



BIODIVERSITY



Iris 'The Geisha'
© NZ Plant Picc Photography



Biodiversity

What does “Bio” means?

Bio = **Life**



Biodiversity

What does “Diversity”
means?

Diversity = Variety



- The term **Biodiversity** was first coined by Walter G. Rosen in **1986**
- **Biodiversity** is the vast array of **all the species of plants, animals, insects and the microorganisms inhabiting the earth either in the aquatic or the terrestrial habitats** (different forms of life). The human civilization depends directly or indirectly upon this biodiversity for their very basic needs of survival–food, fodder, fuel, fertilizer, timber, rubber, leather, medicines and several raw materials.
- Approximate **10 to 80 million species** exist.



CONCEPT AND TYPES OF BIODIVERSITY

☐ As defined in convention on Biological diversity signed at **Rio De Jenerio (Brazil) in 1992 by 154 countries**, the Biodiversity defined as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic eco-systems and the ecological complexes of which the area part- this include diversity within species, between species and of ecosystem.”

☐ According to **IUCN in 1998**, “the **variety and variability of species of their population, the variety of species or their life forms.**”



- Although our understanding of the earth's organisms—its biological resources- is still imperfect, **there is no doubt that the abundance and diversity of living organisms provide many benefits and make our world a beautiful and interesting place to live.** Biodiversity is generally described in terms of its 4 fundamental and hierarchically related levels of biological organisms. **This are 4 main types of Diversity:**

1-Genetic diversity

- It includes the **genetic variations within species, both among geographically separated populations and among individuals within single population.**





2-Species diversity

- It includes full range of species from micro organisms to giants and mammoth (huge) varieties of plants and animals, e.g. single celled viruses and bacteria etc. and multi-cellular plants, animals and fungi.

3-Ecological Diversity (Diversity of Ecosystem)

- This includes the different types of forests, grass lands, wet lands, water bodies like streams, lakes and oceans, coral reefs, rocky mountains etc.



4-Functional Diversity

- This includes the different types of biological and chemical processes such as mass and energy flow essential for the survival of living organisms.
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- Because genes are parts of species, and the species make up ecosystems- the concept of biodiversity reflects an interrelationship among its three components. *Biodiversity is distributed uniformly across the globe. It is substantially greater in some areas than in the others.* Generally, species diversity increases from the poles towards the tropics- **for instance, among the terrestrial systems, the tropical rain forests, which cover only 57% of the earth's land area, possess as much as over 50% of the world's species.**

