UG SEM 5/ HONS/SDG

Biodiversity is defined as "the variety and the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."

Biodiversity forms the foundation of the vast array of ecosystem services that critically contribute to human well-being.

Biodiversity is important in human-managed as well as natural ecosystems.

Decisions humans make that influence biodiversity affect the well-being of themselves and others.

Without biodiversity, the health of the planet is at stake.

Genetic diversity

The range of genetic material present in a gene pool or population of a species.

Wild mustard species have much more genetic diversity than the domestic varieties

Species diversity

The variety of species within a given area, habitat or region. This includes the number of species and the number of individuals of each species

This variety alters from habitat to habitat. The rainforests at one end with great variation and the polar ice caps at the other with little variation.

Habitat diversity

The number of different habitats per unit area that a particular ecosystem or biome contains. If diversity increase here it will probably lead to an increase in the other two.

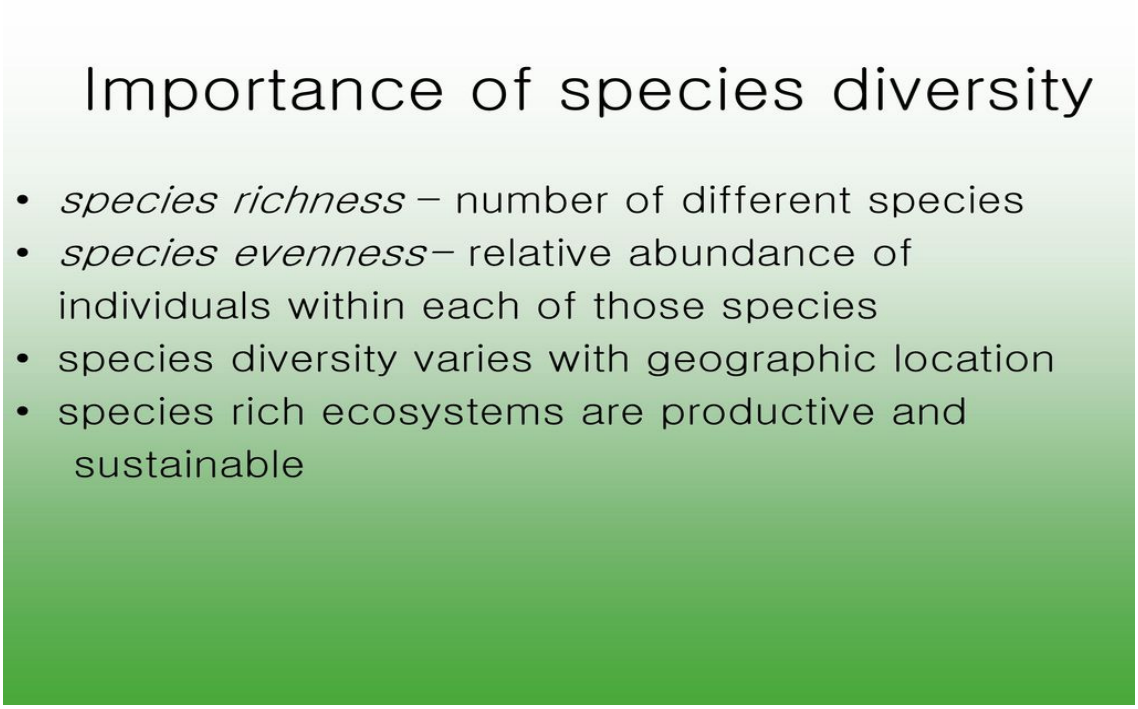
Species diversity- species are distinct units of diversity, each playing a specific role in an ecosystem.

Species diversity refers to the variety of species within a region.

The simplest measured is species richness that is the number of species per unit area. Generally the greater the species richness, the greater is the species diversity. Number of individuals among the species may also vary resulting into differences in evenness or equitability and consequently in diversity.

Species richness is only one aspect of diversity.

Not all species exist in equal numbers, some are rare, some are common but not numerous and others are very abundant.



Genetic Diversity

Genetic diversity refers to the differences in the **genetic make-up of a distinct species and to the genetic variations within a single species**.

It concerns DNA (or RNA in some viruses) sequences.

Humans, for example, have different eye and skin colors, hair textures, propensity for disease, reactions to pollutants, heights, hormone levels and so on.

We are the same species but have genetic variations which make us diverseGenetic diversity refers to the variation of genes within a species

The differences could be in alleles, in entire genes or in chromosomal structures.

The Genetic diversity enables the population to adapt to its environment and respond to natural selection.

