



Definition

- Biodiversity is defined as **‘the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems’**.
- Biologists most often define biodiversity as the **"totality of genes, species and ecosystems of a region"**.

Origin of the Term

- The term biological diversity was used first by wildlife scientist and conservationist, **Raymond F. Dasmann**, in the year 1968.
- The term's contracted form biodiversity may have been coined by **W.G. Rosen** in 1985.

Levels of Biodiversity

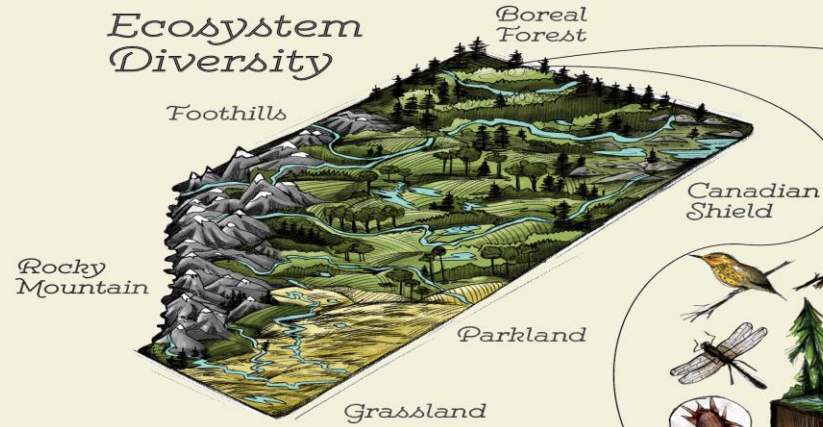
There are **three levels of biodiversity** :

1. Genetic diversity आनुवंशिक
2. Species diversity and प्रजाति
3. Ecological diversity पर्यावरणीय

Genetic Diversity

- **There can be a large number of genetic combinations possible within a particular group of species.**
- E.g. each human being is very different from all others.

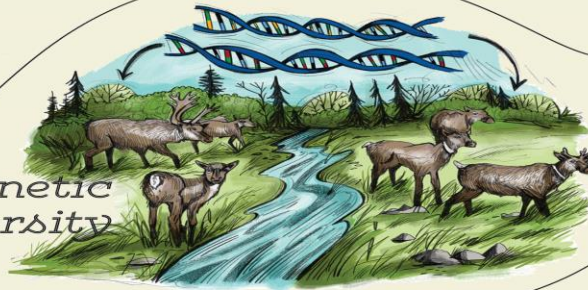
Ecosystem Diversity



Species Diversity



Genetic Diversity



- Genetic diversity is essential for a healthy breeding population of a species.
- **Lesser genetic diversity increases possibility of inbreeding** which can eventually lead to the extinction of the species.
- Wide diversity allows adaptation of some individuals to extreme conditions which in turn decide the survival of a particular species.

Species Diversity

- Species diversity refers to the **number of species of plants and animals that are present in a region.**
- Species diversity consists of
 - 1.Species richness (simple count of species)
 - 2.Species evenness (how equal the abundances of the species are)

Communities *a* and *b* both contain five tree species. However, because community *b* has greater species evenness, it has higher diversity.

Community *a* is dominated by one of its five species and so has lower diversity than...

...community *b*, which has the same five species but in equal proportions.

(a)

Lower
species
evenness



(b)

Higher
species
evenness



- A high level of species richness may indicate the presence of rare species or species that are unique to an ecosystem.
- Areas that are rich in species diversity are called ‘hotspots’ of diversity.
- India is among the world’s 17 nations that are exceptionally rich in species diversity.
- 17 megadiverse countries are: Australia, Brazil, China, Colombia, Democratic Republic of the Congo, Ecuador, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, South Africa, United States and Venezuela.

Ecological Diversity

- It is the **variation in both terrestrial and aquatic ecosystems** found in a region.
- It also takes into account the **variation in the complexity of a biological community**, including the number of different niches, the number of trophic levels and other ecological processes.

