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Biodiversity & Conservation

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Biodiversity And Conservation

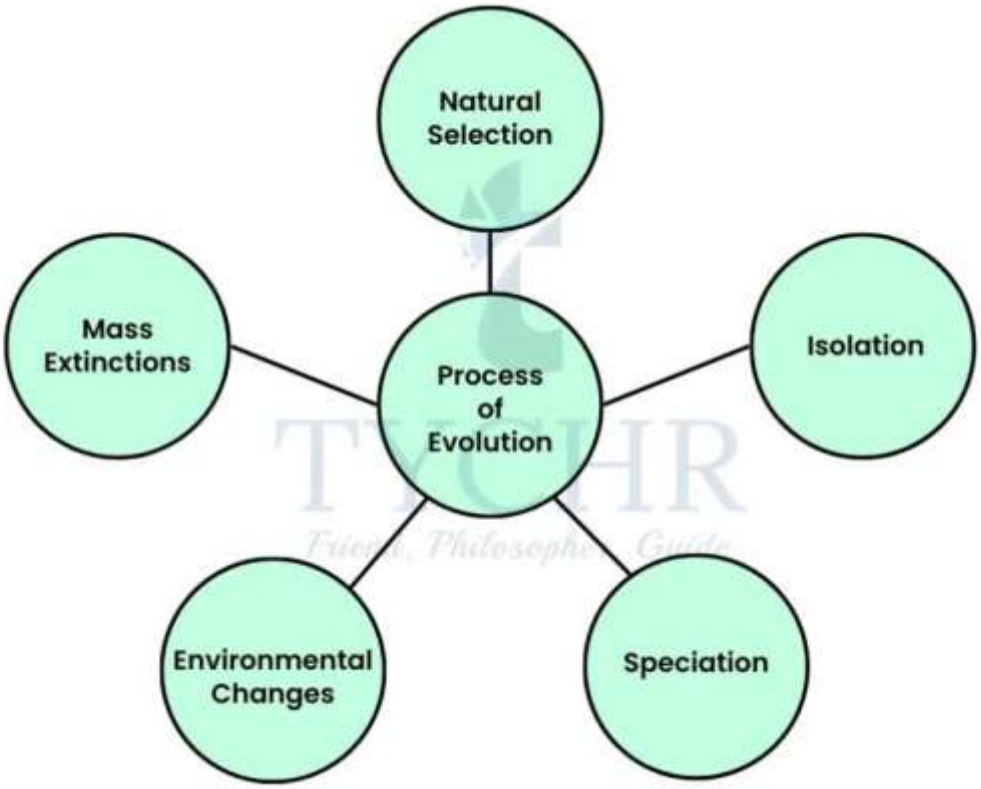


Figure 1 Various factors that influence the process of Evolution.

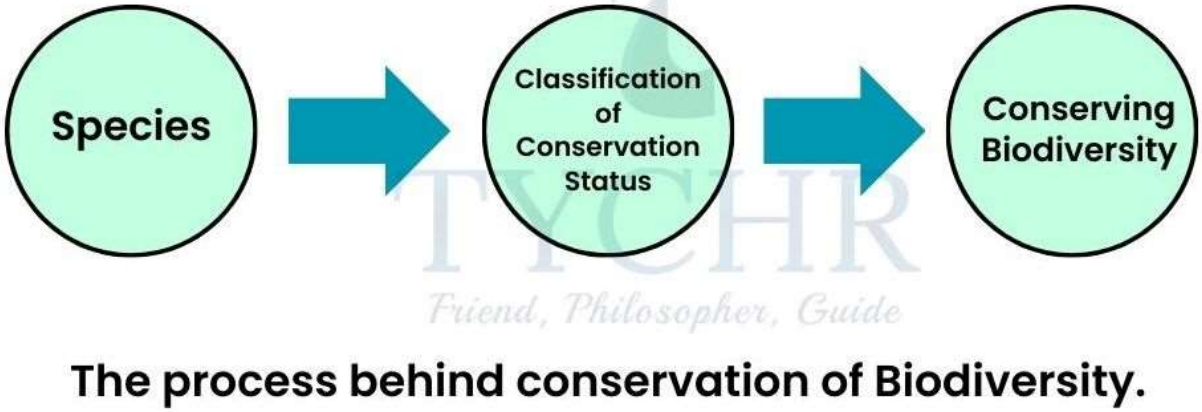
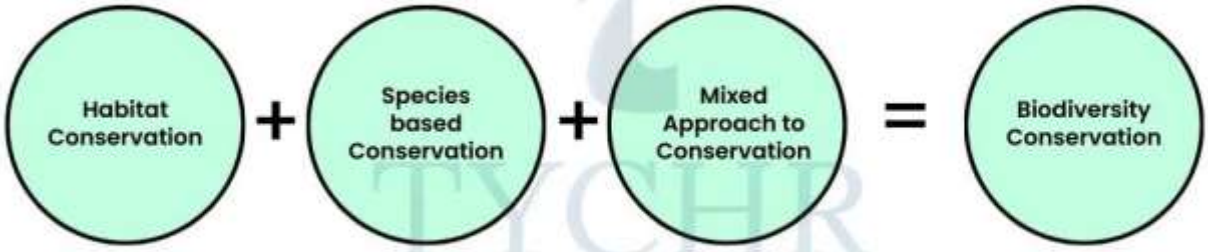


Figure 2 The process behind conservation of Biodiversity.



