BIODIVERSITY IMPORTANCE AND CONSERVATION

Importance of Biodiversity

- **Biodiversity has very much important ecologically and economically and it also plays an important role in our daily life because it is applicable in different fields for the sake of better development in the modern World.**
- Some of the important fields of biodiversity
  1. **Importance in Agriculture**
  2. **Importance in Human Life**
  3. **Industrial Importance of Biodiversity**

Many goods and services provided by ecosystems

- Provision of food, fuel, fibre and shelter and building materials
- Purification of air and water, detoxification and decomposition of wastes
- Stabilization and moderation of the Earth's climate
- Moderation of floods, droughts, temperature extremes and the forces of wind
- Generation and renewal of soil fertility, including nutrient cycling
- Pollination of plants, including many crops; control of pests and diseases
- Maintenance of genetic resources as key inputs to crop varieties and livestock breeds and Medicines
- Cultural and aesthetic benefits

Importance in Agriculture

- In agricultural field biodiversity plays an important role to produce a new variety of plants or crops by producing a change in their genetic traits and it also help in preventing the crops from diseases such as coffee plants, rice plants etc. It is also called as agricultural biodiversity.

Importance in Human Life

- **Biodiversity plays a major role in our lives because they are very useful for the production of different useful products such as food, water and different type of medicines.**
- **It also involves in fighting against different disasters.**
- **It produces a great variety of pharmaceutical products which help in recovery.**

- **Biodiversity provides medical models for research into solving human health problems.**
- **For example, researchers are looking at how seals, whales, and penguins use oxygen during deep-water dives for clues to treat people who suffer strokes, shock, and lung disease.**

Industrial Importance of Biodiversity

- **In the field of industry it is also used to produce different kinds of materials such as building material which derived from different kinds of biological resources and through biodiversity.**
- **The industrial products which are produce as a result of biodiversity are fibers, dyes, oil, rubber etc.**

Importance in Ecosystem

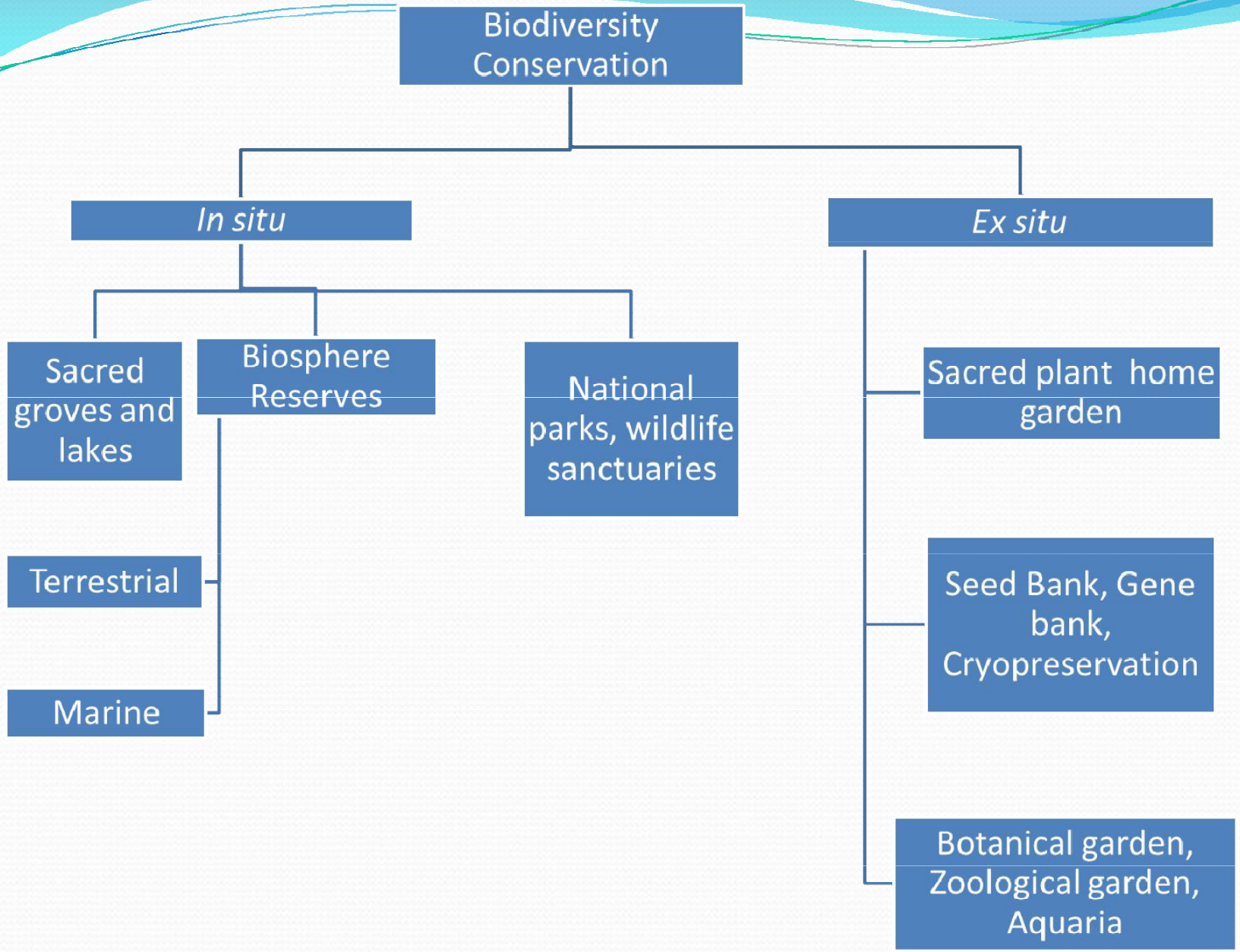
- Biodiversity also supplies indirect services to humans which are often taken for granted.
- These include drinkable water, clean air, and fertile soils.
- The loss of populations, species, or groups of species from an ecosystem can upset its normal function and disrupt these ecological services.
- Recent declines in honeybee populations may result in a loss of pollination services for fruit crops and flowers

