Biodiversity and conservation

What is biological diversity ?

- Biodiversity or biological diversity refers to the numbers, variety and variability of living organisms and ecosystems.

- Biodiversity is the earth's primary life support system and is a precondition for human survival.

- Includes all the terrestrial, marine and other aquatic organisms.

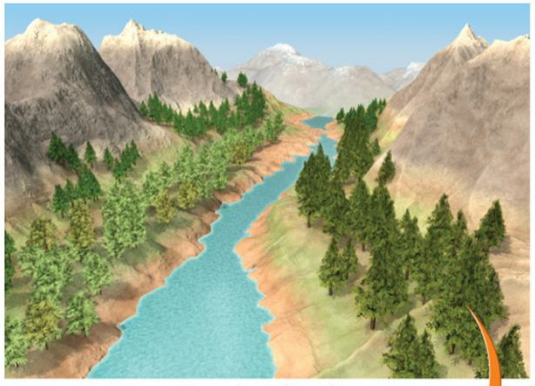
- Also covers diversity within species, between species, as well as the variation among ecosystems.

Levels of Biodiversity

1. Genetic diversity: variation among genes

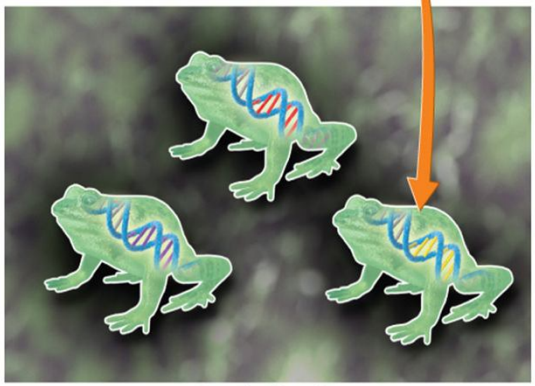
2. Species diversity: variation among species

2. 3.Ecosystem diversity: variety of habitats



Ecosystem diversity

Species diversity



Genetic diversity

Levels of biodiversity

<u>Diversity of genes</u>: Chihuahuas, beagles, and rottweilers are all dogs—but they're not the same because their genes are different.

- refers to the variation of genes within species i.e., different genes & combinations of genes within populations
- covers distinct populations of the same species such as the thousands of traditional rice varieties in India.

Chihuahua

Beagle

Rottweilers

Diversity of species: monkeys, dragonflies, and meadow beauties are all different species.

- refers to the number of plant and animal species present in a community or an ecosystem.
- Species diversity is very high in tropical rainforests and low in isolated islands.

Saki Monkey

Golden Skimmer

Meadow Beauty

Variety of ecosystems: Prairies, Ponds, and tropical rain forests are all ecosystems. Each one is different, with its own set of species living in it.

- It is the **variety of habitats** found in an area.
- or, variety of forests, deserts, grasslands, aquatic ecosystems etc. that occur in the area.

Paines Prairie

Hoh Rain Forest

Florida Sand hill Pond

Value of Biodiversity

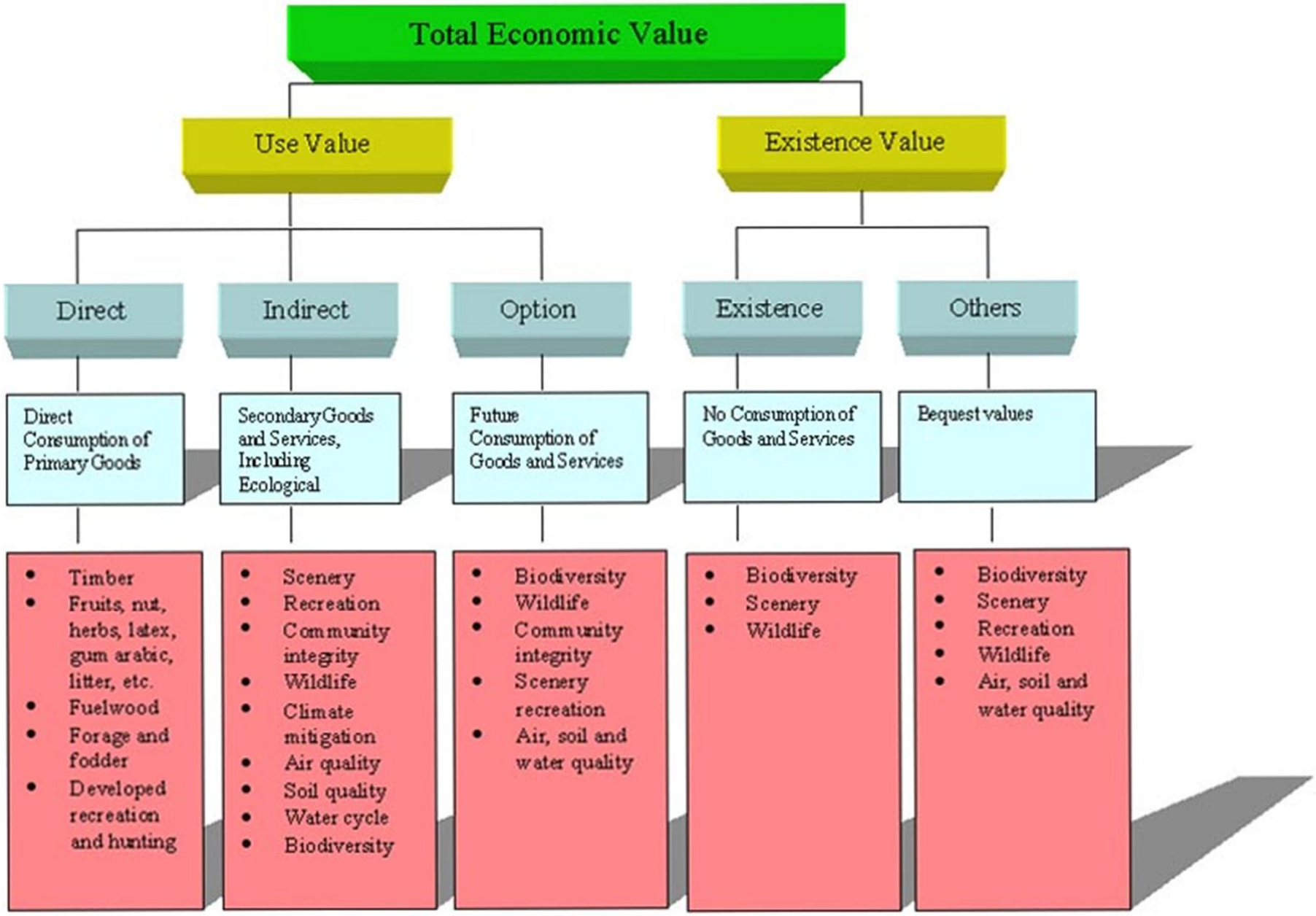
= ?

- **Consumptive values:**
  Food
  Goods like fuel, timber, paper, and medicines

- **Recreation:** The biodiversity of the planet enables activities like wildlife tourism, nature photography, bird watching etc.

- **Genetic resources:** Biotechnology and genetic engineering use the genes of organisms to make new types of crops, medicines etc.

- **Ecosystem functions**
- **Aesthetic and cultural benefits**


Total Economic Value
Use Value
Existence Value
Direct
Indirect
Option
Existence
Others
Direct Consumption of Primary Goods
Secondary Goods and Services, Including Ecological
Future Consumption of Goods and Services
No Consumption of Goods and Services
Bequest values
• Timber
• Fruits, nut, herbs, latex, gum arabic, litter, etc.
• Fuelwood
• Forage and fodder
• Developed recreation and hunting
• Scenery
• Recreation
• Community integrity
• Wildlife
• Climate mitigation
• Air quality
• Soil quality
• Water cycle
• Biodiversity
• Biodiversity
• Wildlife
• Community integrity
• Scenery recreation
• Air, soil and water quality
• Biodiversity
• Scenery
• Wildlife
• Biodiversity
• Scenery
• Recreation
• Wildlife
• Air, soil and water quality

- **Option value:** we have the option of paying now for the future use of nature. For example, we might contribute now for the establishment of a wildlife park so that we can use and enjoy the facility later.