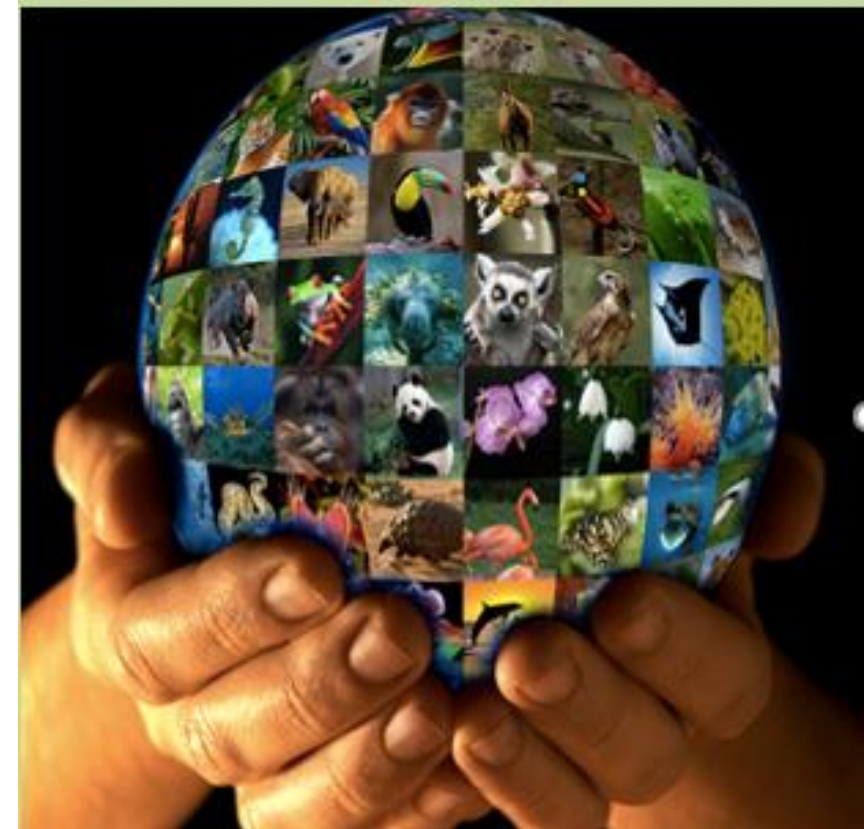


- **Why is Biodiversity important? Does it really matter if there aren't so many species?**
- **Biodiversity boosts (support) ecosystem productivity where each species, no matter how small, all have an important role to play. For example, a larger number of plant species means a greater variety of crops; greater species diversity ensures natural sustainability for all life forms; and healthy ecosystems can better withstand and recover from a variety of disasters. And so, while we dominate this planet, we still need to preserve the diversity in wildlife.**



Why does Biodiversity Matter?

- Without biodiversity a variety of organisms, ecosystems, and natural processes would not exist
 - E.g.; the production of air, the cycling of carbon and nitrogen
- Humans are a part of and dependent on ecosystems

