plots.

i) does not show too much of variations in year to year productivity.

ii) ~~Resistant~~ Resistant to occasional disturbances (man-made or natural)

iii) Resistant to invasion by alien species.

Importance of biodiversity for survival of species can be explained by rivet popper hypothesis proposed by Paul Ehrlich

→ A.T. this hypothesis ecosystem is like an aeroplane & all its parts are joined together using thousands of rivets (species)

→ If every passenger, travelling in it, starts popping rivets to take home (causing a species to become extinct) it may not affect safety (proper functioning of the ecosystem)

→ But as more and more rivets are removed the plane becomes dangerously weak over a period of time.

→ Loss of rivets on the wings (key species that drive major ecosystem function) is more serious than loss of rivets on seats or windows inside the plane.

Loss of Biodiversity

→ Biological wealth of earth is declining rapidly & human activities major reason.

→ Colonization at trophic levels Pacific Islands by human led extinction > 2,000 native bird species.

→ IUCN was founded in 1948.
Head quarter → Switzerland

★ → IUCN work on nature conservation & substainable use of natural resources.

→ IUCN red list threatened species an inventory of Global conservation status of biological species.
Compiled in Red Data Book
Initiated in 1963.

→ IUCN Red list (2004) enlist extinction of
784 species.
- 338 vertebrates
- 359 invertebrates
- 87 plants

→ In last 500 years.

→ Red list of (2012)
132 plants & species & animal species extinction in India.
↓
Some examples

i Dodo (Mauritius), Quagg (Africa), Thylacine (Australia), Steller's sea cow (Russia) & 3 Sub species of tigers (Bali, Javan & Caspian)

ii) 27 species disappeared in last 20 years in the World.
> 15,500 species endangered

Note → 12% of all bird species, 23% of all mammal species, 32% of all amphibian species & 31% of all Gymnosperm Facing Extinction. threat

Amphibians are more Vulnerable to extinction

iii) Endangered species
High risk of extinction in near future due to decrease in its habitat, excessive predation.

→ ex- Asiatic lion, Bengal tiger, Lion tailed macaque, Nilgiri langur, Gangas river dolphin etc.

Extinction in Biodiversity

→ Study of fossils record reveals that large Scale loss of species had also occurred earlier even before humans appeared.

{ There have been 5 episode of mass extinctions
During long-period of > 3 billion years due to natural climate. e.g → Extinction of dinosaurs

→ Currently earth is heading towards the 6th extinction which is different from previous episodes in the rates.

→ Current species extinction rates are estimated to be 100-1000 times faster than in the prehuman times.
Humans activities are responsible for faster rates.

→ If present rate goes on then 50% species might be wiped out within next 100 years.

Loss of biodiversity may lead to

i. Decline in plant production.

ii. Lower resistance to environment.

iii. Increased variability in ecosystem processes. Such as Water use; pest & disease cycles etc.

CAUSES OF LOSS OF BIODIVERSITY

Four major causes also called the Evil Quarter

1-Habitat loss and fragmentation

- Most important cause of extinction of both plant & animals species.
due to habitat loss → 14% earth's land surface covered by tropical rainforest

now limited to only 6% in last few year

- Amazon rainforest (lungs of the planet) are also being cut & destroyed for cultivation of Soybean or converted into Grasslands for raising beef cattle.

→ degradation of many habitat by pollution also threatens the survival of many species.

→ When large habitats are broken up into small fragments due to various human activities, mammals & birds requiring large territories & certain animals with migratory habits are badly affected.
Leading to population declines

2. Over exploitation

- → Humans are dependent on nature for food and shelter. But human needs turns into greed

→ this leads to degradation & extinction of natural resources

- Presently many marine fishes are overharvested, which is threatening the existence of some Commercially important species

3- Alien (Exotic) Species Invasions

Introduction of alien species also causes risk of extinctions.

When alien species are introduced, some of them turn invaise and cause ~~diseas~~ decline of indigenous species.

e.g → Nile perch (fish)

↓

A lave Predater fish when introduce into Lake Victoria in East Africa eventually led to the extinction of > 200 species of Cichlid fish in the lake.

- In India

→ weed species like → Parth-enium (carrot grass), lantana and water hyacinth (Eichhornia) had caused immense environmental damage & posed threat to our native species.

→ Recent introduction of African Catfish (clarias garcepinus) illegally for aquaculture purpose is posing great threat to the indigenous catfish of Indian rivers.

4- Co-Extinctions

when a species become extinct the plant

and animals species associated with it, in an obligatory way also extinct.

e.g → species of fish become extinct all parasites unique/specific to that fish also face extinction.

Similarly → case of a co-evolved plant pollinator (mutualism).

NOTE → Extinction of one species invariably leads to extinction of the other.

Biodiversity Conservation

→ protection, upliftment & scientific management of biodiversity so as to maintain it at the optimum level & derive sustainable benefits for present as well as future generation.

① Narrowly Utilitarian Argument

→ Based on obvious reasons.
→ Human derive countless direct economic benefit from nature e.g - food, firewood, ~~dyes~~ fibre, construction material & product of medicinal purpose.

→ 25% drugs currently sold in market world wide derived from plants.

→ derived from plants & 25000 plant species are used in traditional medicines

- bioprospecting
  ↓
  Exploration of molecular, genetic and species-level diversity for obtaining products of economic importance.