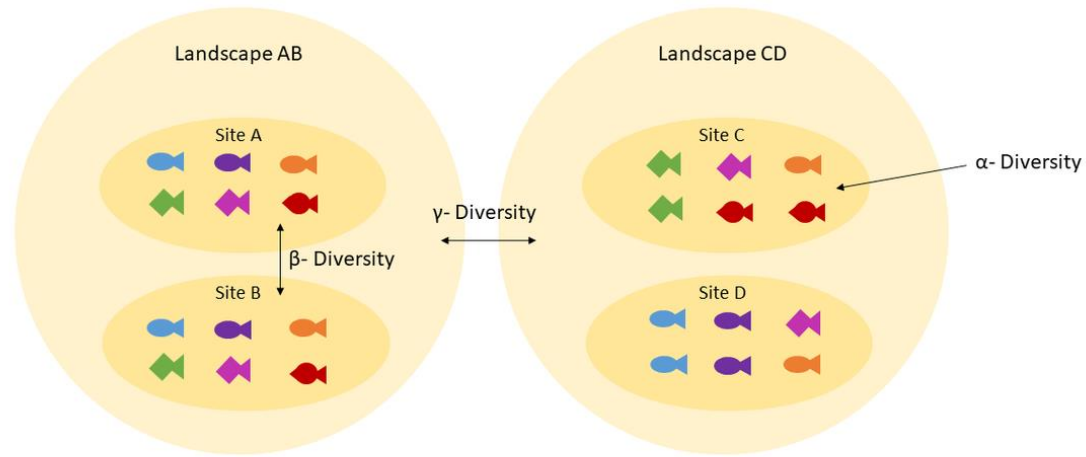
Measurement of Biodiversity

- Biodiversity is measured in terms of
 - Species richness
 - Species evenness
- The measurement of biodiversity as it indicates the health of an ecosystem.

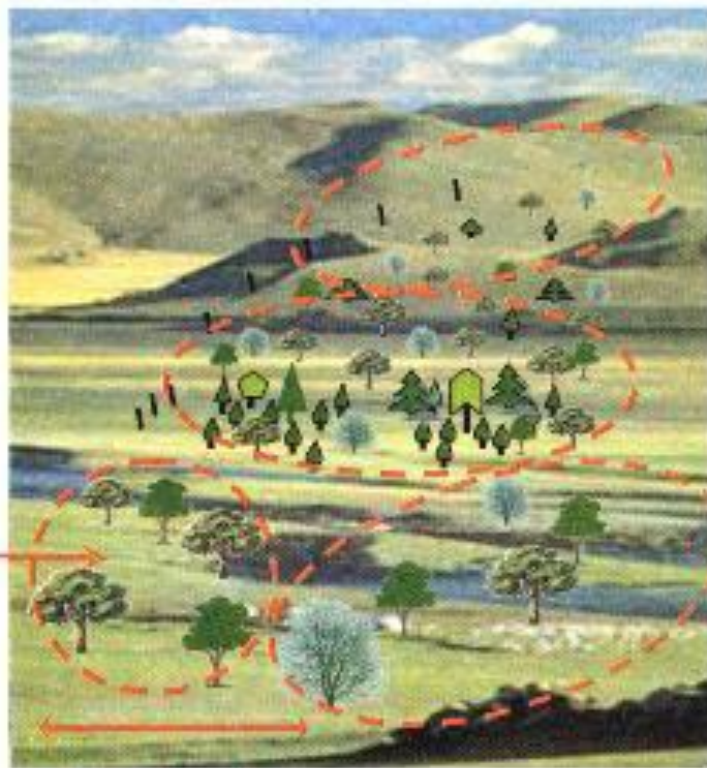
Alpha, Beta And Gamma diversity

- R.H. Whittaker described **three terms for measuring biodiversity over spatial scales**: Alpha, beta, and gamma diversity.
- **Alpha diversity**: It refers to the diversity within a particular area or ecosystem at a local scale expressed by the number of species (i.e., species richness) in that ecosystem.
- **Beta diversity**: It is the ratio between regional and local species diversity. In other words, 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.
- More diverse a ecosystem=> More stable it is=> Better chances of it surviving any adversity.