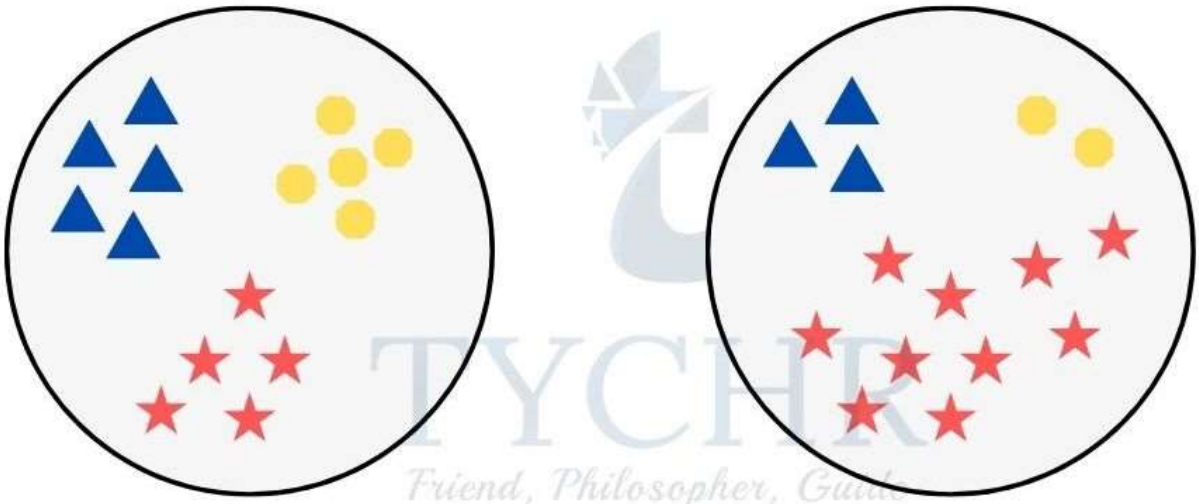
3 Three different ways through which global biodiversity can be conserved.

Figure 3 Three different ways through which global biodiversity can be conserved.

3.1 Introduction To Biodiversity

3.1.1 Biodiversity

The word “biodiversity” is derived from the term “biological diversity”. The concept includes habitat, species and genetic diversity:



Richness and evenness in two different communities.

Figure 4 Richness and evenness in two different communities.

- Species Diversity- refers to the variety of species per unit area; it includes both the number of species present and their relative abundance. richness and evenness are components of biodiversity. Richness is a term that refers to the number of a species in an area, and evenness refers to the relative abundance of each species.
- Habitat Diversity- is often associated with the variety of ecological niches. Eg: a woodland has many habitats compared to a dessert.
- Genetic Diversity- A large gene pool leads to high genetic diversity and a small gene pool to low genetic diversity. However, the term regularly alludes to the variety inside one animal groups, it can likewise be utilised to allude to the variety of qualities in all species inside an area. Conservation of Biodiversity

3.1.2 Conservation Of Biodiversity

Conservation means 'keeping what we have'. The goal of conservation is to safeguard species and their habitats from human-caused disturbances like deforestation and pollution. Protection exercises plan to slow the pace of eradication brought about by the impacts of impractical abuse of regular assets and to keep up with biotic connections between species. Conservation biologists use Simpson's index, a diversity index, to evaluate the impact of disturbance.
Quantification of biodiversity is crucial to conservation efforts because it enables the identification, exploration, and placement of appropriate conservation measures in areas with high biodiversity.

3.2 Origins Of Biodiversity

3.2.1 How Biodiversity Arises From Evolutionary Processes

The theory of evolution by natural selection was first developed by Charles Darwin. Because species show variation, those individuals that have adapted best to their surroundings (i.e. those that fit their environment) survive.

- Populations of a species show variation
- All species overproduce
- Even after over-production, the level of population remains the same.
- Overproduction leads to competition for resources

- The fittest, or best adapted organisms, survive
- The survivors reproduce and pass on their adaptive genes to the next generation
- The gene pool of the population changes over time, and new species emerge.

Speciation

The genetic makeup of a species changes over time through natural selection, which, when combined with isolation, can result in speciation. Subpopulations become genetically distinct to the point where they are unable to interbreed and are therefore distinct species if gene flow between them is prevented.