The amount of genetic variation is the basis of speciation. It has a key role in the maintenance of diversity at the species and community levels.

Genetic diversity within a species often increases with environmental variability.

Ecosystem diversity

Ecosystems include all the species plus all the abiotic factors characteristic of a region.

For example a desert ecosystem has soil, temperature, rainfall patterns and solar radiation that affect not only what species occur there but also the morphology, behaviour and the interactions among these species.

Ecosystem diversity describes the number of niches,

trophic levels and

various ecological processes that sustained energy flow, food webs and the recycling of nutrients

Components and gradients of biodiversity

WHITTAKER 1972 described three terms for measuring biodiversity over spatial scales

alpha, beta and gamma

Alpha diversity refers to the diversity within a particular habitat or ecosystem. It is expressed as a number of species per unit area.

If we examine the change in species diversity between two ecosystems then we are measuring the beta diversity. We are counting the total number of species that are unique to each of the ecosystems being . Beta diversity allows us to compare diversity between ecosystems

Gamma diversity is a measure of the overall diversity for the different ecosystems within a region.

MEGADIVERSE COUNTRIES

The mega-diverse countries are **those that house the largest indices of** biodiversity**, including a large number of endemic species.**

This concept was first proposed in 1988 by Russell Mittermeier and is now used to raise awareness to the protection of natural biodiversity, and particularly in the countries where this is more abundant and threatened.

Although they only account for around 10% of the Earth's surface, the mega-diverse countries house at least 70% of the planet's terrestrial biological diversity, including more than two thirds of all non-fish vertebrae species and three quarters of all the higher plant species.

The World Conservation Monitoring Centre (WCMC) of the United Nations Environment Program has identified a total of 17 mega-diverse countries: **Australia, Brazil, China, Colombia, Ecuador, United States, Philippines, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, Democratic Republic of Congo, South Africa** and **Venezuela.**

A region which on one hand is a significant reservoir of biodiversity and, on the other

hand ,is threatened with destruction is designated as 'biodiversity hotspot". Myers et al., (2000 defined biodiversity 'hotspots' as areas of high biologtcal diversity with high endemism which are also under severe anthropogenic threats.

To be called a hotspot, a region has to be able to fulfil at least two criteria including:

1. It should comprise of at least 1500 species of vascular plants i.e. more than 0.5% of the world's total plants.

2. It should have lost greater than or equal to 70% of its original habitat.

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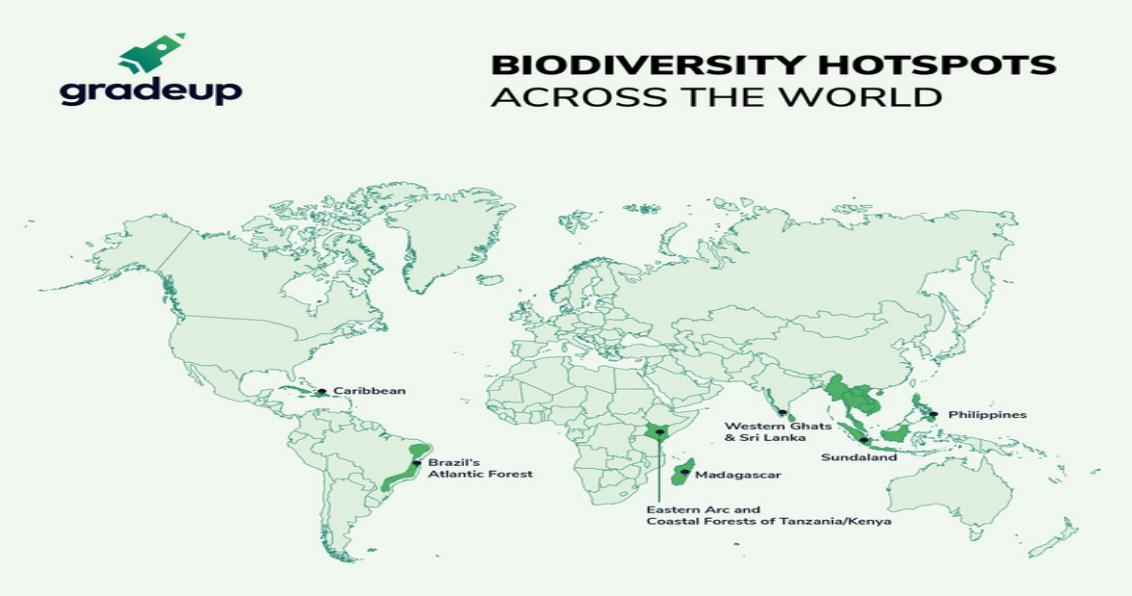


Keystone Species

If the activity of a species determines community structure in spite of their low abundance (or Biomass) that species is called a keystone species.