- **Medicinal value:**

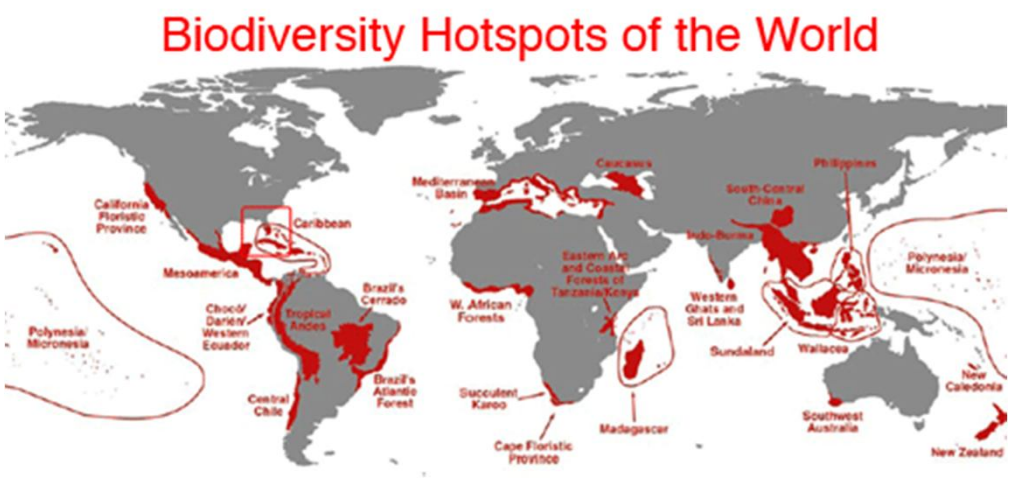
  Hundreds of plants are still used in the traditional medicine in the developing countries.

  More than 60% of the world's population depends directly on plants for medicines.

  ex: *cinchona* for malaria, *rauwolfia serpentina* for hypertension, *texol* fromTaxus brevifolia for cancer, *Artemisnin* from *Artemisia annua*

Where is the biodiversity

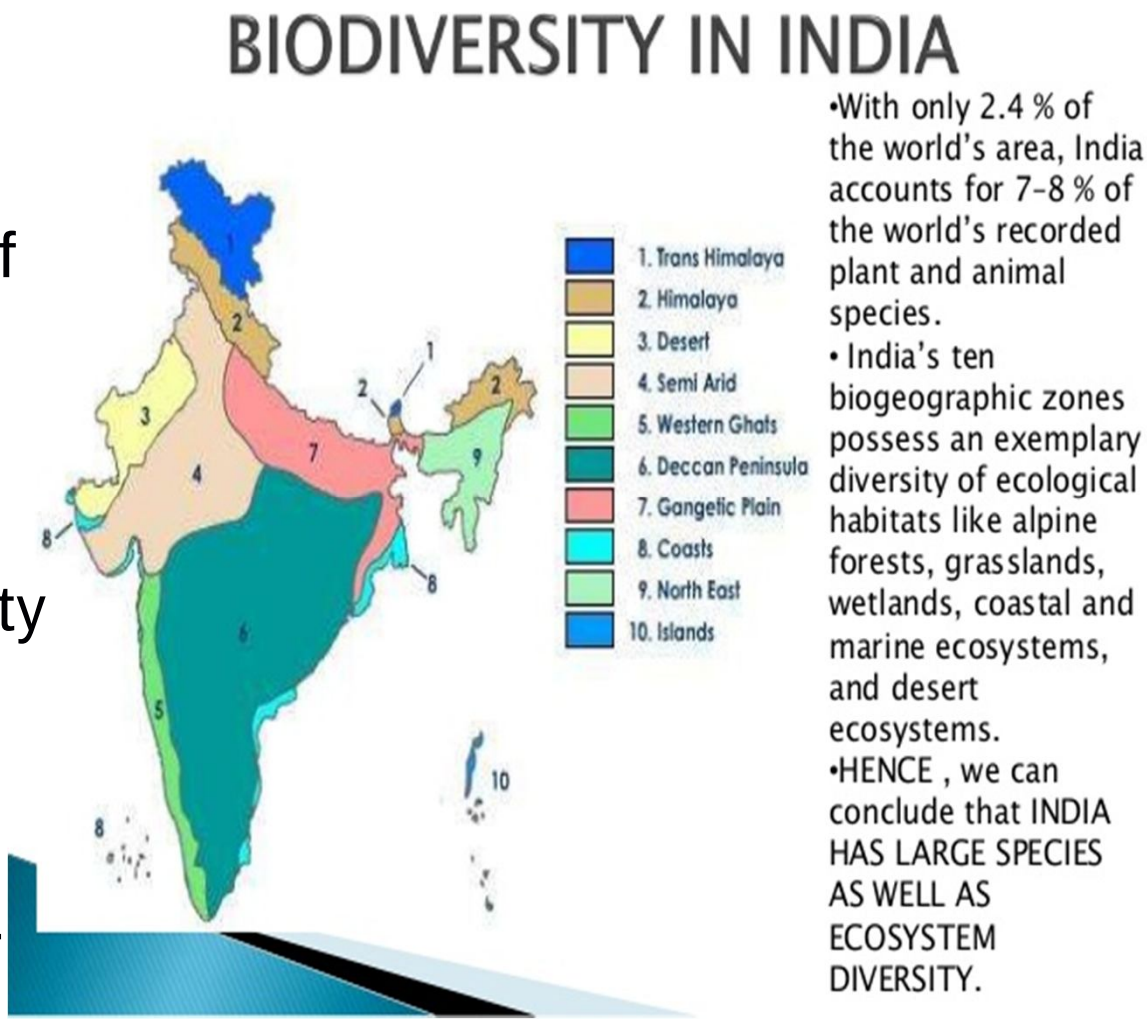
- Everywhere
  - Every continent and habitat has unique life forms
- Concentrated in the tropics
  - Panama: > 500 species of breeding birds
  - Arctic: 50-100 species



Where is all the biodiversity?

- Mostly in the developing countries
- Tropical forests account for 50-75% of species

- India:
  - A mega-biodiversity country
  - Not fully explored and documented
  - Biodiversity under threat



The 19 most biodiverse nations of the world are listed in Table.