- **The Earth's biodiversity contributes to the productivity of natural and agricultural systems.**
- **Insects, bats, birds, and other animals serve as pollinators.**
- **Parasites and predators can act as natural pest controls. Various organisms are responsible for recycling organic materials and maintaining the productivity of soil.**

Importance in Genetic Diversity

- **Genetic diversity is also important in terms of evolution.**
- **The loss of individuals, populations, and species decreases the variety of genes—the material needed for species and populations to adapt to changing conditions or for new species to evolve.**

BIODIVERSITY CONSERVATION


Biodiversity Conservation
In situ
Ex situ
Sacred groves and lakes
Biosphere Reserves
National parks, wildlife sanctuaries
Terrestrial
Marine
Sacred plant home garden
Seed Bank, Gene bank, Cryopreservation
Botanical garden, Zoological garden, Aquaria

In situ Ex situ

In situ:

- Conservation of species in their natural habitat
- E.g. natural parks, nature reserves

Ex situ:

- Conserving species in isolation of their natural habitat
- E.g. zoos, botanical gardens, seed banks

Conservation approaches

- *<u>In-situ</u>*
- Involves protection of natural areas with high biodiversity.

- *<u>Ex-situ</u>*
- here we conserve biodiversity in an artificial setting.

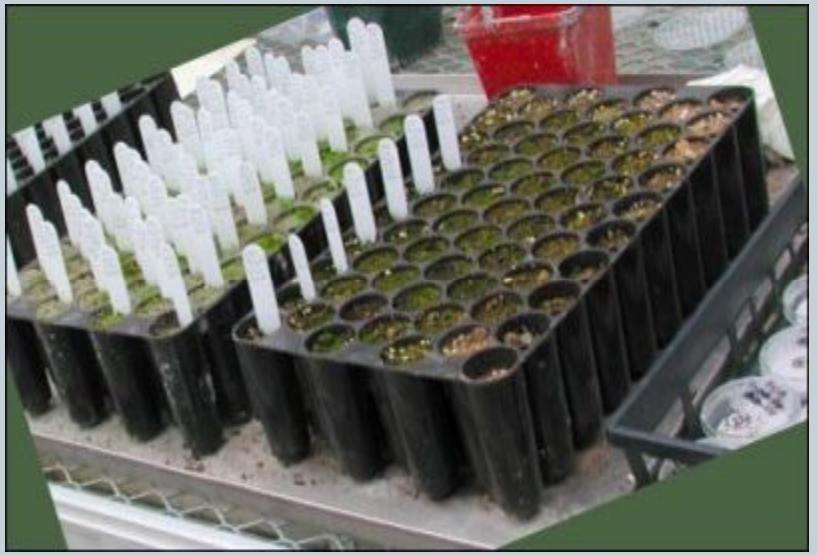


Table: Threatened Plants of India by Status Category

Ex	EW	CR	EN	VU	LR/cd	LR/nt	DD
7	2	44	113	87	1	72	14

Legend
Ex-extinct;
EW-Extinct in the Wild
CR- Critically Endangered
VU-Vulnerable
LR/cd-Lower Risk conservation dependent
LR/nT- Lower Risk near threatened
DD-Data Deficient
Source:
IUCN. 2000