2- Broadly utilitarian Argument

i Production of oxygen (Amazon forest produce 20% of total oxygen in the earth's atmosphere via photosynthesis.)

ii Pollination is ~~does~~ not possible without pollinator layer. i.e: bees, bumble bees, birds & bats.

iii Control of floods & Soil Erosion

iv Intangible benefits of nature like aesthetic pleasures.

3. Ethical Argument

→ Every species has an intrinsic value, even if it is not of any economic value to us.

→ our Moral duty to care for their well being & pass on our biological legacy in good order to future generations.

→ Plants like → Tulsi and peepal have religious importance as well.

Approaches to Conserve Biodiversity

In Situ Conservation

- Biodiversity hotspots
- Protected areas
  - → National park
  - → Ramsar sites
  - → Biosphere reserve
  - → wildlife Sanctuaries
  - → Sacred Groves.

Ex Situ Conservation

- Protection of gametes
  - → cryopreservation
  - → seed Banks
  - → Tissue culture
- Protection of threatened species
  - → Botanical gardens
  - → Zoological Parks
  - → Wildlife Safari Park

I In Situ (Onsite) Conservation

Conservation of and protection of the whole ecosystem and its biodiversity at all levels in order to protect the threatened species.

1. Biodiversity Hotspots

- Eminent Conservationists have identified certain regions for the maximum protections. Called biodiversity hotspots.

- endemism
  species confined to a region & not found ~~anywhere~~ anywhere else)

Initally 25 bidiversity hotspots : +9
Now 34 " " all over world

- Hotspots in India (3)
  - Western Ghats and Sri Lanka
  - Indo-Burma (1) & Eastern Himalaya (1)

All together cover less than 2% of earth's land area but have high diversity.

→ Ongoing mass extinctions could by reduced 30% through strict protection of these hotspots.

2- Protected Areas

i. National Parks

→ These are government maintained areas (90 in India) for betterment of wildlife.

1st national Park in India → Hailey's National Park (1936)

ii. Wildlife Sanctuaries

→ tracts of land with or without lake where wild animals can take refuge without being hunted.

448 in India.

⁂

→ Other activities like collection of forest products, harvesting of timber, Private ownership of land, tilling of land etc. are allowed here.

iii. Biosphere reserves

→ large tracts of protected land with multiple use preserving the genetic diversity of ecosystem by protecting wildlife, tradional life styles of tribals & Varied plant & animal genetic resources.

→ They have been setup under MAB (Man & Biosphere) Programme of UNESCO. ↓1986 in India

14 in India

iv Sacred groves

→ Small groups of forests with special religious importance in a particular culture are also of mythological importance.

- These are undisturbed forest without any human interventions & include a number of rare, endangered and endemic species.

- Found in

★ Khasi and Jaintia Hills in Meghalaya, Aravalli Hills of Rajasthan. Western Ghat regions of Karnataka and Maharashtra and Sarguja Chanda & Baster areas of Madhya Pradesh

- These are protected by nature people as a part of cultural tradition

In Meghalaya Sacred groves are the last refuges for a large number of rare & threatened plants.

(v) Ramsar Sites

These are wetlands designated as internationally important under the Convention

Wetland held at Ramsar

→ Iran in ~~1967~~ 1971 conservation & wise use of wetlands. Thus known as Ramsar Convention

[The maintenance of their ecological character achieved through the implementation of ecosystem approaches, within context of sustainable development.
→ (wise use of wetlands)

* → Wise use of wetland & their resources for the benefit of humankind.

26 Ramsar Sites in India

ex- Ashtamudi wetland Kerala
Sambhar lake Rajasthan
Chilka lake Odisha
Renuka wetland Himachal Pradesh etc

II. Ex-Situ (off site) Conservation

Remove from natural habitat and preserve in special setting where they can get care and & protection easily

Protection of Threatened species

Done by live collections of wild life and domesticated species in Botanical Gardens, Zoological Parks Safari Parks etc.

zoological

India has 355 parks,
↳ Animals which have extinct in the wild are Continued to be maintained, ~~and has~~

35 botanical Gardens
↳ where plants species are protected.

Protection of Gametes

1. Seed banks
Storage of different genetic strains of Commercially important plants in the form of seed is one of most widespread & valuable ex-situ approaches of Conservation strategy

2- Tissue Culture
is widely used to produce clones of a plant in a method known as micropropagation.

This method useful in ~~maintenance~~ maintaining a large No. of genotype in small area, rapid multiplication of even endangered species & for hybrid recuse
eg → Banana & Potato.

3- Cryopreservation
method of in in Vitro conservation in liquid N_2 at temp. of -196°C (-130°F) in a controlled rate freezer for vegetatively propagated crops & storing other biological materials.

INTERNATIONAL INITIATIVES

- Biodiversity Conservation is a collective responsibility of all the nations.

(The Earth Summit) held in Rio de Janeiro in 1992 called upon all nations to take part or initiative in Biodiversity Conservation

- In a follow up World Summit on Sustainable Development was held in 2002 in Johannesburg South Africa.

- In this 190 countries made Commitments to significantly reduce the current rate of biodiversity loss at Global regional & local levels by 2010.

NOTE → In 2012 United Nations Conference on Sustainable Development was again held at Rio & is called Rio+20 or Rio Earth Summit 2012.