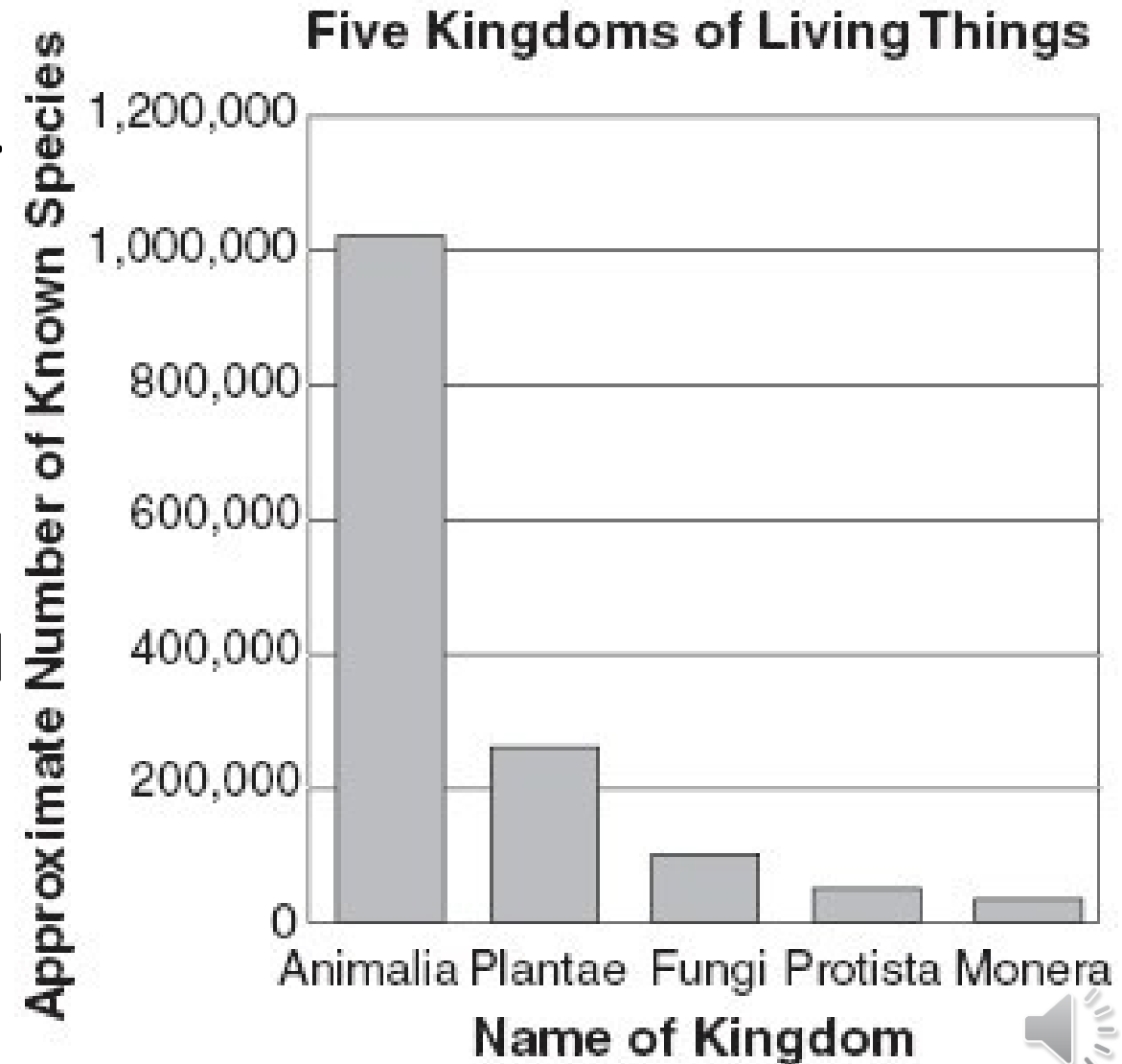


DISTRIBUTION OF BIODIVERSITY

Flora and fauna diversity depends on-

- ☐ Climate
- ☐ Altitude
- ☐ Soils
- ☐ Presence of other species

Most of the biodiversity concentrated in Tropical region.

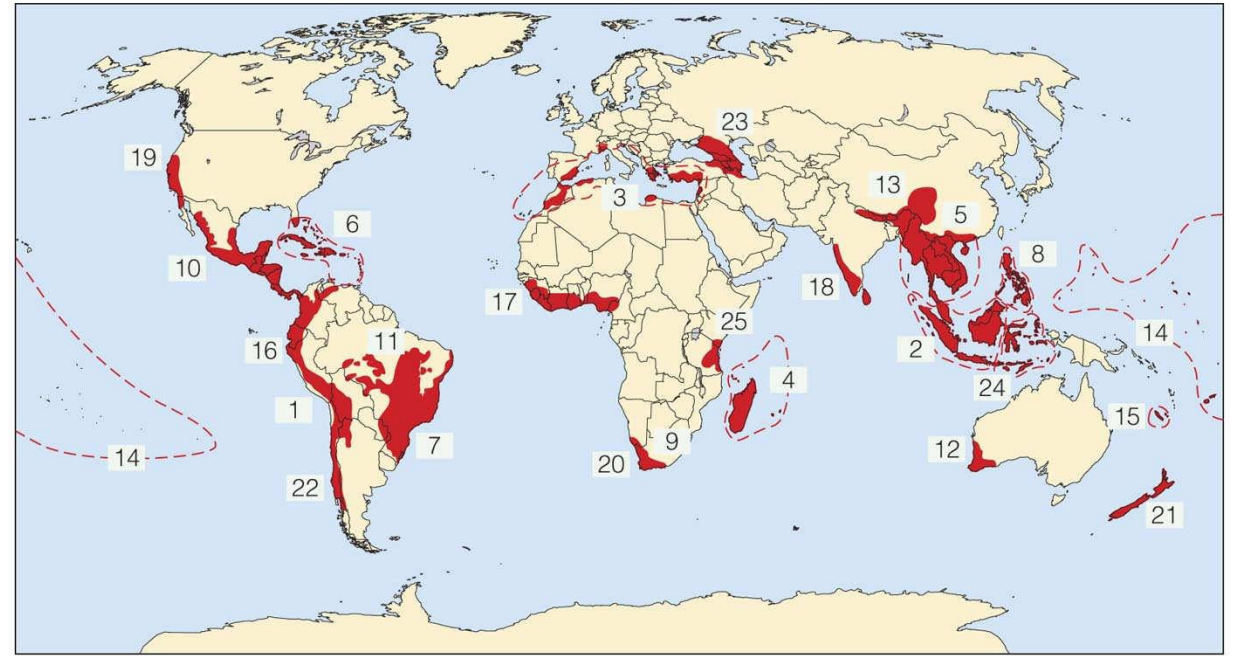


- **BIODIVERSITY HOTSPOTS:**

A region with **high biodiversity** with most of species being **Endemic**.

India have two Biodiversity sites:

- Hotspots- East Himalayan
- Region and Western Ghat.



