

Biodiversity

Assessment and Conservation

CCC704 : PART I



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Look deep into nature, and then you will understand everything better. -Albert Einstein

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BIODIVERSITY

VIDEO - slide



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Biodiversity: Assessment and Conservation

Lecture Contents

- 1. Introduction – Definition;**
- 2. Genetic, Species and Ecosystem diversity;**
- 3. Bio-geographical classification of India;**
- 4. Magnitude and Levels of Biodiversity;**
- 5. Biodiversity at global, National and local levels: India as a mega-diversity nation; Hot-spots of biodiversity;**
- 6. Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India;**
- 7. Conservation of biodiversity : *In-situ* and *Ex-situ* conservation of biodiversity.**
- 8. Importance of Biodiversity**
- 9. Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.**

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1. Introduction

BIODIVERSITY



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Introduction -BIODIVERSITY

What is Biodiversity?

The word BIODIVERSITY originates from the two words,

Latin word “DIVERSITAS” = VARIETY or DIFFERENCE.

The whole word BIO DIVERSITY generally therefore means:
VARIETY OF LIFE.

- Biodiversity, or biological diversity, is a term based on living individuals and species.
 - Biodiversity is the diversity of life in all its forms and at all its levels of organization.
 - Simply it means all the living organisms in different ecosystems of a region in the biosphere .

All forms of BIODIVERSITY



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Biodiversity is life

Etymology of “Biological Diversity”



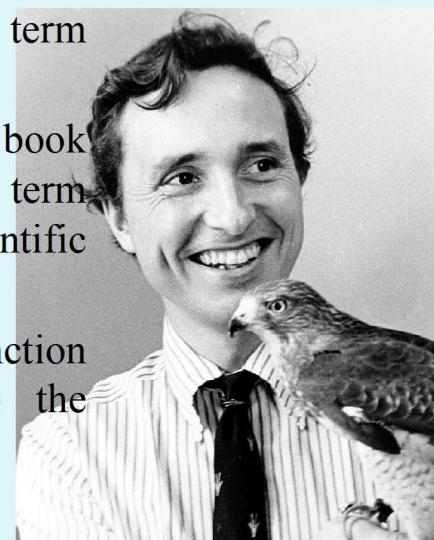
Etymology- “the study of the origins and history of words and their meanings”

The term “**Biological Diversity**” was originally coined by **Raymond F. Dasmann**, a wildlife scientist and conservationist in US.

He used the term “**Biological Diversity**” in a book published in **1968** titled “**A Different Kind of Country**” (MacMillan Company, New York. ISBN 0020728107).⁷

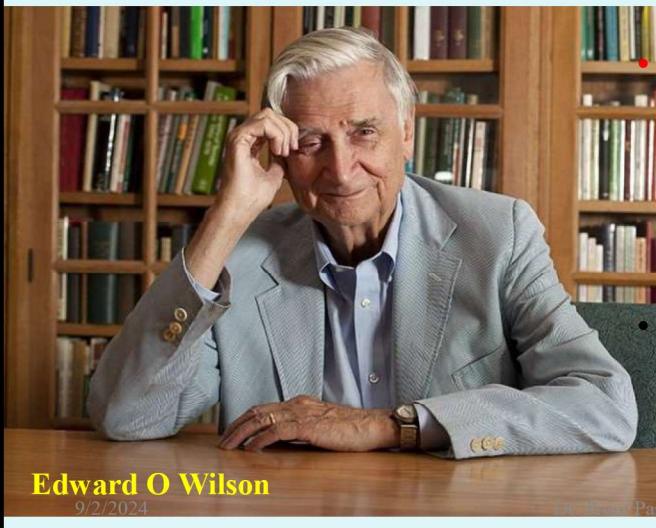
First introduction of term “Biological Diversity” to Science

- The term “**Biological Diversity**” was widely adopted only after more than a decade, when in the 1980s it came into common usage in **science and environmental policy**. Until then the term “**Natural Diversity**” was commonly used.
- **Thomas Lovejoy**, in the foreword to the book *Conservation Biology*, introduced the term “**Biological Diversity**” to the scientific community in 1980 and
- Made the first projection of global extinction rates in the **Global 2000 Report*** to the President, USA that same year.