Isolation

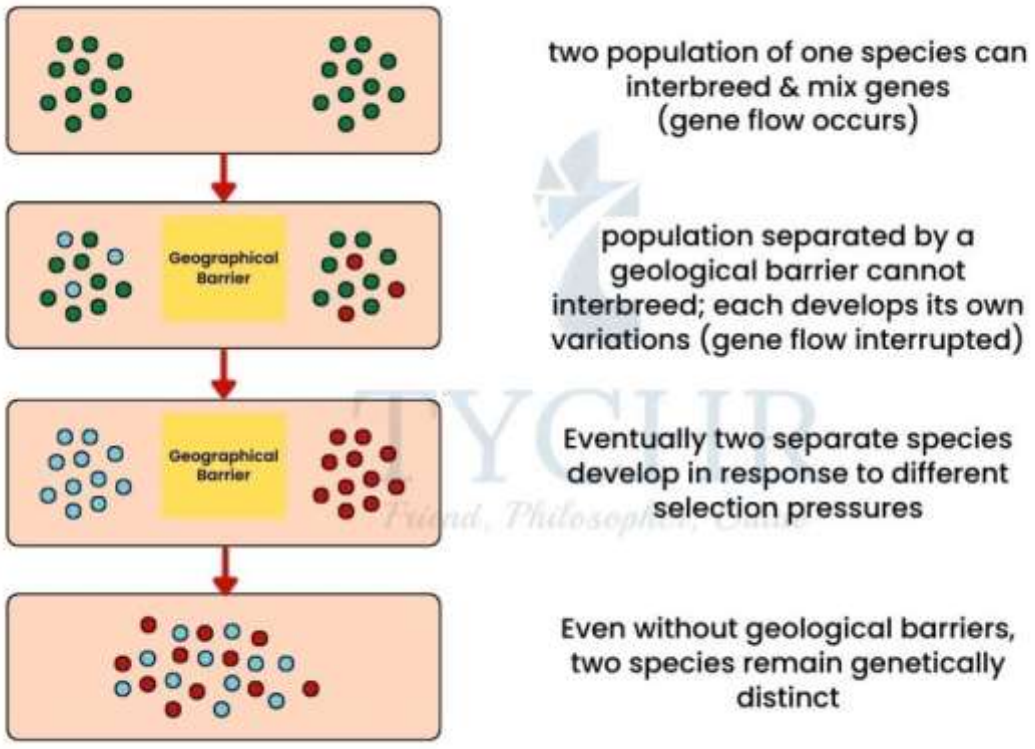


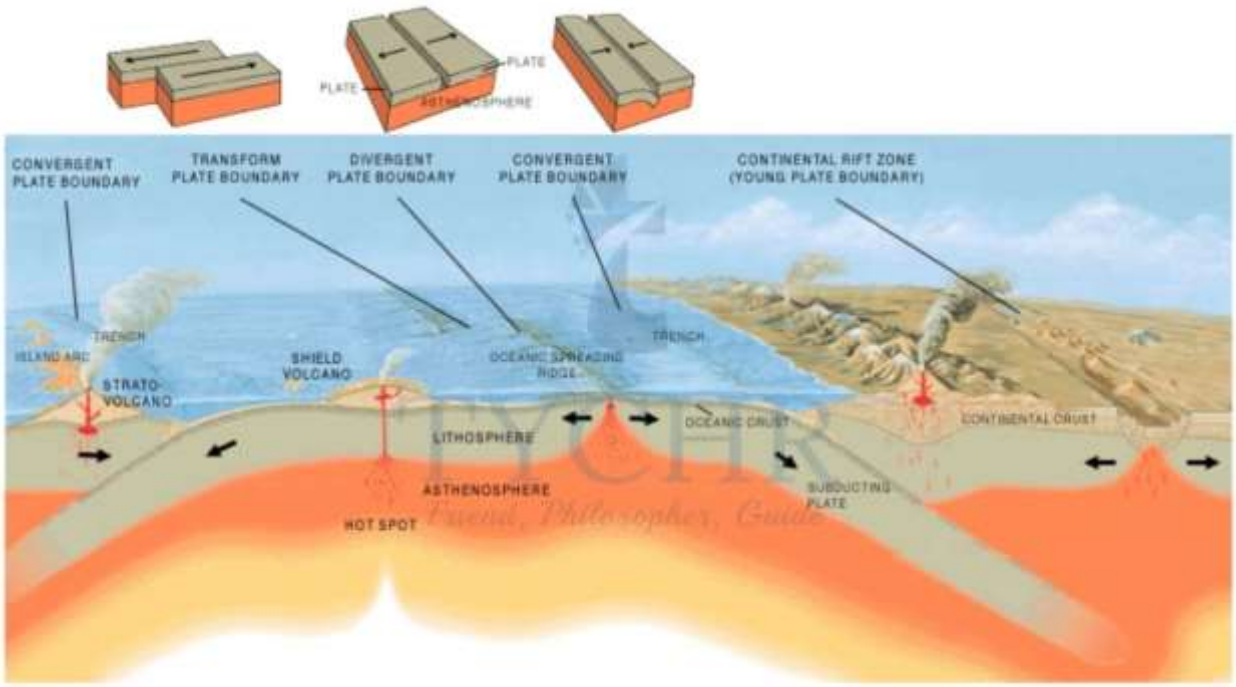
Figure 5 Geographical Isolation in various environments.

Isolation is essential to the process of speciation. Isolating mechanisms separate the populations so that natural selection can act separately on each population, leading to speciation. There are different types of isolation:

- Geographical isolation: As a result of island formation, loss of land bridges, mountains

- Behavioural differences: Different reproductive displays, songs, daily activity
- Anatomical differences: Reproductive organs, size.

Plate Boundary Types



- Divergent Boundary- Constructive – new crust being formed
- Convergent Boundary- Destructive – crust being destroyed
- Transform Boundary- Conservative – friction is created

Continental-Continental Divergent Boundary	Oceanic-Continental Convergent Boundary	Oceanic-Oceanic Convergent Boundary	Continental-Continental Convergent Boundary
• Continental plates diverge and form rift valleys. • Deep lakes/sea	• Subduction of denser oceanic crust beneath less dense	• Oceanic crust sub-ducted beneath oceanic crust.	• Continental plates collide and increase plate

s can form in the gaps; the creation of new aquatic habitats drives speciation. Magma from rift can create new land, giving more opportunities for evolution.	• continental crust. • Leads to new island arcs and mountain areas forming as magma rises from the subduction zone. Often volcanic.	• Rising magma causes volcanic activity and new islands to form, providing new habitats and driving speciation.	thickness. • New mountain ranges are formed – habitats at different altitudes contribute to biodiversity.	

3.2.3 Mass Extinctions

- A period where at least 75% of total species on Earth were wiped out at the same time. Species disappear in a geologically short time period due to abiotic phenomena.
- All mass extinctions have resulted in an increase in biodiversity – the large-scale loss of species left new opportunities for surviving populations to undergo adaptive radiation and fill different niches.