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EASTERN HIMALAYAS

biodiversity hotspot



area

27,500 km²



300

mammal
species



977

bird
species



176

reptile
species



105

amphibian
species

The Himalayan grasslands have the densest population of Bengal tigers, which live alongside Asian elephants and one horned rhinos. The mountains offer refuge for red pandas, golden langurs and takins. This is the only known location in the world where Bengal tigers and snow leopards share habitat.





Western Ghats and **SRILANKA**



LOSS OF BIODIVERSITY



- Biodiversity is destroyed in a number of ways either by **natural changes or by human disruption**.
- The loss of even a single species is considered as a tragedy as each form of life is a natural storehouse of irreplaceable substances the genetic materials. **As species become extinct, the fine balance of nature is disturbed to great extent.** The loss of even a single species can alter a food chain/food web, i.e. ecosystem disruption, and upset the delicate balance between one species **that preys upon another.**



- ☐ Narrow geographical area
- ☐ Low population
- ☐ Low breeding rate
- ☐ Natural disasters



- **Natural Causes**

- **Species arise through processes of mutation, isolation, and natural selection. Evolution can proceed gradually over millions of years or may occur in large jumps when new organisms migrate into an area or when environmental conditions change rapidly.** In a sense, species that are replaced by their descendants are not completely lost. The much larger modern horse, for instance, has replaced the tiny Hypohippus, but most of its genes probably still survive in its distant offspring.





Eohippus
(50 million years ago)



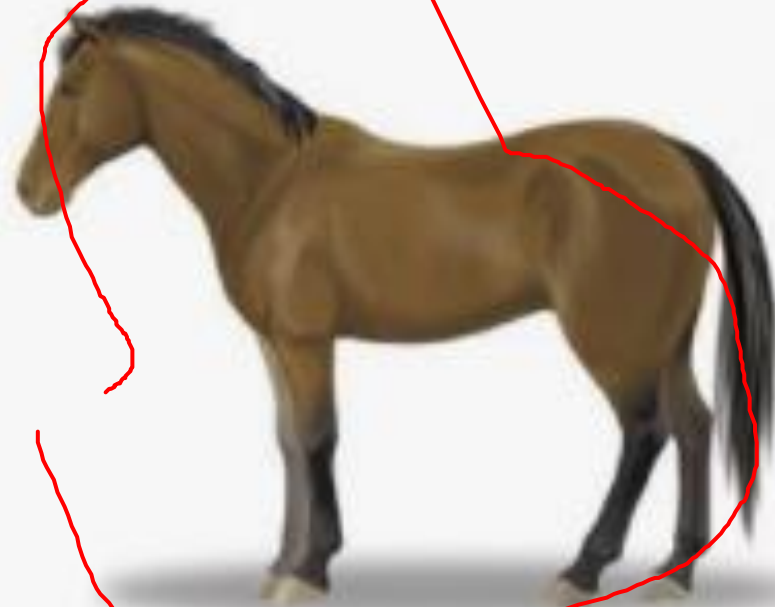
Mesohippus
(35 million years ago)



Merychippus
(10 million years ago)



Pliohippus
(5 million years ago)



Equus
(At Present)