The term was introduced by Robert Payne(1966) to describe the importance of the Predatory starfish*Pisaster* on the intertidal community. *Pisaster* breed on a variety of intertidal organisms preventing any one species from becoming very common and outcompeting the others thus promoting species richness.

They play a vital role in controlling the relative abundance of other species.

The loss of a keystone species can lead to short population drops and extinction of other species that depend on it for certain services and and causes serious disruption in the functioning of the community.

Keystone species are those which have an extremely high impact on a particular ecosystem relative to its population.

Keystone species are also critical for the overall structure and function of an ecosystem, and influence which other types of plants and animals make up that ecosystem.

Thus, in the absence of a keystone species, many ecosystems would fail to exist.

Bees

With the aid of other pollinators (some of which, like hummingbirds, are also keystone species), bees support the reproduction of as much as 90 percent of the world's flowering plants.

Not only do they pollinate fruits, vegetables, and other crops that provide humans with everything from food to clothing to fuel, but they also help produce the seeds, nuts, berries, and fruit that countless other species in ecosystems around the world survive on.

Without bees, there would be a bottom-up cascade of consequences throughout the food chain.

Flagship Species

A flagship species is a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause.

These species are chosen for their vulnerability, attractiveness or distinctiveness in order to generate support and acknowledgement from the public at large.

By focusing on, and achieving conservation of that species, the status of many other species which share its habitat – or are vulnerable to the same threats - may also be improved.

Flagship species

-are usually relatively large, and considered to be 'charismatic' in western cultures.

-may or may not be keystone species and may or may not be good indicators of biological process.

-is a species chosen to represent an environmental cause such as an ecosystem in need of conservation.

Chosen flagship species

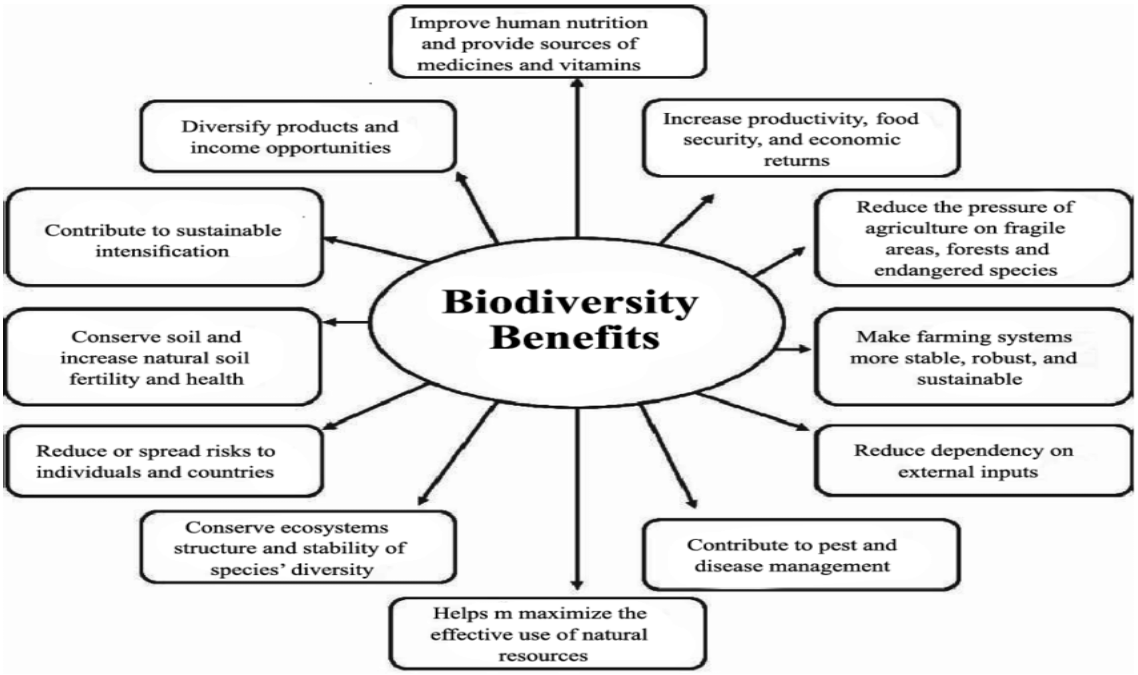
include

The **Bengal tiger** *(**Pantheratigris**),*

the **giant panda** (***Ailuropodamelanoleuca**),*

the **African elephant** *(**Loxodonta** sp.)* and

Asian elephant (*Elephasmaximus*).