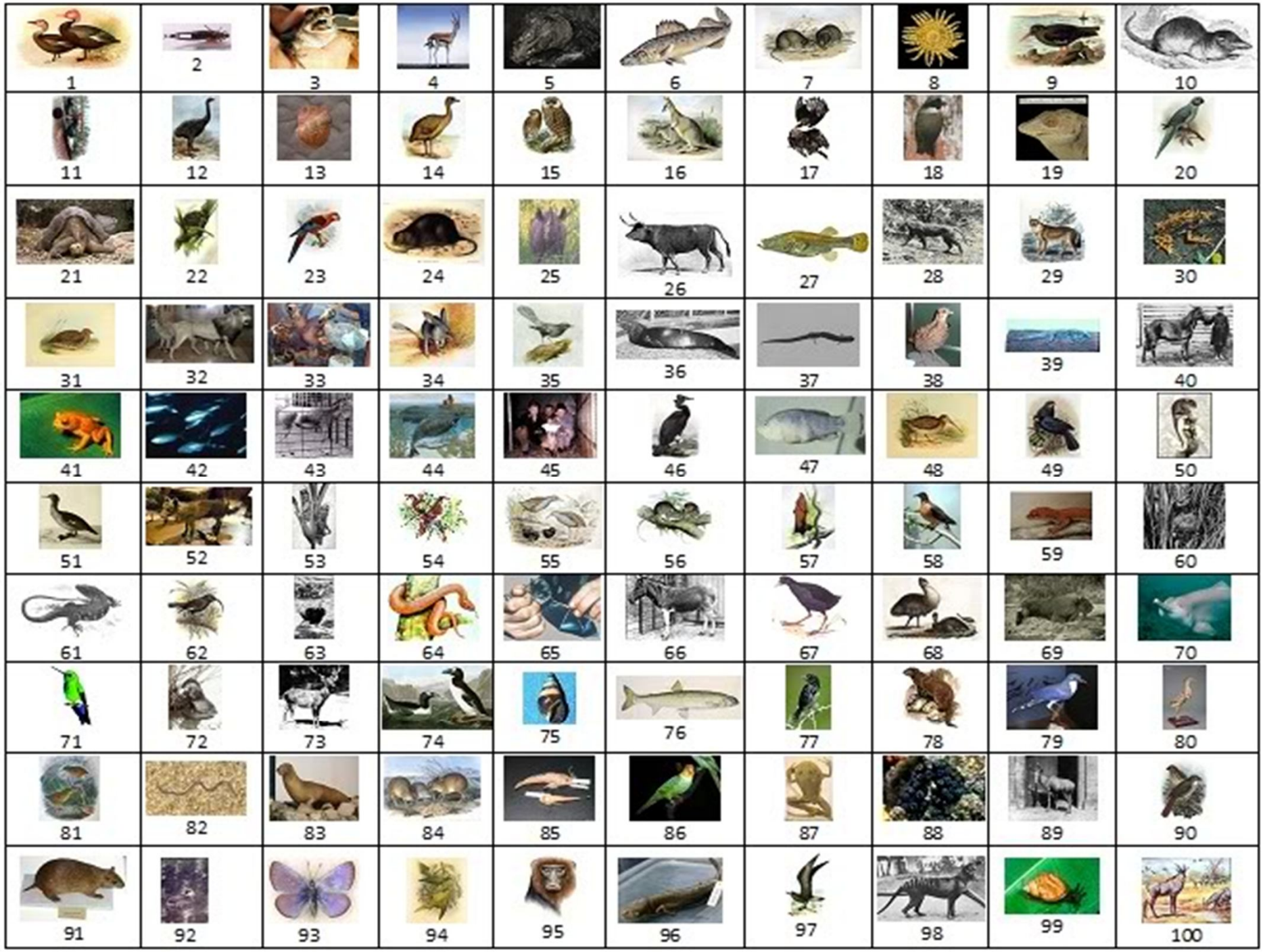
Australia	Madagascar
Brazil	Malaysia
Cameroon	Mexico
China	Myanmar
Colombia	Peru
Costa Rica	Philippines
Ecuador	South Africa
Ethiopia	Venezuela
India	Zaire
Indonesia	

Origins of Food Plants

Plant	Place of Origin
Potato	Andes, South America
Wheat	Turkey and Afghanistan
Bean	Central America
Coffee	Ethiopia
Soya, Cucumber, Orange	China
Rice	India

What is meant by extinction of species?

- An irreversible loss of species is called biological extinction.
- By extinction we mean complete disappearance of a species, that is not a single member of the extinct species is found on earth.
- **Local** and **ecological** extinction
- Before a species goes **biologically** extinct, it goes through stages of local and ecological extinction
- Local extinction means that the species is no longer found in the area it once inhabited.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Endangered Species

The species which are at the verge of extinction are known as *endangered species*. For example

- Asiatic elephant
- Great Indian Rhino

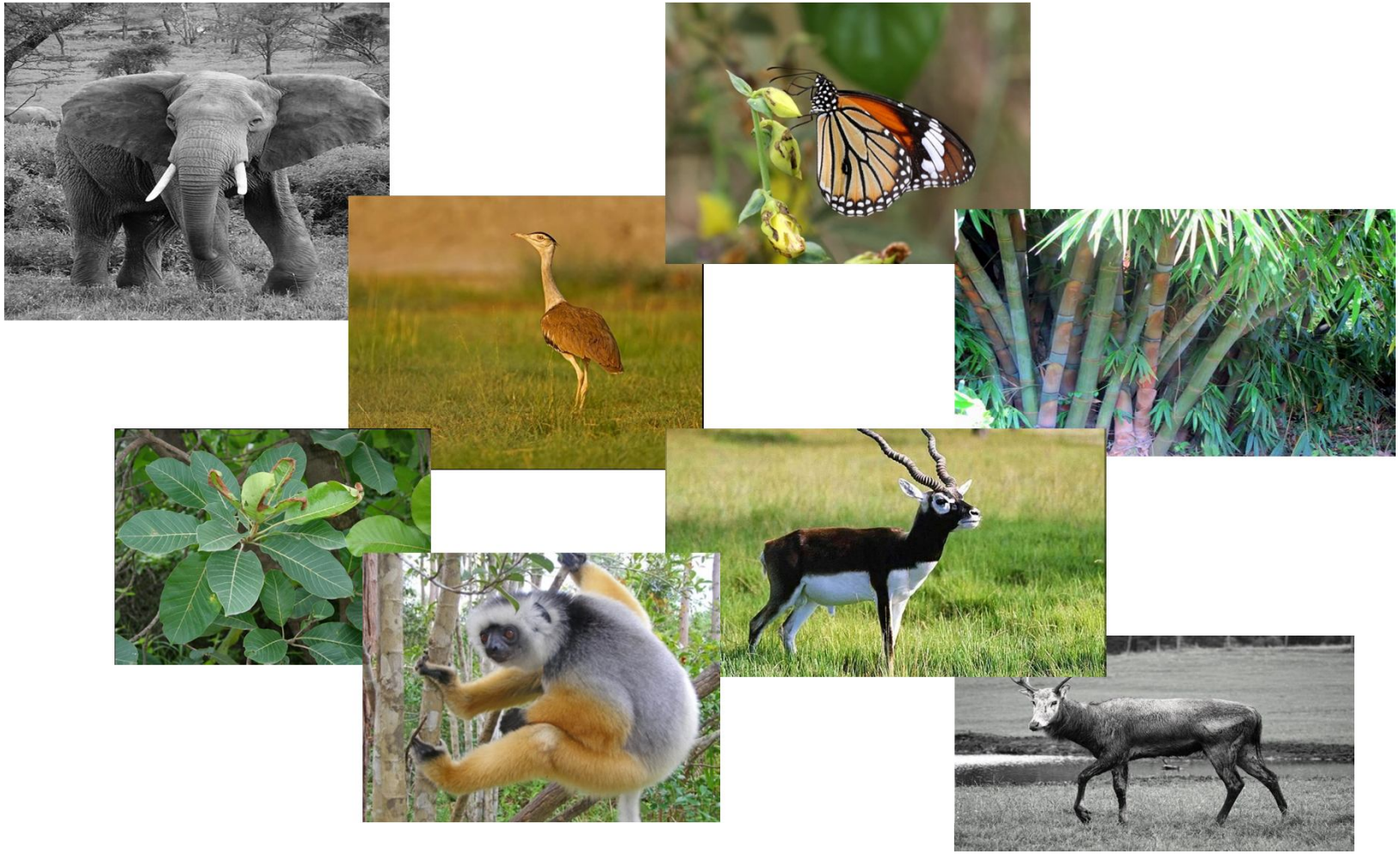
Endemic Species

The species which are confined to a particular region are known as *endemic species.*

These species remain limited in their distribution because of certain geographical barriers, such as sea, valley, mountain, etc.

EDGE species

- Refers to species of animals that are Evolutionary Distinct and globally Endangered.



How do we declare species as being threatened or endangered?

- For a species to survive and flourish, enough numbers must be present in the habitat to make reproduction possible.

- If density and population size fall below threshold values, the numbers start going down.

- A species declared endangered when the number of survivors is so small that it could soon become extinct over all or most of its habitat. Unless it is protected, it will move into critically endangered category, before it goes extinct.