Ordovician – Silurian Extinction	Late Devonian Extinction	Permian – Triassic Extinction	End Triassic Extinction	Cretaceous Tertiary Extinction

Impact: 439 million years ago, killed 86% of all species. **Causes:** drop in sea levels as glaciers formed; rise in sea levels as glaciers melted.	**Impact:** 364 million years ago, killed 75% of all species. **Causes:** global cooling followed by global warming.	**Impact:** 251 million years ago, killed 96% of all species. **Causes:** Flood volcanism that reduced sea oxygen. Tectonics and movement of Pangaea- which exposed isolated areas and organisms to increased competition.	**Impact:** 199 million years ago, killed 80% of all species. **Causes:** flood volcanism (lava) erupting from opening in the Atlantic, leading to climate change.	**Impact:** 65 million years ago, killed 76% of all species. **Causes:** Impact of the asteroid created a crater in the Gulf of Mexico – dust thrown into the atmosphere by impact could have reduced sunlight, limiting productivity and dropping temperature. Plate tectonics and re-arrangement of the world's land.

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3.3 Threats To Biodiversity

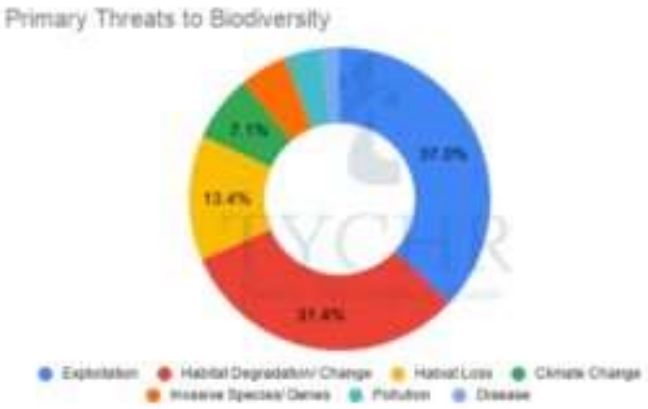

Figure 8 Source: McLellan, 2014

3.3.1 Species On Earth

Number of Species on Earth estimates vary considerably, as they are based on models and limited classification data. As a result, many habitats and groups are significantly under-recorded.

- Current consensus at 9 million species
- Most described species are larger organisms, mostly animals, easier to study
- Most diverse groups (insects, bacteria, fungi) are most difficult to study
- Of 1.8 million described species, 1% are vertebrates, yet they are the most studied

3.3.2 Rates of Species Loss

- 30,000 – 60,000 species a year, 100 – 100,000x greater than background extinction rate
- Existing species must be identified and named in order to understand extinction
- Humans contribute greatly to diversity loss, e.g. mammals 1 every 200 years should be lost, yet 90 species extinct in past 400 years.

3.3.3 Causes Of Species Loss

- Natural Causes- Typically hazard events such as volcanoes, ice ages, drought
- Human Causes- Habitat destruction, invasive species, pollution, overharvesting, hunting all reduce diversity
    - Habitat Destruction- Habitat degradation, fragmentation and loss
    - Introduction of Invasive Species-Invasive species compete with endemic species, leading to extinction of native species
    - Pollution- Chemicals, plastics, oil spills damage habitats and kill organisms.
    - Agricultural Practices- Destroy native habitats and replace them with less diverse monocultures, non- specific pesticides often used in agriculture and wipe out both native and pest species. Plantation crops replace natural ecosystems.
    - Mining Activities- Often destroy forests containing endangered species
    - Overharvesting and Hunting – animals are hunted for food, medicines etc.

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3.3.4 Threats To Tropical Biomes

Figure 9 Coral reefs only occupy 0.1% of the area of the ocean but they

support 25% of all marine species on the planet. One of the biggest reasons for the decline of coral reefs is coral bleaching as a result of global warming. 5.9% of earth's land surface, some of the most globally biodiverse areas. Unsustainable exploitation of these areas results in loss of biodiversity and ability to perform ecological services. 1.5 ha of tropical rainforest is lost every 4 seconds- includes rainforests, coral reef, mangrove forests.

- Complex and warm structures, stable climates increase productivity and allow many niches to be supported.
- Perform crucial ecosystem functions- soil erosion prevention, controlling water cycle & weather, carbon sequestering etc.

Human Activity and Disturbance

- Deforestation and forest degradation driven by increasing demands for timber, beef, land for crops, and biofuels impact rainforests.
    - Palm oil plantations replace a diverse climax community with a monoculture.
    - Large timber removal means fast growing species block out light for slower K-strategists.

- The rate of loss of biodiversity varies depending on the ecosystems present, protection policies available, environmental viewpoints and stage of economic development.

3.3.5 Dispute Conservation, Sustainable Development And Exploitation.

Due to their obligation to support local economies, LICs frequently engage in ecosystem exploitation; because they do not rely on ecosystems for income, HICs can preserve them.

- Arguments to preserve biodiversity are different in LICs, where most tropical biomes are found.
- For sustainable development to occur in LICs towards becoming MICs, balance between using land for income and conservation must be struck using local and governmental support.

3.3.6 Determining Conservation Status

The Red List

Figure 11 The Indri is a primate from Madagascar. Reasons for being on the Red List: loss of its rainforest habitat.

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Figure 10 The European Eel. Reasons for being on the Red List: low population number caused by overfishing

Published by IUCN (international Union of Conservation of Nature), seeking to conserve genetic diversity through awareness and providing a basis for conservation decisions at local and global levels.

- To identify species requiring conservation
- To identify species with conservation status concern
- To catalogue species facing a high risk of global extinction

3.4 Conservation Of Biodiversity

3.4.1 Arguments For Conserving Biodiversity

Goods are easier to quantify than indirect values and services.