MODES OF CONSERVATION

There are two distinct modes of conservation *viz., in-situ* conservation and *ex-situ*

conservation.

1 *In-situ* Conservation

Conservation of a species (or genetic resources) within their original habitat is termed as *in-situ* conservation.

For *in-situ* conservation, the area with most potential resource base needs to be identified and the area

is to be demarcated as protected area.

As the species is conserved in their natural habitat, hence, this type of conservation is also commonly

called as 'on-site conservation'.

India is carrying out *in-situ* conservation since long back through establishing a network of protected

areas (PAs)throughout the country safeguarding the natural habitatsof several threatened species.

Such PAs are of various categories *viz.* species oriented wildlife reserves, nationalparks, wildlife

sanctuaries, biosphere reserves, community reserves, conservation reserves, cultural landscapes, etc.

2 *Ex-situ* Conservation

Conservation of a particular species, or a part of it. outside its original habitat is known as*ex-situ* conservation.

In this mode of conservation, the sample population is usually kept in a simulated environment and is perpetuated in

*genetic*resource centres,

zoological parks,

botanical gardens, etc

.

Besides, gene pools and gametes are stored in germplasm banks for seeds, pollens, semen, ova, cells, tissues etc.

Therefore, *ex-situ* conservation is commonly referred to as `outside habitat conservation'.

In addition to protection of a species in captivity, the objective of *ex-situ* conservation is also to reintroduce the individuals of wild species back to the nature.

TIGER

The main threats to the tiger are hunting, poaching, habitat loss, deforestation and a shortage of its prey. The world's biggest cats are suffering from the loss of their habitat and a lack of available prey. Intensive farming, livestock grazing, and also the excessive use of forest resources by humans have largely contributed to their disappearance.

Habitat destruction and loss of prey species

Large-scale habitat destruction and decimation of prey populations are the major long-term threats to the existence of the dwindling tiger population in the country. Less than a hundred years ago, tigers prowled all across India and the sub-continent. But growing human populations, particularly since the 1940s, have contracted and fragmented the tiger's former range. Although extensive habitat is available in some landscapes, agriculture, clearing of forests for development – especially road networks, hydel projects are forcing tigers into small and scattered islands of remaining habitat. Tigers need large territories. And along with habitat, tigers have also suffered a severe loss of natural prey populations – in particular ungulates such as deer and antelopes.

ILLEGAL WILDLIFE TRADE

The most immediate threat to the survival of continental tigers is poaching to supply the demand for tiger parts on the black market.

Despite a global trade ban in the past few decades, the demand for tiger products as status symbols, decorative items, and folk cures has increased dramatically, leading to a new poaching crisis.

Project Tiger:

The Government of India launched Project Tiger on April 1, 1973 in the Corbett National Park as a consequence of the concrete international effort to create an awareness and raise funds for saving the tiger. KailashSankhala was the first director of Project Tiger.

This international effort was led by Guy Mountfort of the World Wide Fund for Nature (WWF).

It ensured maintenance of a viable population of tigers in India "for scientific, economic, aesthetic, cultural and ecological values, and to preserve for all times, areas of biological importance as a national heritage for the benefit, education and enjoyment of the people".

Initially, nine tiger wildlife reserves (with 268 tigers) constituted the Project Tiger network. The government has set up a Tiger Protection Force to combat poachers and funded relocation of villagers to minimize human-tiger conflicts.

The enhanced village relocation;

rehabilitation of communities involved in traditional hunting and

mainstreaming livelihood and wildlife concerns in forests;

and fostering corridor conservation through restorative strategy to stop habitat fragmentation.

International Cooperation in Tiger Conservation:

A memorandum of understanding (MoU) with Nepal on controlling trans-boundary illegal trade in wildlife and conservation.

i. A protocol on tiger conservation with China.

ii. A Global Tiger Forum of Tiger Range Countries for addressing international issues related to tiger conservation.

iii. A resolution along with China, Nepal and Russia for restricting breeding tigers on a commercial scale and for adopting measures to conserve wild tigers.

Wildlife (Protection) Act, 1972 was amended in 2006 to incorporate the creation of the National Tiger Conservation Authority. The first meeting of the National Tiger Conservation Authority was held in November 2006.

With the amendment of this Act, a Wildlife Crime Control Bureau was also subsequently established.