The advantages of *in situ* conservation

- **The species will have all the resources that it is adapted too**
- **The species will continue to evolve in their environment**
- **The species have more space**
- **Bigger breeding populations can be kept**
- **It is cheaper to keep an organism in its natural habitat**

In-situ conservation

- **Protected area**
- **Biosphere reserve and national parks**
- **On farm and home garden conservation**

Functions of biosphere reserves

Each biosphere reserve is intended to fulfil basic functions, which are complementary and mutually reinforcing:

- **a conservation function** - to contribute to the conservation of landscapes, ecosystems, species and genetic variation;
- **a development function -** to foster economic and human development which is socio-culturally and ecologically sustainable;
- **a logistic function -** to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development.

Biosphere Reserves

- The Indian government has established 18 **Biosphere Reserves of India**, which protect larger areas of natural habitat (than a National Park or Animal Sanctuary), and often include one or more National Parks and/or preserves, along buffer zones that are open to some economic uses.
- Protection is granted not only to the flora and fauna of the protected region, but also to the human communities who inhabit these regions, and their ways of life.

In-situ conservation

- ***National parks (88), and sanctuaries (490)***
- ***Expansion of the protected area network***
- ***Population surveys and assessments and database creation***
- ***Mapping of forest types, protected areas, and natural forests***
- ***Improved protection efforts and a landscape approach to conservation***
- ***Regular population-habitat viability and risk simulations***
- ***Geographical information systems and remote sensing in planning and monitoring***
- ***Creation of new conservation reserves***
- ***Community reserves***
- ***Joint Forest management***
- ***Voluntary, field based organizations and NGOs (non-governmental organizations)***

Nilgiri	Tamil Nadu, Kerala and Karnataka
Nanda Devi	Uttaranchal
Nokrerk	Meghalaya
Manas	Assam
Sunderbans	West Bengal
Gulf of Mannar	Tamil Nadu
Great Nicobar	Andaman and Nicobar
Similpal	Part of Mayurbhanj district (Orissa)
Dibru-Saikhowa	Part of Dibrugarh and Tinsukia district (Assam)
Dehang Debang	Part of Siang and Debang velley (Arunachal Pradesh)
Pachmarhi	Parts of Betul, Hoshangabad and Chindwara districts (Madhya Pradesh)
Kanchanjanga	Part of Kanchanjanga Hills (Sikkim)

The national parks and sanctuaries






Zoos: Disadvantags

- They have a very small gene pool in which to mix their genes
- **Inbreeding** is a serious problem
- Zoos and parks try to solve this by **exchanging specimens** or by artificial insemination where it is possible
- ***In vitro* fertilisation** and fostering by a closely related species has even been tried
  (Indian Guar – large species of cattle - cloned)
- Even if it is possible to restore a population in captivity **the natural habitat may have disappeared** in the wild
- Species that rely on this much help are often considered to be **"the living dead"**

Botanical Gardens

- **There are estimated to be around 1600 botanical gardens throughout the world and these receive over 150 million visitors a year**
- **The Botanic Gardens Conservation Institute (BGCI) was set up in 1987 and its role is to collect and make available information on plant conservation**
- **These botanical gardens are important as it is estimated that 60,000 plant species could be lost in the next 50 years**

Botanical Gardens

- Botanical gardens tend to look after plants in one of the five categories below
  - Rare and endangered
  - Economically important (for example as fuel or medicine)
  - Species that are needed for the restoration of an ecosystem
  - Keystone species
  - Taxonomically isolated species

Botanical Gardens

- **Selecting these species is hard and a number of factors must be taken into consideration**
  - **Extinction risk**
  - **Suitability of plant for ex-situ conservation**
  - **Value of plant**
  - **Ease of collection**
  - **Funds available**
  - **Chances of success**

Botanical gardens

- Botanical gardens show the same problems as captive breeding of animals
- Originally the role of botanical gardens was economic, pharmaceutical and aesthetic
- There range of species collected was limited
- The distribution of botanical gardens reflects the distribution of colonial powers
- Most are found in Europe and North America
- But plant diversity is greatest in the tropics

Botanical Gardens – plant re-introductions

- In some ways plant re-introductions are easier than animal e.g. easy to monitor as plants don't move
- In others, it is harder because if the wrong site is selected then the plant cant get up and move
- When re-introducing it must be decided on whether seeds, seedlings or adults are going to be replaced, each has their pros and cons

BOTANICAL GARDENS SUCCESSES - TORREY PINE

- In 1988 there were only 400 to 500 individuals of the Torrey pine (*Pinus torreyana*) in the wild