Aesthetic Reasons	Ecological Reasons	Economic Reasons	Ethical Reasons	Social Reasons

Species/ habitats are pleasant to look at.	Habitats with endemic species must be preserved. Higher biodiversity = more resilience & stability = continued ecosystem services in future. Species extinctions have knock-on effects throughout food webs.	Value of ecotourism, genetic resources & commercial considerations of capital. Genetic diversity can allow improvements in crops etc. to be made – a genetic resource. Commercial resources (capital as medicines etc. or successful tourism)	Intrinsic value of a species – all have a right to survive, responsibility to protect for future	Ecosystems provide homes, livelihoods and cultural cohesion for indigenous people.

3.4.2 Conservation Organisations

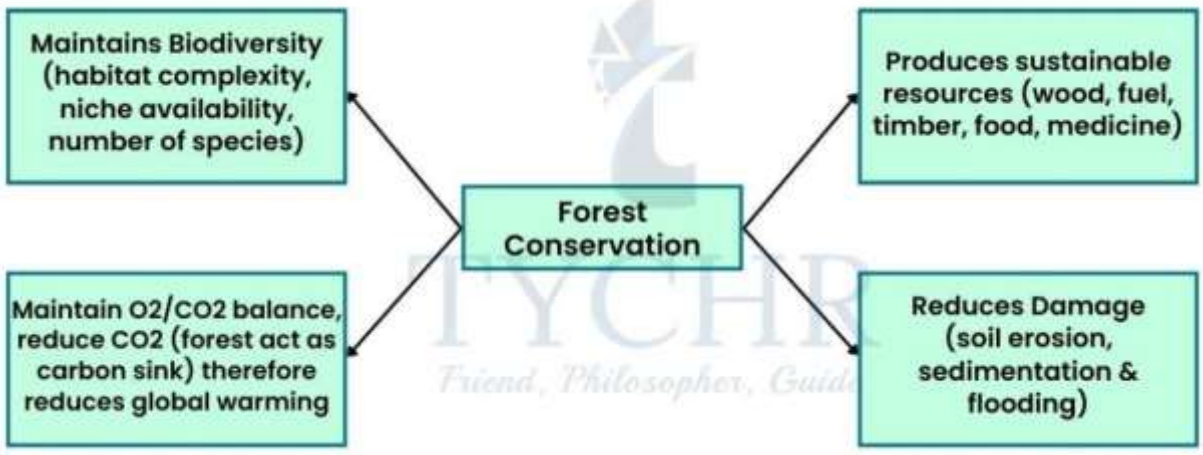

Figure 12 The biological significance of a forest.

it can be international, governmental or non-governmental, and their use of the media, speed of response, diplomatic constraints, finances, and influence all play a role in how successful they are at conservation.

	NGOs	IGOs
	• Not run, influenced or funded by governments • Field based, gathering information to support their claims • Radical to spread their message and be heard • Example: Greenpeace, WWF	• Established through agreements to allow global cooperation between governments • Information from paid scientific research • Less controversial, more conservative approach • Example: United Nations Environment Programme.
Use Of Media	Gain coverage through protests & campaigns (charismatic species), putting pressure on governments.	Cooperates with media to effectively communicate policies and decisions to the public.
Speed Of Response	Fast, members already at consensus regarding course of action.	Slow (bureaucratic), decisions directed by governments & require consensus.
Agenda	Using public pressure and lobbying to influence government policies and legislation.	Provides guidelines and implementing international conservation treaties.
Funding	From private donations.	Budget from national economies.

Political Pressures	Environment focused, working towards idealistic conservation strategies.	Can be politically/economically driven rather than environmental.

- Both provide information to educate public on environmental issues, publishing reports and data
- Both encourage partnerships between nations and organisations to conserve ecosystems
- Both monitor species and conservation areas at local, regional and global scales

3.4.3 International Conventions On Biodiversity

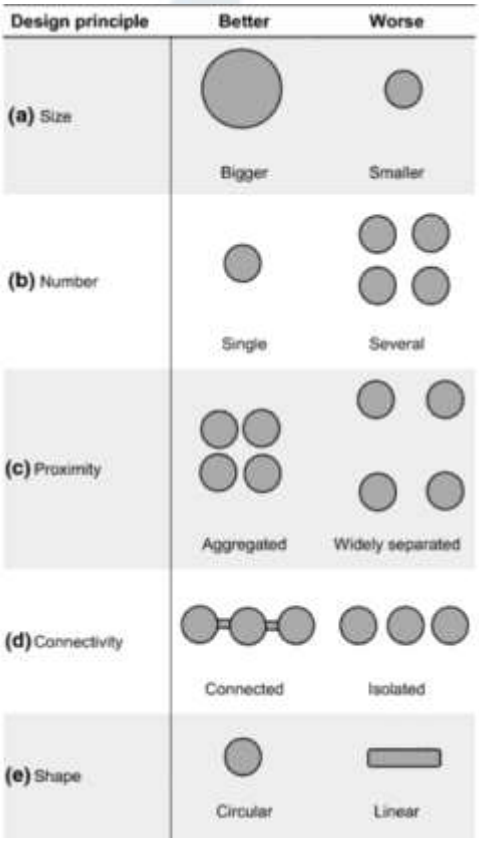

Figure 13 The shape, size and connectivity of reserves are important in the design of protected areas.

Conventions aim to create collaboration between nations for biodiversity conservation. IUCN (International Union for Conservation of Nature)

- Founded in 1948, concerned with importance of conservation of resources for sustainable development.
- Established Red List and World Conservation Strategy with the UNEP and WWF

In Situ Conservation

- The conservation of species in their natural habitat.
- Endangered animals & their habitats are protected, conserving many other species.