First Use of “Biodiversity” in a Scientific Publication

- The term's contracted form **Biodiversity** was **coined** by W.G. Rosen in 1985 while planning the 1986 National Forum on Biological Diversity organized by the National Research Council (NRC).



Father of **Biodiversity** :

- W.G. Rosen in 1985

“**Biodiversity**” word first appeared in a *Scientific publication* in 1988 when Socio-biologist, **E. O. Wilson** used it as the **title of the proceedings of that forum**.

Since then the term has achieved widespread use among biologists, environmentalists, political leaders, and concerned citizens.

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Biological Diversity

First definition of Biological Diversity-----	United Nations Earth Summit in Rio de Janeiro
Year of First definition-----	1992

Definition of Biological Diversity

“the variability among living organisms from *all sources*, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part, this includes diversity within species, between species and ecosystems.”

This definition was adopted by the United Nations Convention on Biological Diversity (CBD)

Technical Terms:

1. A species is often defined as a group of individuals that actually or potentially interbreed in nature.
2. Individuals: population of same species.
Cross Breeding -- offspring- (infertile- no sperm & Ovum)
3. Mule (Male Donkey ~ Jack & Female Horse ~ mare)
4. Hinny- (Male Horse ~ & Female Donkey)

Definition of Biodiversity

*“Biodiversity or biological diversity is the variety of life in all its forms, levels and combinations, including

- Ecosystem diversity,
- Species diversity, and
- Genetic diversity”



Recently, the scope of biodiversity has been widened to **include all human related activities** such as traditional/folk knowledge, folk dance, folk tales, folk songs, folk music, etc.

* Source: (IUCN, UNEP, and WWF Rio Summit on Biodiversity, 1991)
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2. Types of Diversity:

Biodiversity is usually plotted as the **Richness of a Geographic area**, with some reference to a temporal scale.

Types of biodiversity include:

- **Genetic Diversity**
- **Species Diversity**
- **Ecological Diversity -Ecosystem**
- **Taxonomic Diversity**
- **Morphological Diversity**



GENETIC DIVERSITY



SPECIES DIVERSITY



ECOSYSTEM DIVERSITY



FUNCTIONAL DIVERSITY

TAXONOMIC DIVERSITY

What is Taxonomy?

Taxonomy is the science of **naming, describing and classifying organisms** and **includes all plants, animals and microorganisms of the world.**

- Morphological,
- Behavioural,
- Genetic and
- Biochemical observations,

Taxonomists -*identify, describe and arrange species* into classifications system, including those that are new to science.

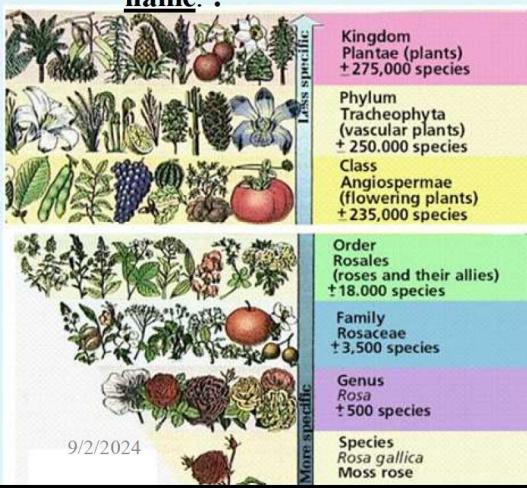
TAXONOMIC DIVERSITY

Binomial system of classification:

The **binomial** naming system is the **classification** used to name **species**.

Each **species** is given a name that consists of **two parts**.

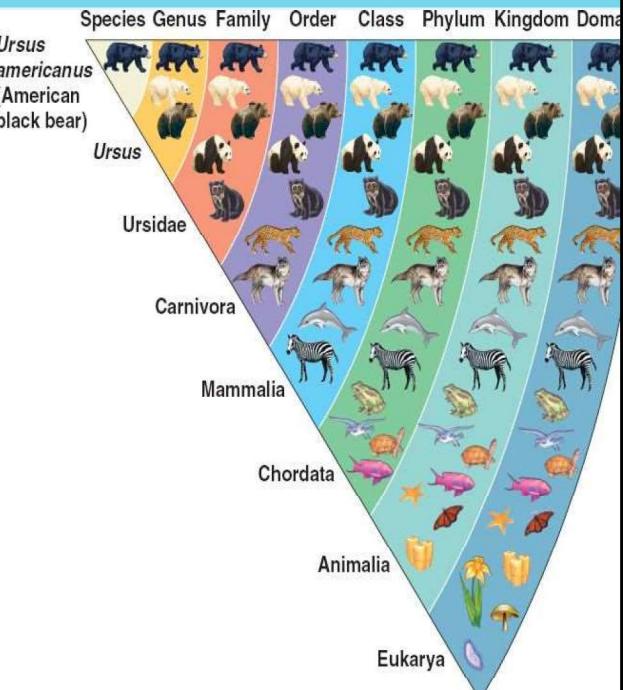
- The first part is the **Genus** to which the species belongs and
- the second part is the **species name**.