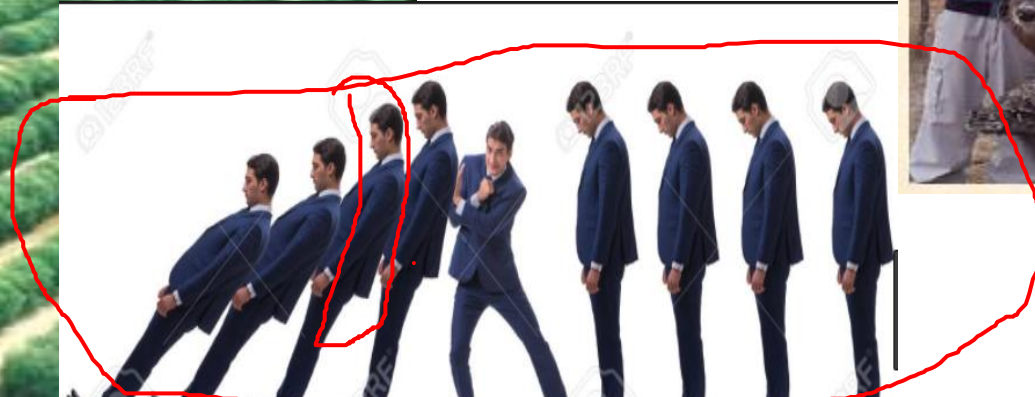


Human-Caused Extinction

Man has a long history of dependence on biological resource hence depletion of resources is obvious. It has never been the pursuit of mankind to completely destroy other species, but in a variety of ways through ignorance or carelessness, **we have reduced biological abundance and driven species into extinction**. Man as a hunter in Stone Age may have been responsible for the extermination of the “Mega fauna” of both America and Eurasia during the Pleistocene era. Climatic change may have been partially or primarily responsible. The loss of species and ecosystems extracts a high price.



- [?]Habitat modification
 - [?]Overexploitation of selected species
 - [?]Innovation by exotic species
- [?]Pollution
- [?]Hunting
- [?]Global warming and climate change
- [?]Agriculture
- [?]Domino effect



- **The scale of human impact on the global biodiversity is huge. It is considered that man has disturbed his own life support system. Tropical forest areas or the world suffer a great loss, which are disappearing at the rate of 17 million hectares (17 sq. kms.) every year. The estimation from the fossil record suggests that the average life of a species is about 4 million years.**
- **According to an estimate, if there are about 10 million species a year at a moderate estimate, we are now likely to lose around 50,000 species a year over the next decades. The following is a broad list of threatened animals:**



Table List of Threatened Animals

Animal group	No. of species
Mammals	507
Birds	1,029
Reptiles	169
Amphibians	57
Fish	713
Insects	1,083
Molluscs	409
Corals and sponges	154
Annelid worms	139
Crustaceans	126



Deforestation and biodiversity destruction to sustain life after independence by our more recent ancestors added fuel to the fire.

However, government has provided substitutes of solar driven appliances for cooking and lighting. Still it has failed to decrease pressure on wood resources.



Table Direct and Indirect Impact of Humans on Biological Resources

Direct impact	Indirect impact
Hunting and food Gathering Fishing Trade in Animal Products Harvesting wild plants Pet and scientific trade Predator and pest control	Habitat destruction Exotic species Introductions Diseases Pollution Genetic assimilation



- **Measuring Biodiversity**

- **Diversity can be defined as the number of species found in a community.** Hence, biodiversity refers to the species richness of an area. Algorithms of biodiversity have been developed to connote species diversity at different geographical scales as follows:

- **A-Alpha Diversity**

- It **indicates the number of species in a single community.** The index can be used to compare the number of species in different ecosystem type (is the mean species diversity in sites or habitats at a local scale.) or (species richness (number of taxa) within a single microbial ecosystem).

- **B- Beta Diversity**

- It indicates the **degree** to which **species composition changes along an environmental gradient** (Ratio between regional and local species diversity) or (diversity in microbial community between different environments (difference in taxonomic abundance profiles from different samples).).



C- Gamma Diversity

- It indicates the **rate at which additional species are encountered as geographical replacements** within a habitat type in different localities (total species diversity in a landscape).

The Value of Biodiversity

The values of the earth's biological resources can broadly be classified into-

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- **Direct Values**
- ~~Consumptive and productive uses.~~
- **Food Resources:** Grains, vegetables, fruits, nuts, condiments, tea-coffee, tobacco, oil from plant resources; and meat, fish, egg, milk (and milk products), honey, etc. from animal resources.
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- **Other Resources:** Medicine, fuel, timber, household accessories, fodder, fiber, fertilizer, wool, leather, paint, resin, wax, thatch. Ornamental plants, rubber, creams, silk, feathers, decorative items, etc.
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- **Indirect Values**

- **Non-consumptive uses and options for the future.**

- 1. Carbon fixing through photosynthesis, which provides the support system for species.
- 2. Pollination, gene flow, etc.
- 3. Maintaining water cycles, recharging ground water, protecting watersheds.
- 4. Buffering from climatic extreme conditions such as flood and drought;
- 5. Soil production and protection from erosion;
- 6. Maintaining essential nutrient cycles, e.g. carbon, nitrogen, and oxygen and others.
- 7. Absorbing and decomposing pollutants, organic wastes, pesticides, and air and water pollutants;
- 8. Regulating climate at both macro and micro levels;
- 9. Preserving recreational, aesthetic, socio-cultural, scientific, educational, ethical and historical values of natural environments.