Ex Situ Conservation

- The preservation of species outside their natural habitat.
- Takes place in botanical gardens, zoos, with captive breeding programmes.
- It focuses on vulnerable species.
- Aims to attract interest & public pressure in conservation.
- Requires more funding.

3.4.4 Designing Protected Areas

Buffers to human influence, area, edge effects, shape, corridors must be considered (BAESC)
Buffer Zones- Successful areas are surrounded by buffers to minimise disturbances from outside influence

Area	Edge Effects	Shape	Corridors
Larger conservation areas preferable to several smaller ones.	Changes in abiotic factors at the edge of a protected area (eg. temp,	Circles are the ideal shape as they have the lowest edge effects.	Close, clumped conservation areas with corridors are better than

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They include more habitats, promoting large population sizes especially among large vertebrates.

The best indication of reserve success is the population of individual species.

Several reserves allow habitats to guard against possible effects of fire etc. that may threaten species.

humidity, wind).

Edges attract species not found deeper within the reserve, leading to competition and an overall reduction in biodiversity.

Larger habitats reduce the perimeter relative to the area, minimising the edge effects.

Long, thin reserves have large edge effects.

Depending on the location of habitats, parks are usually irregular.

fragmented areas.

Animals can migrate, disperse and recolonise in the event of a disturbance.

Migration and seasonal movements are made possible by genetic flow through corridors, which reduce obstacles to movement like roads and car accidents.

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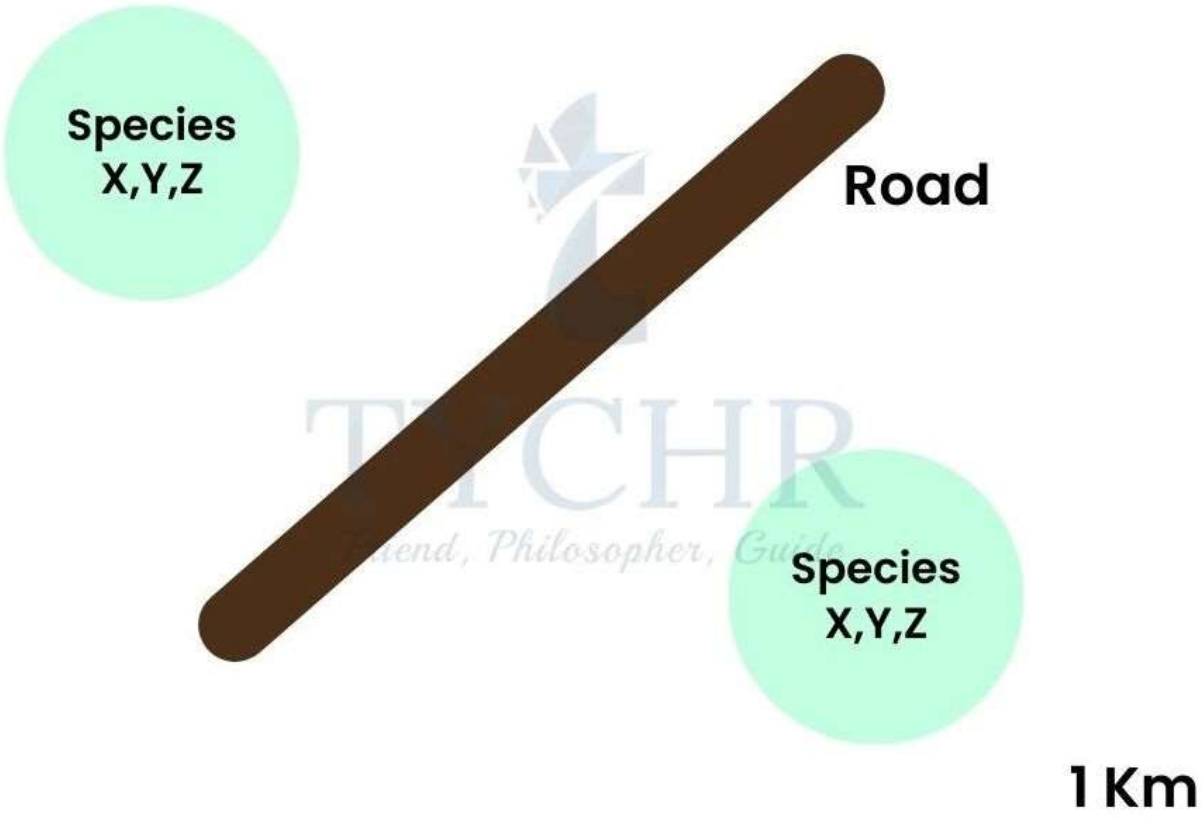

Figure 14 Two wildlife reserves – one has two isolated reserves whereas the other has a corridor connecting two habitat areas. Species X, Y and Z are found in all three reserves.