Alpha
diversity
of a
community



Beta diversity
between
communities

Gamma
diversity of
a region

Biodiversity Depletion

There can be three ways in which biodiversity of a region is depleted:

1. **Direct ways:** Deforestation, hunting, poaching, commercial exploitation.
2. **Indirect ways:** Loss or modification of the natural habitats, introduction of exotic species, pollution, etc.
3. **Natural causes:** Climate change, volcanoes, earthquakes, epidemics etc.

Biodiversity Conservation Methods

Biodiversity conservation efforts can be grouped into two categories:

1. **In-situ (on-site) methods:** स्व-स्थाने संरक्षण
 - It involves protection of plants and animals **within** their **natural habitats** or in protected areas dedicated for protection and maintenance of biodiversity.
2. **Ex-situ (off-site) methods:** बाह्य-स्थाने संरक्षण
 - These methods involve conserving species **outside** their **natural habitats**.

The following methods are used in In-situ conservation:

1. National Parks
2. Wildlife Sanctuaries
3. Biosphere Reserves
4. Biodiversity Hotspots
5. Gene Sanctuary
6. Community Reserves अभयारण्य समुदाय
7. Sacred Groves पवित्र उपवन

Gene Sanctuary

- A gene sanctuary is an area where plants/germplasms are conserved under natural conditions.
- It may includes both biosphere reserves as well as national parks.
- India has set up its first gene sanctuary in the Garo Hills of Meghalaya for wild relatives of citrus.
- Efforts are also being made to set up gene sanctuaries for banana, sugarcane, rice and mango.

Sacred Groves

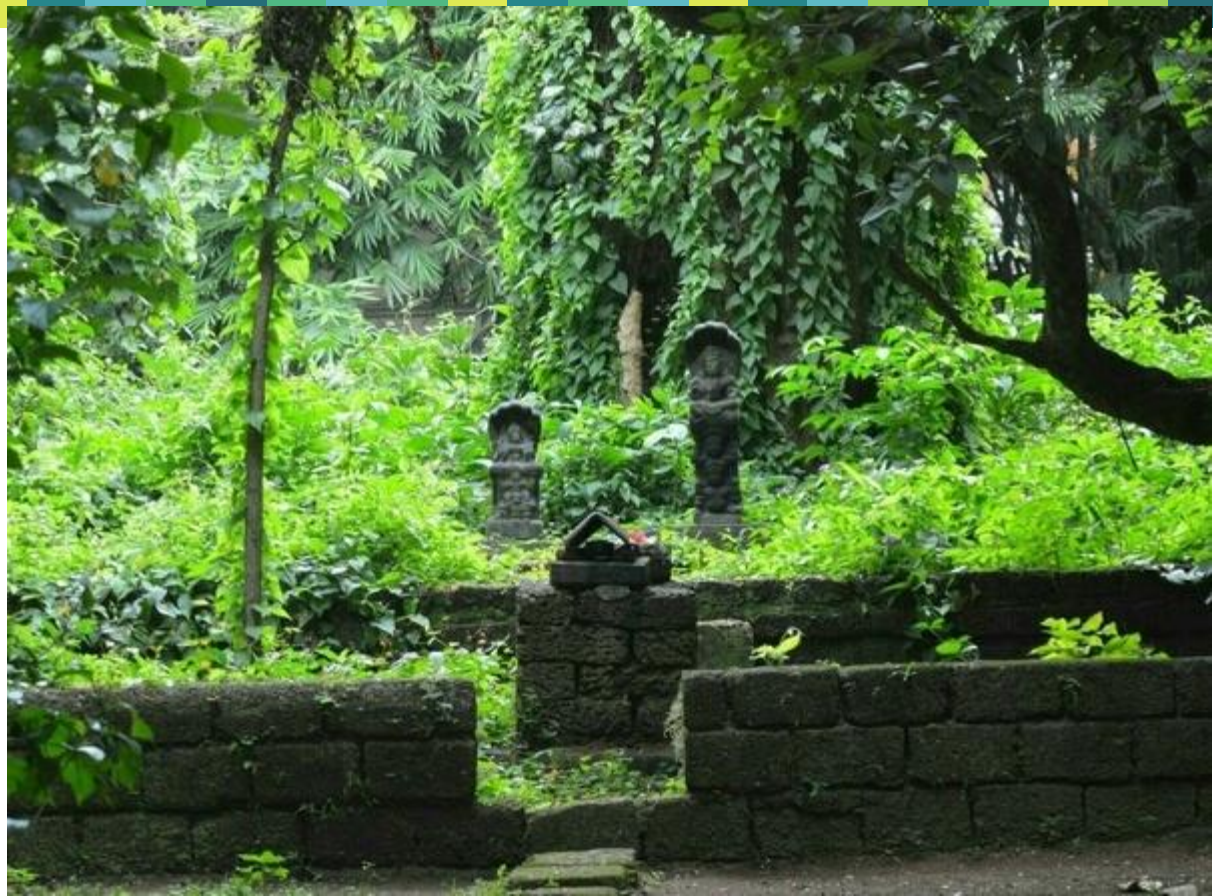
- Sacred groves are protected forest out of religious belief in fragments which usually have a significant religious connotation for the protecting community.