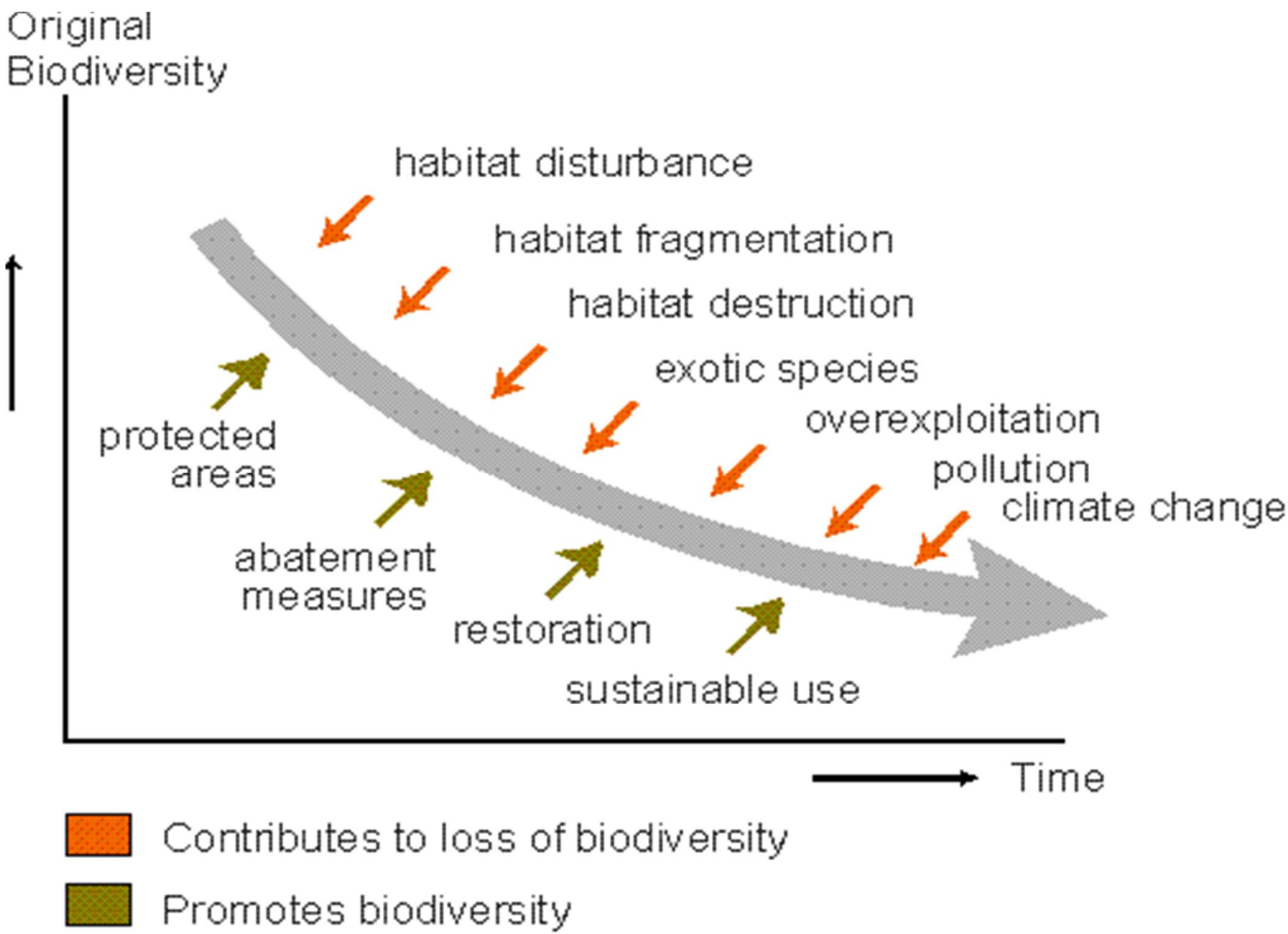
Threats to Biodiversity

- Urbanization and Unplanned development and habitat destruction
- Poaching of wildlife
- Environmental pollution
- Global climate change
- Invasion by introduced species
- Mining
- Exploitation of water resources
- Eutrophication
- Waste disposal
- Deforestation and Forest fires
- Overgrazing

Lantana Camara

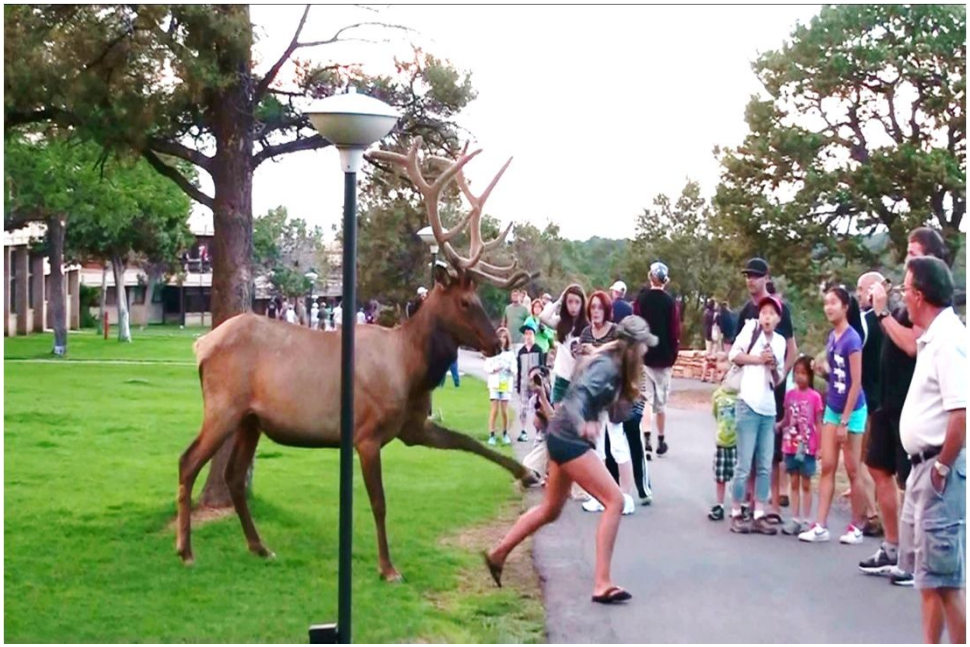
Causes of Biodiversity Loss

- Habitat loss and degradation
- Destruction of biodiversity-rich areas like tropical forests
- Destruction of coral reefs and wetlands
- Ploughing of grasslands
- Radical alteration of river systems by dams and water withdrawals threaten freshwater fish species
- Pollution of freshwater streams, lakes, and marine habitats


Original
Biodiversity
habitat disturbance
habitat fragmentation
habitat destruction
exotic species
overexploitation
pollution
climate change
protected
areas
abatement
measures
restoration
sustainable use
Time
Contributes to loss of biodiversity
Promotes biodiversity

Habitat fragmentation

- For a species to survive it requires a minimum extent of area in the ecosystem. Due to human impact, many large, continuous areas of habitat are being reduced in extent. This has many effects:



- Species become divided into smaller populations that cannot sustain themselves.
- Species becomes more vulnerable (exposed) to predators
- Ex: migratory birds face the loss of their seasonal habitats.
- Fragmentation creates barriers that limit the ability of the species to disperse and colonize new areas.

Commercial hunting and poaching

- Illegal trade in rare and endangered species of plants, birds and animals estimated to be US$ 8 billion per year.
- Animals such as rhinoceros, tiger, leopard, gorilla, butterfly etc.
- Decorative plants are also sold to collectors.
- The poachers, mostly poor people, depend on this trade for their livelihood.
- The country of origin does not get any benefit since no taxes or duties are paid. The country loses its biodiversity for nothing.

Induction of non native species

- When non native species introduced in an ecosystem and it has no predators, competitors, parasites, or pathogens to control its numbers, it can reduce or wipe out many local species.