- **(i) Consumptive Use.** Man is mostly dependent on plant and animal resources for his' dietary requirements. A major share of our food comes from domesticated crops and animals. Still we derive major of food from wild species. A large section of human population is dependent on food, which we gather from seas and oceans that is harvested from free roaming wild organisms. Seafood is rich in minerals and vitamins and contains up to 60 percent of the protein.
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- **(ii) Productive Use.** Trade and commerce industry is very largely dependent on forests. Besides, timber, firewood, paper pulp, and other wood products, we get many valuable commercial products from forests. Herbs of medicinal value. Rattan, cane, sisal, rubber, pectins, resins, gums, tannins, vegetable oils, waxes, and essential oils are among the products gathered in the wild form forest areas.





(iii) Medicine. Many medicinal and aromatic plants are being exploited in the wild to tap their potential for different cure in the field of drug extraction e.g. *Hippophae rhamnoides*, *Ephedra Kerardiana*. *Dactylorrahiza hatageria* etc. Besides, they are being cultured in plantations and protected in wild to encourage in-situ and ex-situ conservation viz. Valley of flowers, Rohtang in Kullu, Lahu & Spiti Valley. Animal products are also sources of drugs, analgesics pharmaceuticals, antibiotics, heart regulators, anticancer and ant parasite drugs, blood pressure regulators, anticoagulants, enzymes, and hormones.



- **(iv) Ecological Benefits.** Man cannot have control over nature in the wild. It can only put “pressure on resources and pollute environment. Then what makes environment act as a self-replenishing system with respect to resource generation and self cleanliness. To answer this comes into picture the role of biological communities. The processes of soil formation, waste disposal, air and water purification, nutrient cycling, solar energy absorption, and management of biogeochemical and hydrological are all beyond the scope of man’s control.



- (v) Aesthetic Use. Wild species of plants and animals have always appealed man's psyche. **Human society has evolved from his early habitat in the forests, which abounds in flora and fauna.**
- Thousands of tourists visit national park, sanctuaries and forests throughout the country and especially in mountainous areas. A glance of **temperate grasslands perhaps the most beautiful landscape pleases and comforts man.** All domestic plants have evolved from wild ancestors and food gathering is no longer a necessity for man but still thousands enjoy hunting, fishing and other adventurous outdoor activities that involve wild species.



- **(vi) Option Values.** This refers to the use of various species for the benefit of mankind, sometime in future. **The hunt for various species under the scope of biotechnology is already underway for finding solutions to various environmental problems.** The environmental issues being addressed to be: pollution as a major problem, ways to fight various disease viz., cancer, diabetes etc., AIDS and others.

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- **RECENT ISSUES ON BIODIVERSITY**

- [?] Some **75 per cent of the genetic diversity of crop plants** been lost in the past century.
- [?] Some scientists estimate that as many as **3 species per hour are going extinct** and 20,000 extinctions occur each year.
- [?] **Roughly one-third of the world's coral reef systems have been destroyed or highly degraded.**
- [?] About 24 per cent of mammals and 12 percent of bird species are currently considered to be globally threatened.
- [?] More than 50 per cent of the world's wetlands have been drained, and populations of inland water and wetland species have declined 50per cent between 1970 and 1999.



Biodiversity Conservation

In situ

Sacred groves and lakes

Biosphere Reserves

National parks, wildlife sanctuaries

Terrestrial

Marine

Ex situ

Sacred plant home garden

Seed Bank, Gene bank,
Cryopreservation

Botanical garden,
Zoological garden
Aquaria



BIODIVERSITY IN INDIA

Categories	No. of Indian Species	% of Indian species Evaluated	Species Threatened In India
Mammals	386	59	41%
Birds	1219	—	7%
Reptiles	495	73	46%
Amphibians	207	79	57%
Freshwater Fish	700	46	70%

Source- Based on Kumar et.al 2000