Hunting and logging are **usually** strictly **prohibited** within these patches.

Other forms of forest usage like honey collection and deadwood collection are sometimes allowed on a sustainable basis.

Indian sacred groves are sometimes associated with temples/monasteries/ shrines or with burial grounds.

Example: *Kavus* of Kerala, *law kyntangs* of Meghalaya.





- Sacred groves enjoy various degrees of sanctity and protection from local communities.
- Meghalaya tribes completely prohibit any kind of human interference in their sacred groves.
- Whereas Gonds of Central India allow collection of deadwood and dry leaves from sacred trees.
- The groves not only protect floral and faunal diversity of the region but also protect associated water bodies and prevent soil erosion and desertification.

However, the introduction of the protected area category [community reserves](#) under the [Wild Life \(Protection\) Amendment Act, 2002](#) has introduced legislation for providing government protection to community held lands, which could include sacred groves.

The following methods are used in ex-situ conservation:

1. Botanical Gardens
2. Zoo
3. Gene Banks
4. Seed Bank
5. Tissue Culture
6. Cryopreservation

निम्नलिखित विधियाँ

Zoos

- Species based conservation method.
- Public enjoyment and education + captive breeding.
- The role of zoos in conservation is limited both by space and by expense.

Central Zoo Authority

- Established in 1992 under Wild Life (Protection) Act, 1972.
- The Authority consists of a Chairman, ten members and a Member Secretary.
- The Authority's role is more of a facilitator than a regulator.

- Some of its functions include to:
 - Specify the minimum standards for housing, upkeep and veterinary care of the animals kept in a zoo;
 - Recognise or derecognise zoos;
 - Identify endangered species of wild animals for purposes of captive breeding and assigning responsibility in this regard to a zoo.

Botanical Gardens

- Botanic gardens are institutions holding documented collections of living plants for the purposes of scientific research, conservation, display and education.
- Botanical gardens should always have complete documentation of their collections, control over plants collected and demonstrate responsible management of their collections.

- Botanical gardens have three main objectives:
 1. **Recreation:** Exhibitions, plant sales, picnics under the trees and relaxing in a natural environment
 2. **Education:** This includes summer camps for kids, classes and seminars as well as publications and other ways of sharing information between botanical gardens and horticulture and botany professionals.
 3. **Scientific study** involving botany, taxonomy and systematics.