Parthenium

Lantana Camara

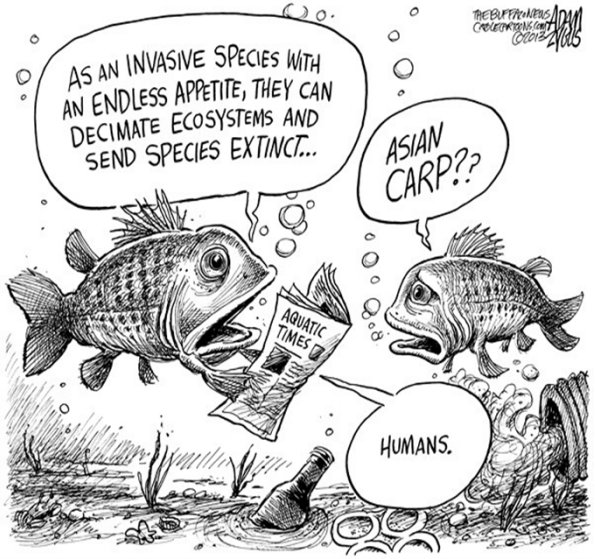
Other causes of biodiversity decline

- Growing population and migration of farmers from overpopulated area

Illustration: Tandberg

- Pollution

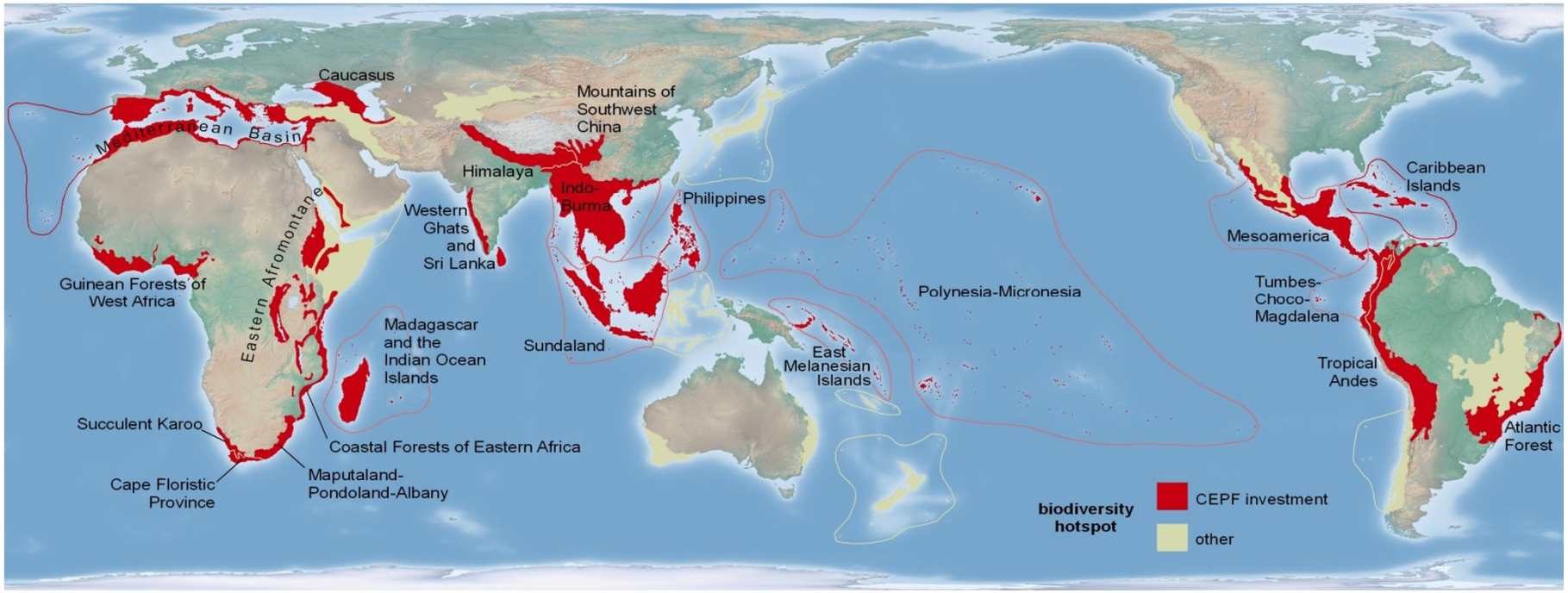
- Overexploitation of resources like over fishing in the ocean and excessive harvesting of medicinal plants by pharmaceutical industries.



- Construction of large dams that flood large biodiversity rich area

What is biodiversity hotspot?

- If an area rich in biodiversity and this flora and fauna are under a constant threat of overexploitation, it is called a biodiversity hotspot.
- There are about 25 such hotspots in the world
- Mostly in the tropical forests.



Hotspots of Biodiversity

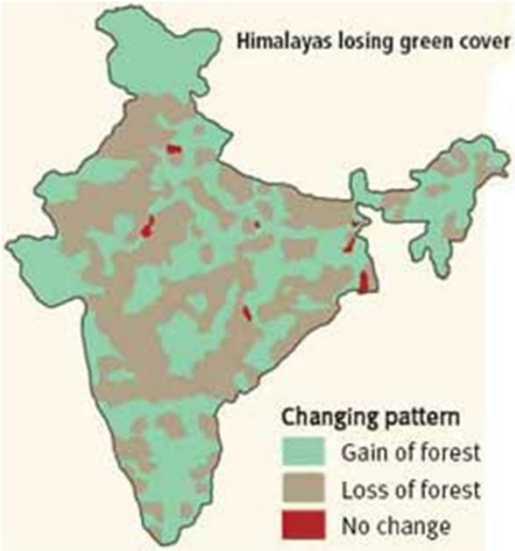
Hotspots are the richest and the most threatened reservoirs of plant and animal life on earth.

Hotspots are classified on the basis of three criteria :

•The number of species present

•The number of those species that exist exclusively in the given ecosystem

•The degree of threat they face



Hotspots of India

- Western Ghats
- North–East Himalaya

Impact of biodiversity loss?

- The poor people in developing countries, who are dependent on diversity for their daily survival, will feel the impact first.
- Soon however industrialized countries will also start experiencing the effects.
- Most of their food crops, medicines, textiles, spices, dyes, and paper originate from plants in the developing countries.
- The destruction of rain forests means that less carbon will be absorbed and natural climate control mechanism are lost. This will have a major impact on the world's climate.


CAUSAL FACTORS
Population
Consumption
Resource efficiency
INDIRECT DRIVERS
Agriculture and forestry
Fishing and hunting
Urban and industry
Water use
Energy and transport
DIRECT PRESSURES ON BIODIVERSITY AND ECOSYSTEMS
Habitat loss, alteration and fragmentation
Over exploitation
Invasive species
Pollution
CO_2
Climate change
STATE OF GLOBAL BIODIVERSITY
Terrestrial
Freshwater
Marine
The benefits that people obtain from ecosystems
ECOSYSTEM SERVICES
Provisioning services
• food
• medicine
• timber
• fibre
• bioenergy
Regulating services
• water filtration
• waste decomposition
• climate regulation
• crop pollination
• regulation of some human diseases
Supporting services
• nutrient cycling
• photosynthesis
• soil formation
Cultural services
• enriching
• recreational
• aesthetic
• spiritual

Biodiversity Conservation

- Every organism contributes, directly or indirectly, in maintaining the ecological balance.

- During last 200 millions years, 100-1000 species become extinct in each country.

- Today we are losing 1500 species every two months.

➢ **Two major approaches of conservation:**

- In situ (on-site or “in the natural or original place”)
- Ex-situ (off-site) conservation

- In situ conservation tries to protect species where they are, that is, in their natural habitat.

- Ex-situ conservation attempts to preserve and protect the species in a place away from their natural habitat.

- In general, in-situ conservation is more cost-effective.

Conservation of Biodiversity

***In situ* Conservation:** Protection of species in their natural habitat.

- National parks
- Wildlife sanctuaries
- Biosphere reserves

***Ex situ* Conservation:** Protection in a place away from their natural habitat.

- Gene banks: seed banks, sperm and ova banks
- Botanical gardens
- Aquaria
- Tissue culture technique
- DNA technology

How is conservation done in situ

- Identification and protection of natural areas that have high diversity.