Kingdom	Animalia	
Phylum	Chordata	
Class	Mammalia	
Order	Carnivora	
Family	Felidae	
Genus	Panthera	
Species	Panthera Tigris	

TAXONOMIC DIVERSITY

Kingdom	Animalia	
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Family	Felidae	
Genus	Panthera	
Species	Panthera Tigris	



Canidae – Dog family

Felidae- Cat family

Binomial nomenclature

The system of nomenclature in which two terms are used to denote a species of living organism, the first one indicating the genus and the second the specific epithet.

- *Ursus americanus*
- *Panthera Tigris*
- *Homo sapiens* – Human beings
- *Macaca mulatta* – Rhesus monkey (Hanuman Monkey)
- *Naja naja* – Cobra snake
- *Solanum tuberosum* – Potato
- *Solanum melongena* – Brinjal
- *Solanum esculentum* - Tomato

TAXONOMIC DIVERSITY

TAXONOMIC DIVERSITY refers to:

- the number and
- the relative abundance of species in a community.

Taxonomic diversity:

The number of species, genera, family is the most commonly assessed diversity type.

Species Abundance

- **Species abundance:**
 - the number of individuals per species,
- **Relative abundance** refers to:
 - the evenness of distribution of individuals among species in a community.

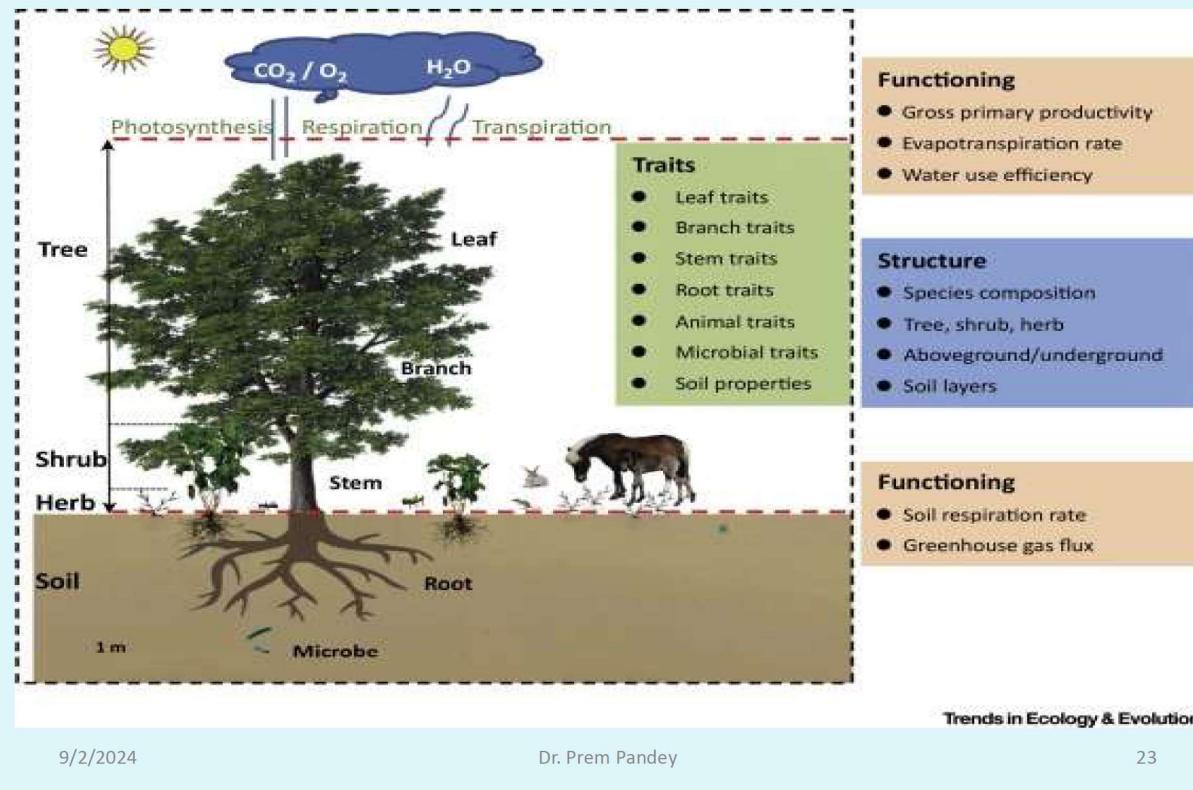