Gene Banks

- Gene banks, also known as germplasm banks, are a type of biorepository which preserve genetic material of plants and animals.
- For plants, this could be through in vitro storage, freezing cuttings from the plant, or stocking the seeds (e.g. in a seedbank).
- For animals, it involves freezing of sperm and eggs in zoological freezers.
- Plant genetic material is preserved at -196° Celsius in Liquid Nitrogen.

Types of Gene Banks

1. **Seed bank:** It preserves dried seeds at a very low temperature.
2. **Tissue bank:** In this technique, seedless plants and plants that reproduce sexually are preserved through particular light and temperature arrangements in a nutrient medium.
3. **Cryobanks:** A seed or embryo is preserved at very low temperatures (usually in liquid nitrogen at -196°C). Mainly for species facing extinction.

Indian Seed Vault is a secure [seed bank](#) lies in a high-altitude mountain pass on the [Chang La](#) seed vault in [Ladakh, India](#). It was built in 2010 jointly by the [Defence Institute of High Altitude Research](#) and the National Bureau of Plant Genetic Resources



Advantages of Ex-situ conservation:

- Animals are fully protected from all kinds of poaching and predation.
- The population of animals can be maintained and distributed in case of threats of becoming endangered.
- Selective breeding can be done to increase the population of healthier animals.
- The health of animals can be monitored and provided with medical assistance whenever required.
- These sites can be used for education and tourism.

Disadvantages of ex-situ conservation

- Limitation of animals to caged surroundings which does not match their natural habitats.
- Exposure to various diseases which decreases their chances of survival.
- Limited genetic diversity.
- Expensive to maintain.
- Reintroduction of animals into the wild may be difficult.

Asiatic Lion Conservation Project

- It was launched in 2018 with an aim to protect and conserve the world's last ranging free population of Asiatic Lion and its associated ecosystem.
- It will strengthen the ongoing measures for conservation and recovery of Asiatic Lion with the help of state-of-the-art techniques/ instruments, regular scientific research studies, disease management, modern surveillance/ patrolling techniques.

Asiatic Lions

- With timely and stringent protection offered by the State Government and the Center Government, Asiatic lions have increased to the current population of over 500 numbers.
- The last census in the year 2015 showed the population of 523 Asiatic Lions in Gir Protected Area Network.

The census is **conducted once every five years**.

The **first Lion Census was conducted by the Nawab of Junagadh in 1936**; since 1965, the Forest Department has been regularly conducting the Lion Census every five years

GROWING NUMBERS

Year	Adult		Subadult	Cubs	Total
	Male	Female			
1990	99	95	27	63	284
1995	94	100	39	71	304
2001	101	114	57	55	327
2005	89	124	72	74	359
2010	97	162	75	77	411
2015	109	201	73	140	523
2020	159	262	115	138	674

Source: Gujarat state forest and environment department sources



What is Block counting method?

India uses this method to estimate the numbers.

In this method, **census enumerators remain stationed at water points in a given block and estimate abundance of lions in that block**, based on direct sighting of lions who need to drink water at least once in 24 hours during the summer

Culture Conservation

- India has nine species of vultures in the wild:
 1. Oriental White-backed Vulture
 2. Slender billed Vulture
 3. Long billed Vulture
 4. Egyptian Vulture
 5. Red Headed Vulture
 6. Indian Griffon Vulture
 7. Himalayan Griffon
 8. Cinereous Vulture
 9. Bearded Vulture or Lammergeier

- The population of three species i.e. White-backed Vulture, Slender billed Vulture and Long billed Vulture in the wild has declined drastically over the past decade.
- These species are ‘Critically Endangered’ (CR) under IUCN criteria.

Causes of population decline:

1. Main reason is intake of **Diclofenac** sodium, an anti-inflammatory drug.
2. Diclofenac administered to animals=> carcass eaten by vultures => **kidney failure**=> neck drooping=> death
3. **Meloxicam** is suggested as a better and safe **alternative** to Diclofenac.