- In situ done primarily by setting up national parks and reserves.

- In situ conservation through reserves is associated with limitations also. They do not receive the level of management and protection they need.

- On-farm conservation

National Park

National park are the area dedicated to conserve species with minimal and very low intensity of human activity.

Objective:

Conservation of species of habitat with minimal and very low intensity of human activity

Features:

No person reside in park other than public servants on duty and person permitted by chief wildlife warden.

Zone:

Core


National Parks in India
N
Hemis High Altitude
Kishtwar
Great Himalayas
Valley of Flowers
Corbett
Sariska
Dudhwa
Desert N.P.
Ranthambore
Shivpuri
Little Rann of Kutch
Van Vihar Bhopal Zoo
Bandhawagarh
Velavadar
Pench
Sanjay
Gir
Satpura
Kanha
Nagzari
Vansda
Tadoba
Sanjay Gandhi N.P.
Indravati
Kankar Valley
Ikshawaka
Molen
Dandeli
Bannirgatta Safari
Nagarhole
Bandipur
Guindy
Silent Valley
LAKSHADWEEP
PAKISTAN
CHINA (TIBET)
NEPAL
Khangchendzhonga
BHUTAN
Nam Dapha
Kaziranga
Sirohi
Keibol Lamjao
MYANMAR
BANGLADESH
BAY OF BENGAL
ARABIAN SEA
Suddle Peak
Mt. Harriet
Button
National Park
Map not to Scale
Copyright (C) Mapience India Limited 2001

Wild life sanctuary

Dedicated to protect wild life and habitat considers the conservation of species only

Objective:

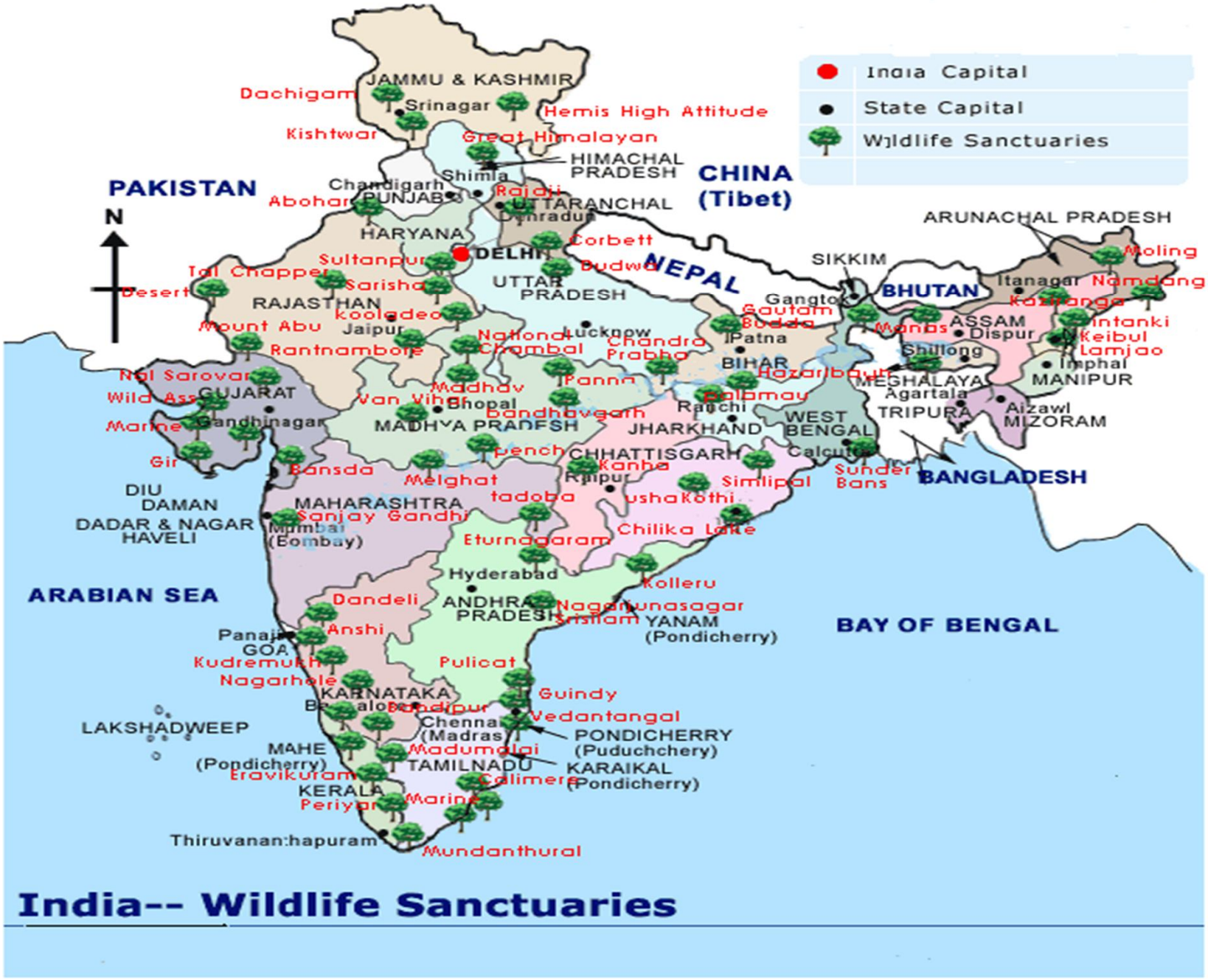
Conservation of species and habitants by manipulative management

Features:

No person reside in park other than public servants on duty and person permitted by chief wildlife warden.

Zone:

Core, Buffer and restoration



India-- Wildlife Sanctuaries

Biosphere reserve

"Natural areas that are generally used for scientific study"

Objective:

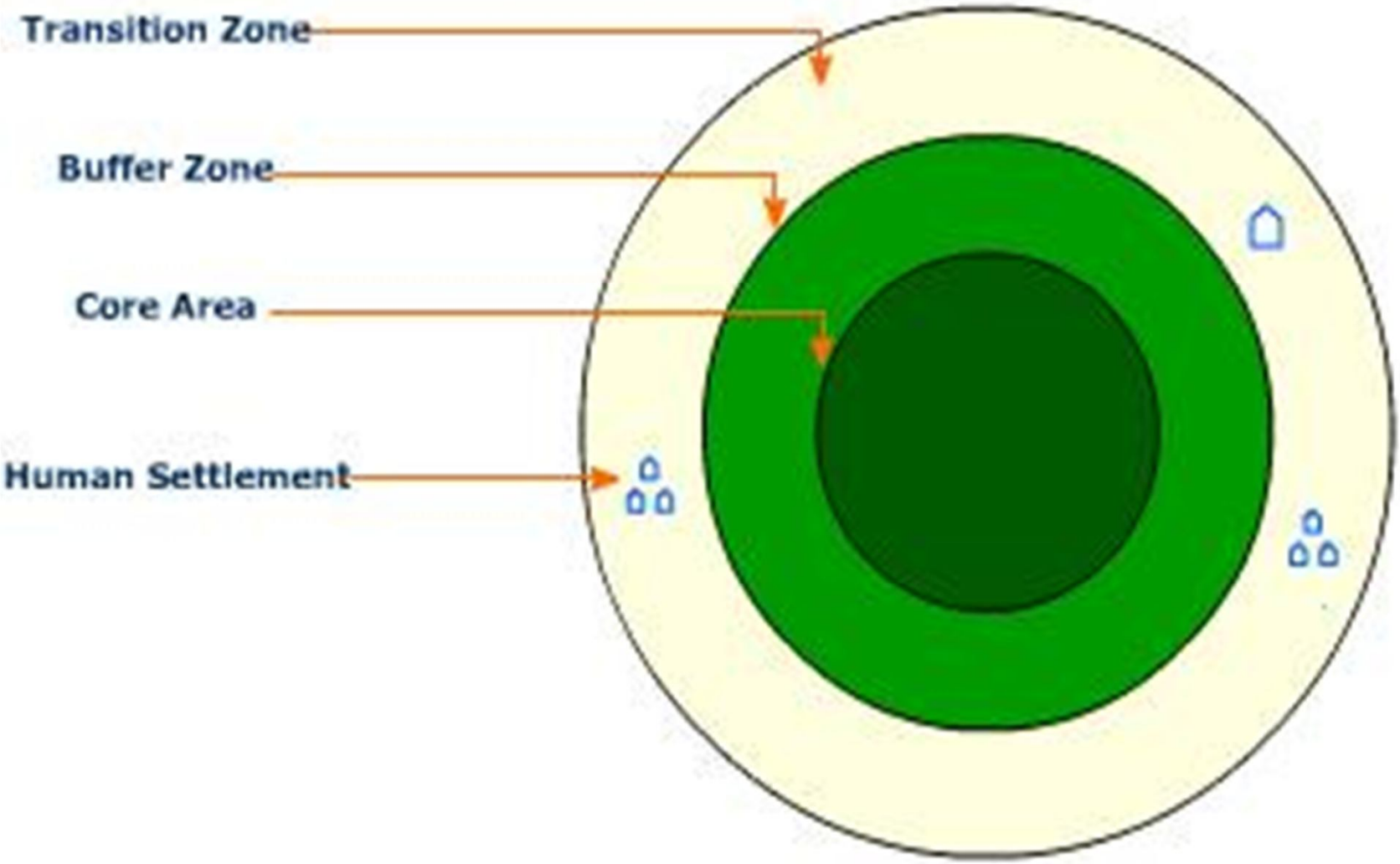
Conservation of natural resources and the improvement of the relationship between humans and the environment