Species Abundance

- In ecology, **abundance** is the **relative representation** of a species in a particular ecosystem.
- **It is usually measured as the number of individuals found per sample.**
- **Relative species abundance** is calculated by dividing :
[the number of species from *one group*]
by
[the total number of species from *all groups*]

FUNCTIONAL DIVERSITY

- **FUNCTIONAL DIVERSITY** refers to the different types of processes in a community that are important to:
 - its structure and
 - function.
- *Functional diversity is a component of biodiversity that generally covers the range of functional traits of organisms prevailing in an ecosystem.*

Functional Traits



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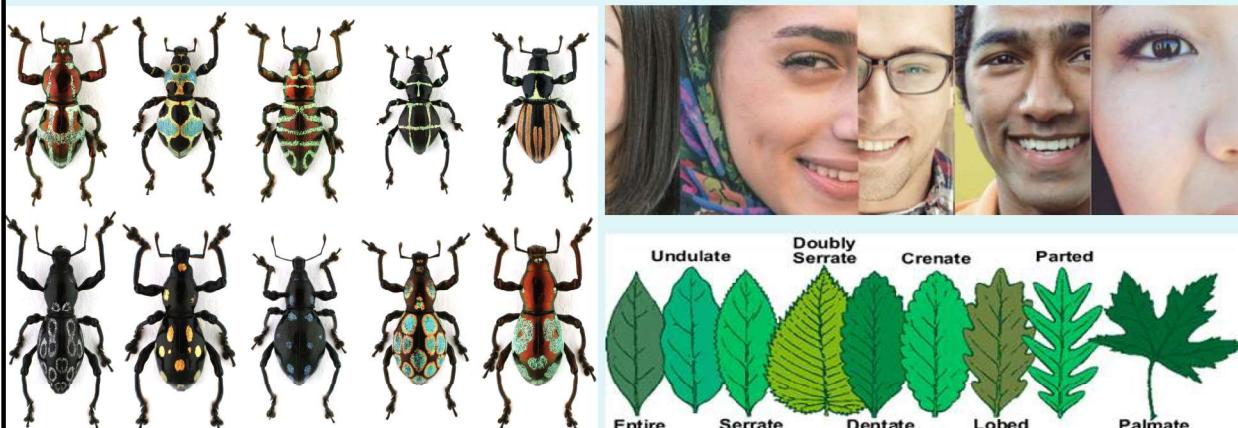
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Functional traits

- **Functional traits** are listed below-
 - Morphological,
 - Biochemical,
 - Physiological,
 - Structural,
 - Phenological, or
 - behavioural characteristics
- These are expressed in phenotypes of individual organisms and are considered relevant to the response of such organisms to the environment and/or their effects on ecosystem properties.