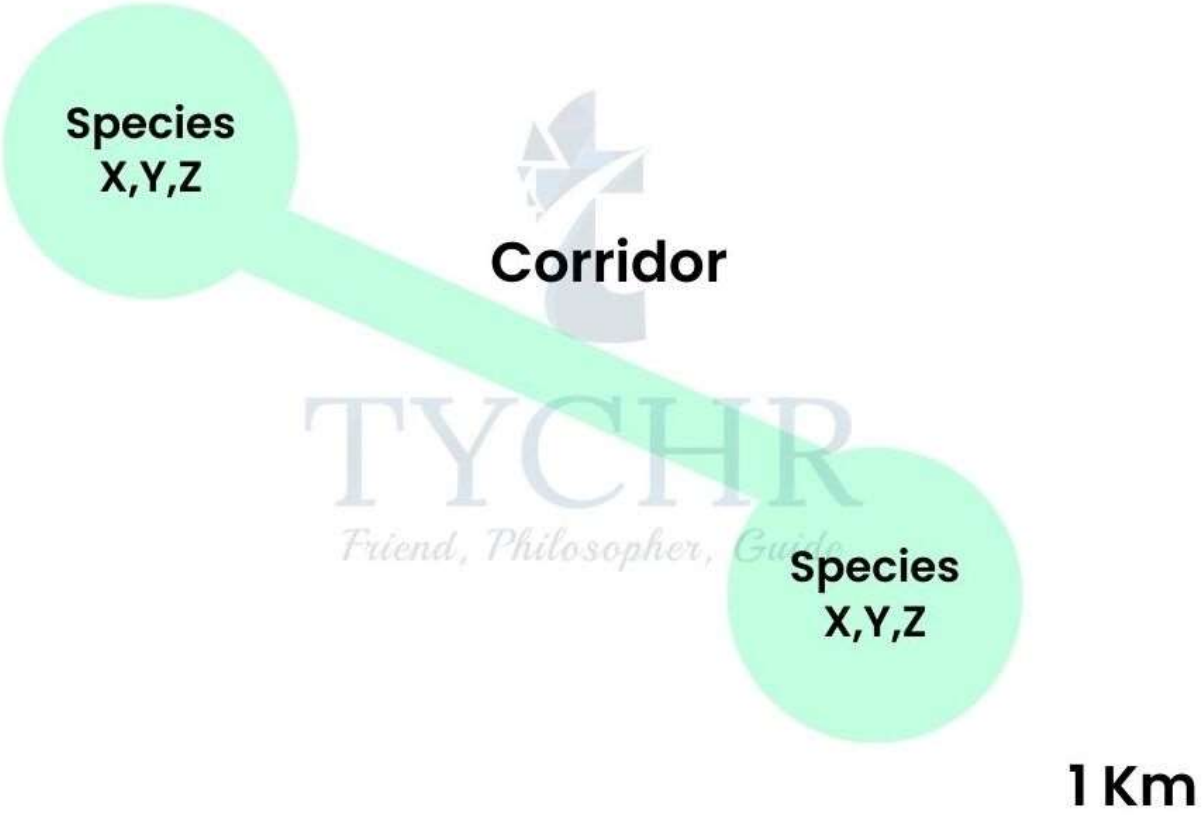

Figure 14 Two wildlife reserves – one has two isolated reserves whereas the other has a corridor connecting two habitat areas. Species X, Y and Z are found in all three reserves.

3.4.5 Species Based Conservation

CITES (Convention On International Trade in Endangered Species) Established in 1973, int'l agreement regulating trade in endangered species aimed at preventing trade in endangered species of plants and animals. While trade in plants & animals is worth billions, it reduces wild populations & exhausts species.

Evaluating A Protected Area

Strengths	Limitations
• CITES currently protects 35,000 species, with countries becoming voluntary members (monitoring trade, extracting fines to discourage trade) – works trans boundary. • ensures the long-term viability of international trade in wildlife. • Legally Binding – participating countries must implement the convention.	• It is voluntary and countries can disagree about the • listing specific species when they join and imposing penalties may not be sufficient to deter wildlife smugglers or reflect the severity of the offence. • CITES lacks financial mechanisms for implementation at the national level.

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Captive Breeding & Reintroduction Programmes (Zoos)

International zoos have focused for a long time on keeping endangered or critically endangered animals in order to shield them from threats in the wild. With the goal of reintroducing animals to the wild once their natural habitats have been protected, captive breeding programs maintain population numbers and genetic diversity.

Advantages	Disadvantages
• They provide a safe haven for critically endangered animals. • They provide an opportunity to research the biology and behaviour of endangered species thereby increasing scientific knowledge about the species they protect. • They can be used to raise awareness and educate the public about the threats faced by the species in the wild. • They can be used to obtain funds to help conservation efforts. • Breeding pairs can be used to increase the number of endangered animals, which can then be used to reintroduce the animal into the wild.	• It can be argued that it is ethically wrong to keep animals in captivity • Captive animals can develop health problems, and species can become stressed in captivity, thereby experiencing behavioural problems • International zoos and wildlife parks are expensive to create and maintain, and funds could instead be spent on habitat conservation efforts • They do not address the causes of reduction in wild populations, e.g. deforestation and hunting.

Flagship Species

Flagship species are “charismatic” species that help protect others in an area. They have a wide appeal to the public, and conserving these species will result in habitat protection that will also protect other species.

Keystone Species

A keystone species is a plant or animal that plays a central role in the way an ecosystem functions. Loss of a keystone species can lead to a significantly different ecosystem or the collapse of the ecosystem altogether. Conservation of keystone species helps to protect the integrity of food webs.