Features:

Both human and natural influenced ecosystems; substantial human settlement.

Zone:

Core, Buffer, restoration or transition


Transition Zone
Buffer Zone
Core Area
Human Settlement

Advantage of in situ conservation

- It ensure the long term protection of the area

- Natural ecosystem spread in large areas provide a good opportunity for conservation as well as evolution

- It offers cheaper means of protecting species in their natural habitat.

Limitations of in situ conservation

- Many reserves do not receive the level of protection and management they need
- Widespread encroachment by poachers, settlers,
- Flora and fauna, as well as resources like wood and minerals continue to be exploited.
- Locals should be trained to conserve the wildlife and restore the degraded areas.

How is conservation done ex-situ?

- ✓ Conserve biodiversity in artificial setting.
- ✓ Chief mode of preservation of genetic resources.

It includes

- storage of seeds in banks and gene in gene bank
- breeding of animal species in zoos
- setting up botanical gardens,
- aquariums and
- research institutes

Seed bank

- Seed banks allow the storage of genetic diversity of whole plant populations
- Seeds are dried in cool conditions (15-18°C) with the relative humidity at 11-15%
- Storage into an airtight container and kept at -20 °C
- This takes about a month

Gene bank

- Gene bank are also known as germplasm bank,
- Gene banks are rather like seed banks
- Eggs, sperm and embryos are cryogenically frozen to protect the genetic variation of a species
- other vegetative propagating parts of various endangered plants can be preserved in these gene bank under viable conditions.

Botanical Gardens

- Botanical gardens are used for the conservation of rare and endangered plant species, for study and research of specific plant characters and for disseminating scientific information and experiences to promote sustainable development.

Botanical garden

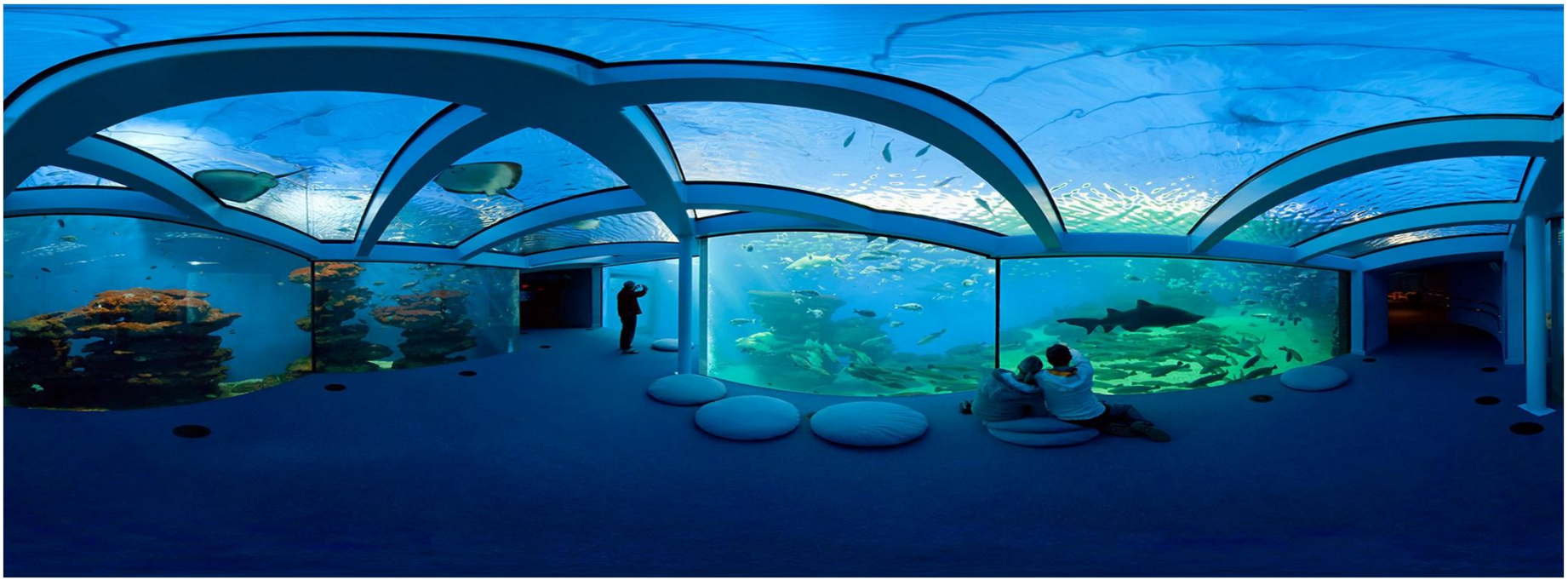
- There are estimated to be around 1600 botanical gardens throughout the world and these receive over 150 million visitors a year
- These botanical gardens are important as it is estimated that 60,000 plant species could be lost in the next 50 year
- The Botanic Gardens Conservation Institute (BGCI)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

Botanical gardens tend to look after plants in one of the five categories below

- **Rare species**
- **Endangered species**
- **Economically important**
- **Species that are needed for the restoration of an ecosystem**
- **Taxonomically isolated species**

Aquaria

- Used for captive propagation of threatened or endangered fresh water species.
- It also play an important role in educational facilities
- The world conservation union (IUCN) is currently developing captive breeding programs for endangered fishes.