Morphological Diversity

Morphological diversity: Physical appearance



Variations in appearance of above species show Morphological Diversity

Morphological Diversity

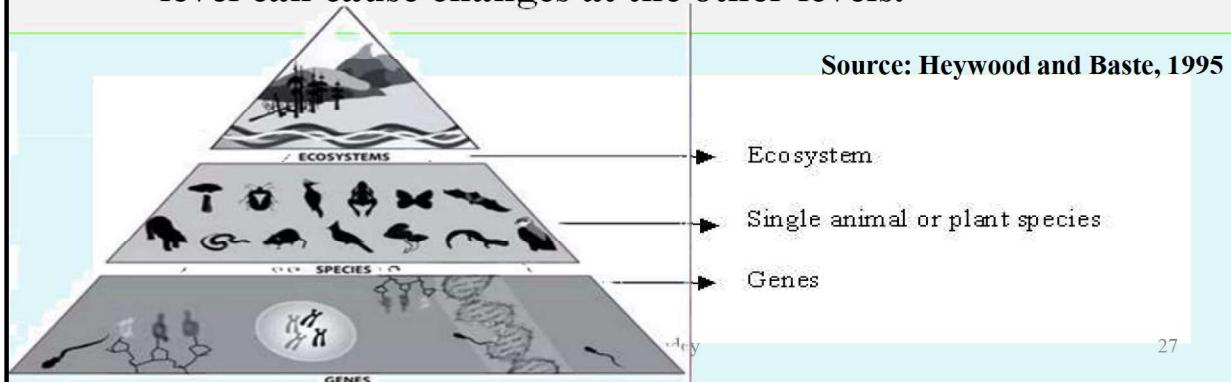
Morphological diversity: Physical appearance of leaves.

VENATION	SHAPES	ARRANGEMENT	MARGINS	ARRANGEMENT ON THE STEM
pinnate	linear	simple	entire	alternate
parallel	obovate	palmately compound	crenate	opposite
palmate	ovate	pinnately compound	dentate	whorled
	pinnately lobed	bipinnately compound	serrate	
	reniform		lobed	
	lanceolate			
	sagittate			

Three Main Key Elements/Groups of Biological diversity

1. Genetic diversity - Diversity of gene within species
2. Organism Diversity - Diversity among species in an ecosystem
3. Ecological Diversity - Diversity of a habitat in a given unit of area.

In effect, these levels cannot be separated. Each is important, interacting with and influencing the others. A change at one level can cause changes at the other levels.



Three Main Key Elements/Groups of Biological diversity

Genetic Diversity, Species/Organism Diversity and Ecological/Ecosystem Diversity are the basic building blocks of biodiversity.

- These groups are intimately interlinked and may have even common elements.
- For example populations appear in all the three elements.

Genetic diversity

Genetic diversity is a level of biodiversity that refers to:

- the total number of genetic characteristics in the genetic makeup of a species.
- *Variation of Genes within a species*

Genetic diversity- measures number of actual variations of species in a population. (how many genes are there)

It is distinguished from **genetic variability**,

Genetic variability describes the tendency of genetic characteristics to vary among species.

- Essential for healthy breeding of population of species

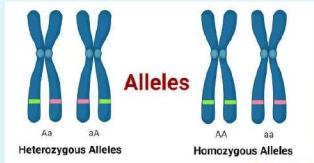
Genetic Variability- How much traits or genotype will tend to vary (How different two alleles of same gene are)-

Alleles – two or more version of gene-

The four types of bases present in DNA and RNA

DNA- ATGC , Pairs 2 bonds A=T & 3 bonds- G≡C

RNA- AGCU, Pairs 2 bonds A=U & bonds G≡C



Genetic diversity

GENETIC DIVERSITY in Populations, Individuals, Chromosomes, Genes, nucleotides

Within a species there are often found a number of **varieties or races or strains/ecotypes**.

Varieties or races or strains/ecotypes differ slightly from each other in one or two or a number of characters such as shape, size, quality of their product, morphology and other qualities such as withstand adverse conditions of environment.

* White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander).

These variations are due to **genetic diversity**. Elements of **Genetic Diversity** are more easily defined than other types of diversity.

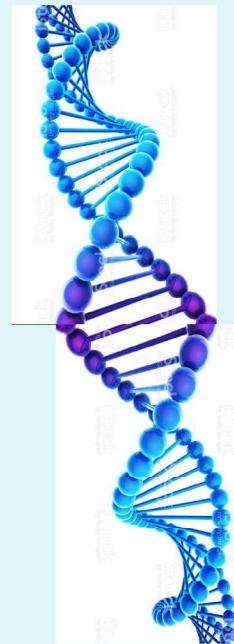


Genetic diversity

Number of Chromosomes in organisms

White bellied Pangolin- 57 Pairs

Humans	- 23 pairs
Gorillas	- 24 pairs
Horse	- 32 pairs



Genetic Diversity

- Elements of Genetic Diversity are more easily defined than other types of diversity.
- It enables a population /organisms to adopt to the environment.
- More survival rate