Mixed Approach

Figure 15 An agouti (Keystone Specie)

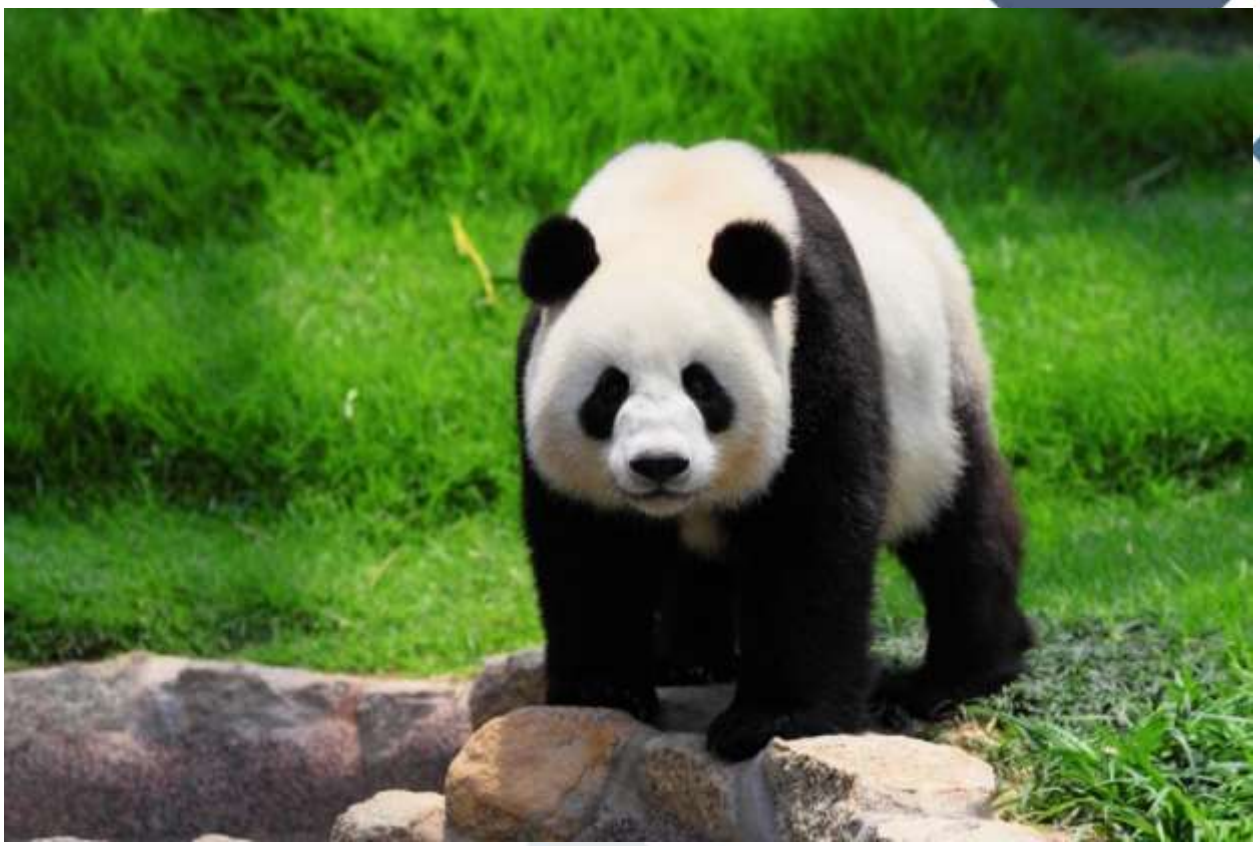

Figure 16 A panda (Flagship Specie)

A mixed approach to conservation combines in situ and ex situ conservation as a means of successfully protecting and prolonging the lives of endangered and critically endangered animals.

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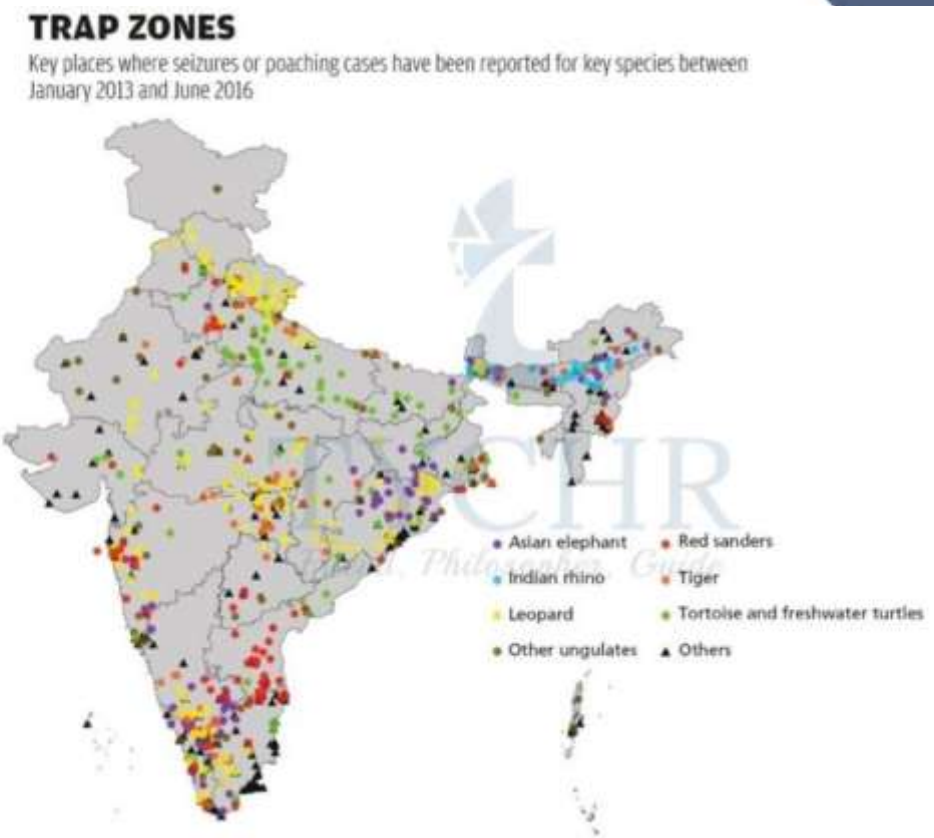

Figure 17 Key places in India where seizures or poaching cases have been reported for key species between January 2013 and June 2016. Source: Down to Earth Magazine.

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