1. **Vulture Breeding and Conservation Centre** has been established at Pinjore, Haryana; Guwahati, Assam; and at Buxa, West Bengal.
2. **Vulture Safety Zones (VSZs):** Natural habitat of wild vultures free from diclofenac infected carcasses; VSZs declared in Jharkhand, Uttarakhand, UP, Gujarat etc.
3. **Vulture Restaurants:** Opened in Maharashtra and Punjab; vultures are fed diclofenac free carcasses sourced from local people who are also involved in the conservation
4. **Captive breeding centres** at Zoos at Bhopal, Bhubaneswar, Junagarh and Hyderabad have also been set up through Central Zoo Authority.
5. Initiatives have been taken to strengthen the mass education and awareness for vulture conservation.

Rhino Conservation

- Rhinoceros are shapers of their landscape and environment.
- They are a keystone species- known to have a disproportionately large impact on its environment relative to its population.

- The habitat of the Indian rhino once extended from Pakistan into northern India and modern-day Myanmar, reaching into Nepal, Bangladesh and Bhutan.

- In India, rhinos can now be found in parts of Uttar Pradesh, West Bengal and Assam.
- In 2012, more than 91 per cent of Indian rhinos lived in Assam, according to WWF-India data.
- Within Assam, rhinos are concentrated within Kaziranga national park, with a few in Pobitora wildlife sanctuary.

Indian Rhino Vision- 2020

- Launched under a partnership of Assam govt., International Rhino Foundation, WWF for Nature, the Bodoland Territorial Council, and the U.S. Fish & World Wildlife foundation.
- Aim: Increase Rhino population to 3000 by 2020 in seven protected areas of Assam.
- Translocating rhinos after trimming their horns from two source populations (Kaziranga and Pobitora) into five target protected areas (Manas, Laokhowa, Buracharpori-Kochmora, Dibru Saikhowa and Orang).

- It will save Rhinos from poaching and epidemics e.g. floods, epidemics in Kaziranga and reduce pressure on a single protected area.
- Rhinos in Pobitora have exceeded carrying capacity and they must be translocated to protect the habitat and reduce man-rhino conflicts.

Snow Leopard Conservation

- Listed on the IUCN red list of threatened species.
- Snow Leopard is found in 12 countries. They are India, Nepal, Bhutan, China, Mongolia, Russia, Pakistan, Afghanistan, Kyrgyzstan, Kazakhstan, Tajikistan and Uzbekistan.
- In India, they inhabit the higher Himalayan and Trans-Himalayan landscape.

Project Snow Leopard

- Launched in 2009.
- Project is operational in Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, and Arunachal Pradesh.
- It aims at promoting a knowledge-based and adaptive conservation framework that fully involves the local communities, who share the snow leopard's range, in conservation efforts.
- It will reduce existing anthropogenic pressures on natural resources and promote conservation education.

Global Snow Leopard and Ecosystem Program (GSLEP)

- It is a high level intergovernmental alliance of all the 12 snow leopard range countries.
- GSLEP seeks to address high-mountain development issues using the conservation of the charismatic and endangered snow leopard as a flagship.

- The GSLEP is a high-level **inter-governmental** alliance of all the **12 snow leopard range countries**.

- **The snow leopard countries** namely, India, Nepal, Bhutan, China, Mongolia, Russia, Pakistan, Afghanistan, Kyrgyzstan, Kazakhstan, Tajikistan, and Uzbekistan.

- It majorly focuses on the need for awareness and understanding of the value of Snow Leopard for the ecosystem.

- The GSLEP Program (2019) is being organized by the **Ministry of Environment, Forest and Climate Change at New Delhi**.

- Currently, the Steering Committee meeting of GSLEP **chaired by Nepal** and **co-chaired by Kyrgyzstan**.