Assorted colors of kernels in different varieties of corn

Diversity of Genetic organization within a species

Degree of variability of the genetic material – DNA



Navara rice variety , Common Paddy , Black Paddy (Manipur)



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Cause of Genetic diversity

- Mutation
- Gene flow
- Sexual reproduction
- Genetic drift
- Random mating
- Crossing over
- Environmental variance

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Reasons of Genetic diversity

Survival and Adaptation

- *Genetic diversity plays a huge role in the **survival and adaptability of a species**.*
- *When a species' environment changes, slight gene variations are necessary for it to adapt and survive.
– **Climate Change***
- *A population is able to adapt to its environment and respond to natural selection due to its genetic diversity.*

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Genetic Diversity

A species that has a **large degree** of genetic diversity among its individuals will **have more variations** from which to **choose the most fitting allele**.

A species with more genetic diversity can adapt better to the changed environmental conditions.

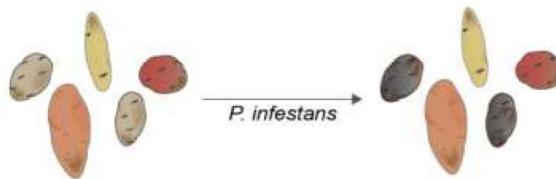
Higher Number of species and Genetic diversity

- The genetic diversity within a species often increases with environmental variability.
- The evolution of a new species i.e., **speciation**, depends upon the amount of genetic variation.
- **Speciation-** Evolutionary process where a species evolved as a new species from the existing one
- A community with higher number of species has greater genetic diversity than the community having only a few species.

Genetic diversity

A species with high genetic diversity cope up adverse conditions / disease.

genetically diverse population



genetically identical population



Inbreeding reduces fitness due to increased homozygosity for harmful alleles and at genes exhibiting heterozygote advantage

A species with low genetic diversity results in uniformity.



uniformity-Clonal plantations-
Eucalypts, Poplars

For example, large monoculture crops/plantations of genetically similar plants often leads to uniformity – may be good for achieving higher yields but a problem when an insect or a disease attacks the plants. For Example: Eucalypts, Poplars

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Genetic diversity

Species that have very little genetic variation are at a great risk.

With very little gene variation within the species, healthy reproduction becomes increasingly difficult, and offspring often deal with similar problems to those of inbreeding.-

Koalas found in Australia have had low genetic diversity for over 120 years-a sign of inbreeding.

Cause of reduction in genetic diversity:

- Inbreeding
- Genetic drift
- * restricted gene flow
- * small population size



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Species Diversity

In **biology**, a species is one of the **basic units of biological classification** and a **taxonomic rank**.

A **species** is often defined as a group of organisms capable of inter-breeding and producing fertile offspring.

Each **species** is a group of organisms with unique characteristics.

An individual of a **species** can reproduce successfully, **creating a viable offspring, only with another member of the same species.**



(Mule* & Hanny^ – infertile cross breed of donkey * and horse ^)

Species Diversity

Broadly speaking Species diversity refers to the *variety of species within a region.*

It includes the full range of species in the region, from microorganisms to multi-cellular plants and animals.

Species Diversity

- Number of different species that are represented in a given community (a dataset) -incorporates both:
 - the number of species in a community (species richness), and
 - the evenness of species' abundances.

Species diversity is the effective number of different species that are represented in a collection of individuals (a dataset).

1. Numbers
2. Types,
3. Distribution of an organism in a given area.



Gloriosa superba in evergreen forest of
Western Ghats



Nilgiri Tahr in Eravikulam Wildlife Sanctuary

Rhododendron - species diversity

Rhododendrons recorded in Indian Himalayan

- Total of 87 species,
- 12 subspecies and
- 8 varieties
- among these 6 species and one subspecies are reported from Western Himalayan and rest from eastern region.
- The maximum concentration of 86% observed in Arunachal Pradesh (75 species).