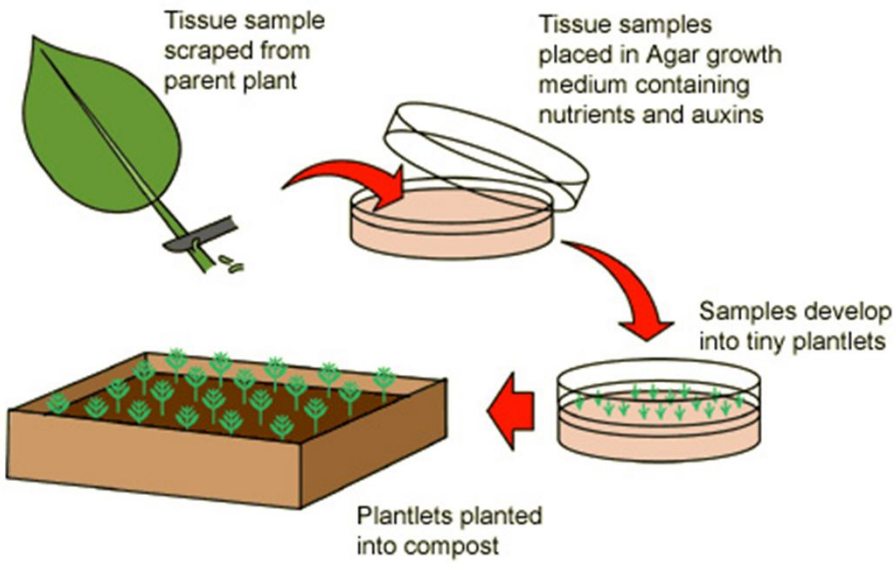
Use of Biotechnology

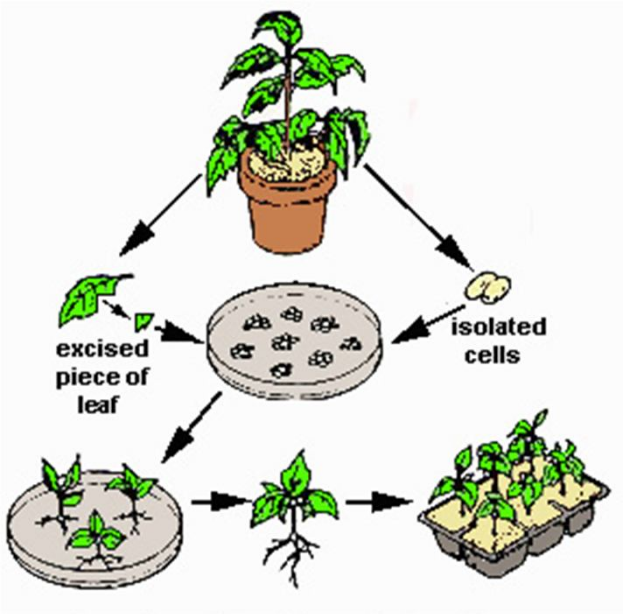
- manipulates the genes in an organism to change its characteristics.
- can make a plant resistant to specific pests or diseases
- can produce new varieties of plants with some desired characteristics.
- could lead to new and improved methods for preserving plant and animal diversity.
- by increasing the value of biodiversity, it could lead to better conservation.

- used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium

- Micro-propagation

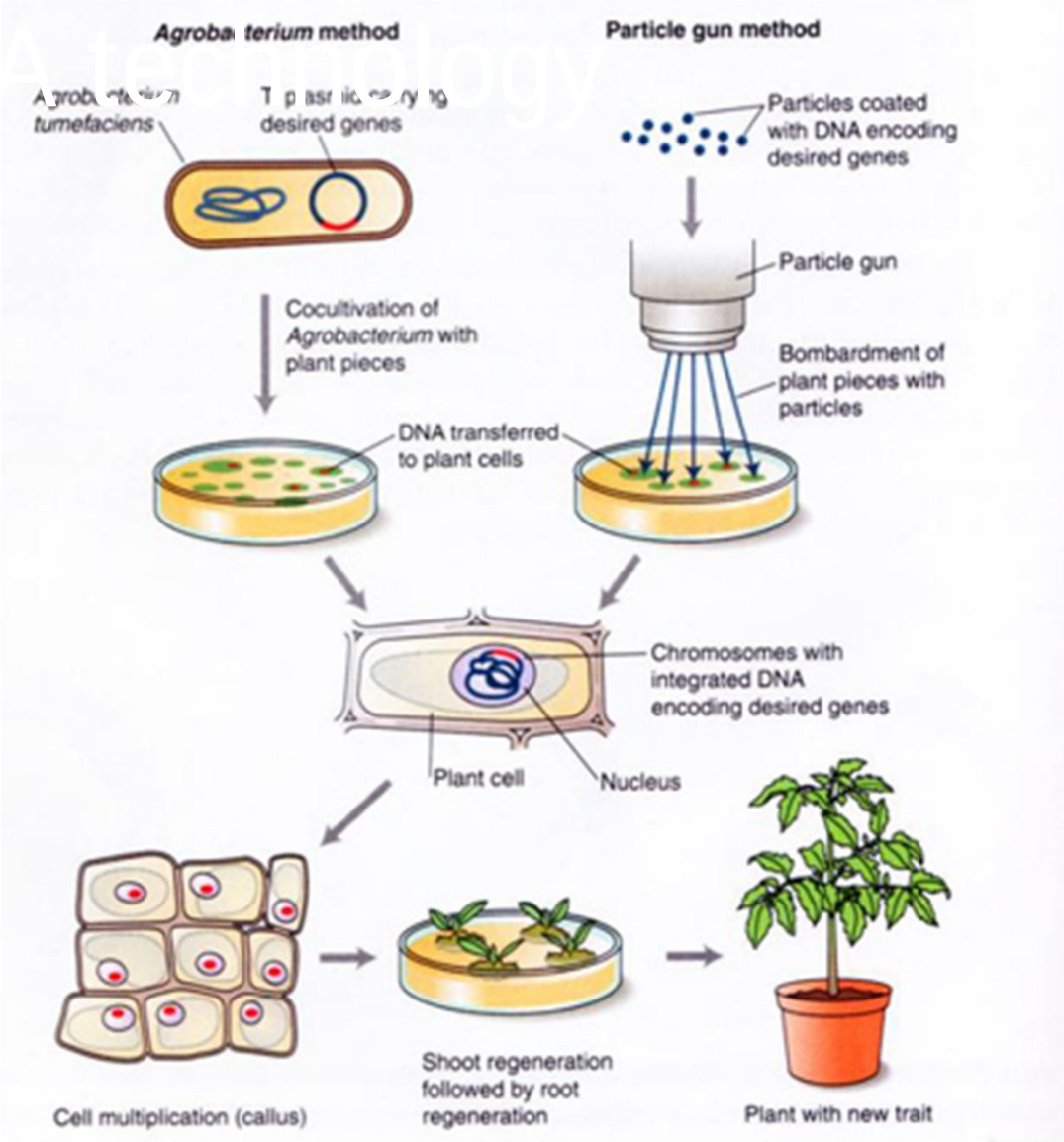
- Technique used for asexual propagation in plants.
- Require specialized lab





Overview of the Tissue Culture Process

- Genetic modification



Zoo

- **The main aim of a zoo is to house whole animals for breeding and re-introduction**
  - **Benefits of Zoo**
  - **To conservation of species**
  - **To educate the public**
  - **Earning**
  - **The world zoos conservation strategy estimates that there are more than 1100 zoos in the world and they receive over 600 million visitors annually**

Zoo contd...

- Along with many other animals zoo also preserve a few individuals of critically endangered species.
- If an animal breed in captivity, the may ultimately reintroduce the species into protected reserves.
- Zoo need large space and huge funds
- Only small percentage of species can be protected in zoos
- Public tends to support the saving of large or popular species i.e. lion, tiger, elephants, etc.
- There is not much interest in protecting smaller and less attractive species, even if they are known to be very important for ecosystem

Advantages of Ex situ Conservation

- It ensure long term conservation of the species
- Due to controlled supervision and assured food, shelter, and security provided in ex situ conservation, the species can survive longer and may breed more than usual.
- The quality of offspring may be improved by genetic techniques, if required
- In ex situ conservation, breeding of hybrid species is possible.

Limitations of Ex situ Conservation

- It is specific method that can be adopted for only a few kinds of species
- It is not a viable option for protection of rare species owing to human interference
- Overprotection of species in ex situ conservation may result in loss of naturality

Both ex situ and in situ conservation methods should be given equal importance as measures of biodiversity conservation

Steps to Preserve Biodiversity

- Undisturbed land should not be used for setting up industries and carrying out other developmental activities. Such projects cause large scale deforestation and ultimately lead to loss of biodiversity
- Germplasm of existing species should be collected so that the threatened and endangered species may be protected against extinction