The Torrey pine

Seed Banks

- Seed banks allow the storage of genetic diversity of whole plant populations
- Preserving the seeds for use later is a long process, it involves;
  - Cleaning
  - X-ray analysis
  - Drying, packaging and storage
  - Germination monitoring

Seed Banks – cleaning

- Occasionally clean seed is collected in the field
- More often seed is collected still in its fruit
- Seed must be taken from the fruit undamaged
- This reduced bulk and disease risk
- Seeds are often liberated by hand

Seed Banks – X-ray analysis

- A few seeds are taken and X-rayed
- This is done to see how many of the sample are empty seeds and find any insect larvae hiding in the seeds
- The X-rayed seeds are often thrown away afterwards as they may be genetically damaged

Seed Banks – Drying, Packaging and Storage

- Drying and freezing the seed increases the time that the seed will last
- Seeds are dried in cool conditions (15-18°C) with the relative humidity at 11-15%
- This takes about a month
- The seed is then put into an airtight container and kept at -20 °C

Seed Banks – Germination Monitoring

- A few seeds are tested for viability once they have been frozen
- If they do not germinate they are either dead or dormant, to distinguish between the two states the vital stain Tetrazolium is used
- A few seeds are tested every ten years to check germination

SEED BANK

Bergen Nat Acc of Arts

(A) The National Center for Genetic Resources Preservation; (B) Seeds are sorted, cataloged, and (C) stored in liquid nitrogen to preserve genetic diversity (D).

(A)

(B)

(C)

(D)

Seed banks

- Seeds can be maintained for decades or even centuries if the conditions are controlled
- <5% humidity and –20°C
- Not all species are suited to this treatment
- Seeds need to be regularly germinated to renew stock or the seeds will eventually loose their viability
- Seed banks are at risk from power failure, natural disasters and war
- Duplicate stocks can be maintained
- Seeds kept in seed banks do not evolve with changes in the environment

Germplasm

- Germplasm is a term used to describe a collection of genetic resources for an organism.
- For plants, the germplasm may be stored as a seed collection or, for trees, in a nursery.

GERMPLASM

Gene Banks

- Gene banks are rather like seed banks
- Eggs, sperm and embryos are cryogenically frozen to protect the genetic variation of a species
- The zoological society of San Diego has developed a frozen zoo

Gene Banks – the frozen zoo

- It is housed by the Zoological Society of San Diego and is one of the worlds largest collections
- The frozen zoo is meant to provide materials to aid species recovery and population viability they also bank cells from species that are close to extinction
- Holds frozen skin cells, DNA, RNA , semen, embryos, oocytes, ova, blood and frozen tissue
- They hold the genetic material from 500 Przewalskis horses, 150 western lowland gorillas, 80 black rhinos, 22 Queensland Koalas and 19 Bornean bearded pigs
- These are all available for scientific study

Gene Banks – the frozen zoo

- Most recently cells from a Hawaiian honeycreeper called a po'ouli
- The species is now extinct in the wild
- Cell harvesting is not a way that the bird can be "brought back to life" but more a way that research can be carried out on their DNA

DNA BANKS

- DNA bank may be defined as a Gene Library in which samples of DNA extract and stored.
- It is in three forms
  - Total genomic DNA
  - DNA library
  - Individual cloned fragments including RFLP probes.
- Three primary DNA databases
  - Gene Bank – Maryland USA
  - EMBL – UK
  - DNA Data Bank of Japan

- In addition DNA banks Protein and RNA banks also developed in some developed countries.
- RNA: Ribosomal Databases- USA
- Protein databases
  - International Protein sequence Database – Multinational.
  - SWISS –PROT – Geneva

In-vitro conservation methods

- Synthetic seed
- Viral free plants through meristem culture
- 1500 wild taxa stored *in-vitro* in various countries

The problems with ex-situ conservation

- Captive and wild populations diverge genetically
- Interbreeding
- Hybridisation
- In the case of gene banks, living populations are necessary to pass on non-genetic learned behaviours
- Ex-situ tends to only save particular species whereas in situ saves whole ecosystems
- Impossible to conserve whales!

The benefits of ex-situ conservation

- With only 3% of land in nature reserves world wide often the only answer
- Botanical gardens can help in ethno biology strengthening collections that have traditional and cultural implications
- Re-introductions have occurred for at least 120 animal species and 15 of these are definitely established in the wild and are now self sufficient populations

CITES Appendices

- **Appendix 1:** Total ban on exploitation
- **Appendix 2:** Limited exploitation subject to quotas
- **Appendix 3:** Species requiring protection in certain states only
- Species are reassessed every 2 years