The Project Tiger guidelines have been further revised and include funding support to states for

OLIVE RIDLEY TURTLE

Threats to survival:

✓Commercial and recreational fishing - Accidental killing of adults through entanglement in trawl nets and gill nets due to uncontrollable fishing during the mating season around nesting beaches is considered to be the **most severe threat** for turtles.

✓Boat strike - Fast moving boats have the potential to cause marine turtle injury or death (boat strike or collision).

✓Poaching - They are still extensively poached for their meat, shell and leather and their eggs have a significantly large demand around the coastal region.

✓Predation – Predation pressure on the juvenile turtles is very high throughout their distribution range. The juveniles are exposed to predators (like feral dogs, jackals, hyenas, predatory and scavenging birds, ghost crabs, fiddler crabs etc.) prowling around their nesting sites and when they emerge from their nests and travel across the beaches to sea water, they are killed in large numbers.

Adult turtles are rarely predated upon by crocodiles, sharks and killer whales in the open seas.

Larvae may die due to infesting by beetles. **Fibropapilloma**, caused by a herpesvirus, is the only disease identified in these sea turtles almost throughout the world.

✓Marine debris – Death can occur when turtles become entangled in or ingest marine debris.

✓Habitat loss and degradation – Face serious threats from destruction and degradation of natural habitat along their nesting beaches. The increasing demands for developmental activities result in excessive release of oil and gas into their sensitive habitats. In power plants, juvenile and sub adult turtles get entrapped within the saltwater cooling intake systems. Some of their foraging grounds are also contaminated due to sewage, agricultural runoff, pesticides, solvents and industrial discharges. Beach erosion has also been cited as potential threat to their nesting grounds.

In addition, coastal developments and exploitation of nesting beaches for ports can directly destroy or degrade beach habitats.

<u>Conservation Initiatives</u>:

✓Various international treaties and agreements has been enforced to prohibit international trade on olive ridley turtles.

✓Coordinated national programmes with cooperation from local communities and NGOs have been focused on their conservation.

✓Arribada management has also played a critical role in conserving olive ridley turtles.

✓Enforcing the use of **'Turtle Excluder Devices' (TED)** in the shrimp trawling industry has also proved effective in some areas. TEDs are specially designed nets with an exit cover which allows the turtles to escape while retaining the catch.

✓WWF-India, along with the fisherman community, are helping in various ways to ensure a safe passage for the hatchings to the sea.

✓Gahirmatha coast serves as the **natal nesting beach** for millions of turtles and is regarded as the world's largest rookery of these turtles. Thus, considering the ecological significance of diverse faunal and floral resource of this coast and its adjoining waters in the turtle conservation, government of Orissa has declared the beach and its adjoining waters as **"Gahirmatha Marine Sanctuary"** in September 1997.

WHITE RUMPED VULTURE

THREATS

1.Electrocution from overhead electricity wires is another reason cited in the research, because the larger the bird and its wing span, the higher the chances of electrocution.

2. Food Shortage

Central government has given a directive to villagers to bury the carcasses of dead animals in order to keep villages clean. While the effort is good, the lack of animal carcasses leaves the vulture hungry and without food.

3.Though the use of Diclofenac may be one of the causes for the vulture deaths, it may not be the sole reason as the drug has also been banned from use and its usage has reduced if not totally stopped. The shelf life of Diclofenac is 6 hours and if the vultures do eat the carcasses of animals who have been administered the drug, the chances of the chemical reaching their body is very less.

4. Pesticides

Many farmers spray cattle carcasses with the pesticide such as Organo-chlorine and Organo-phosphorous to prevent them from spreading foul odour. This pesticide infested carcass may be eaten by the vulture leading to its death. The scientists have found instances where hundreds of vultures have died this way.

Conservation Actions Proposed

1.Continue to measure the frequency of diclofenac and ketoprofen-treated carcasses available to vultures.

2.Support the ban on the veterinary use of diclofenac, and support species management or restoration, as needed. Strengthen public awareness and public support programmes, including providing veterinary camps and livestock management training (SAVE 2014).

3.Monitor remaining populations Monitor the sale of veterinary drugs, and contamination of ungulate carcasses/dead vultures (SAVE 2014).

4.Provide supplementary food sources, with appropriately-sized carcasses, where necessary for food-limited populations.

5.Support captive breeding efforts at a number of separate centres with the aim of holding at least 150 pairs of each species in captivity (Johnson *et al.* 2008, Pain *et al.* 2008).

6. Manage genetic stock in the captive-bred population (Bowden *et al*. 2012). Promote the immediate adoption of meloxicam as an alternative to diclofenac, and improve its availability (SAVE 2015).