- *Rhododendron arboreum (Burans)* is found in Himalayas (Uttarakhand, NE Himalayas) as well as Anamudi Hills (Kerala/Tamil Nadu) – disjunct distribution

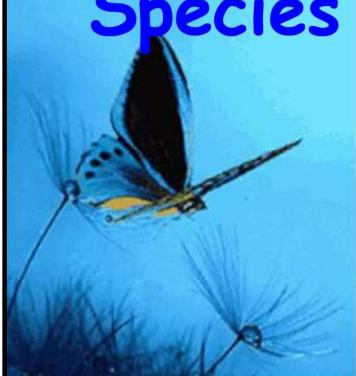
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Species Diversity

Species Diversity of butterflies

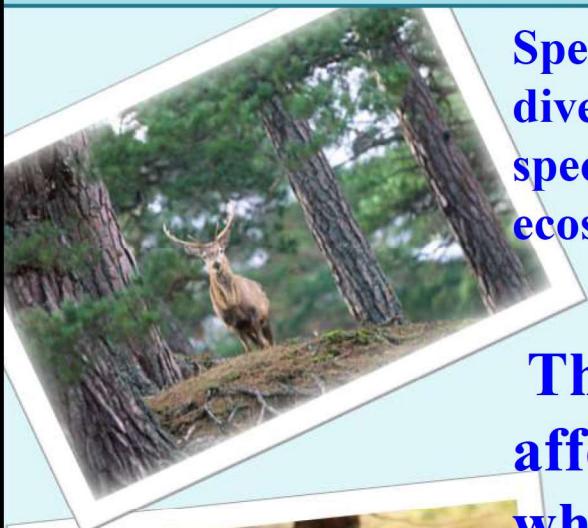


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Species Diversity



Species are distinct units of diversity, each of which have specific role to play in the ecosystem.

Therefore, loss of a species affect the ecosystem as a whole.



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Species Diversity

Species diversity consists of two components:

- Species richness and
- Species evenness.

Species richness is the number of different **species** represented in an ecological community, landscape or region.

- **Species richness** is simply a count of **species**, and it does not take into account the abundances of the **species** or their relative abundance distributions.
- **Species evenness** refers to how close in **numbers** **each species** in an environment is.

Species evenness

Species evenness refers is a measure of the relative abundance of the different species making up the richness of an area.

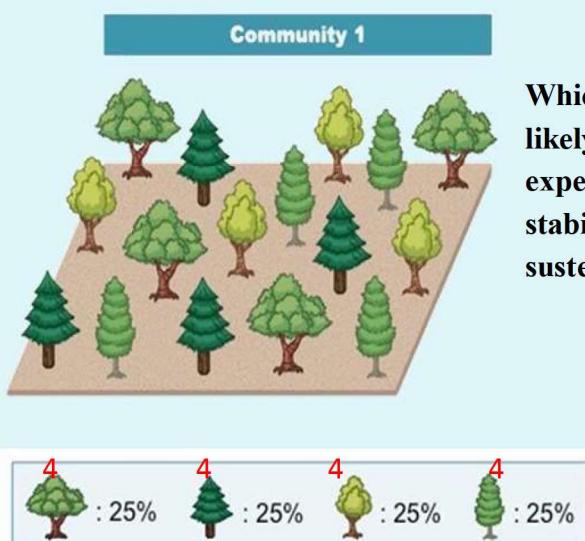
- Evenness can be calculated as-

$$\text{Relative abundance} = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals}}$$

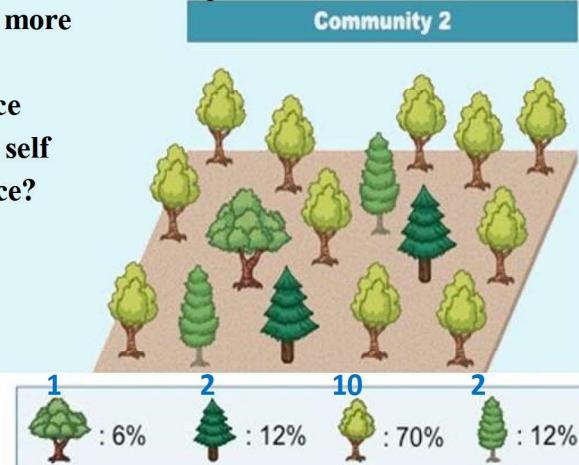
- Mathematically, Species evenness is defined as a diversity index, a measure of biodiversity which quantifies how equal the community is numerically.
- So if there are 40 foxes, and 1000 dogs, the community is not very even.
- But if there are 40 foxes and 42 dogs, the community is quite even.

➤ Species richness and species evenness

- The first community has 4 species, and almost 4 number of individual in each species



- The second community has 4 species, and different number of individual in each species.
- One species has one individual, few has 2, and one has up to 10.

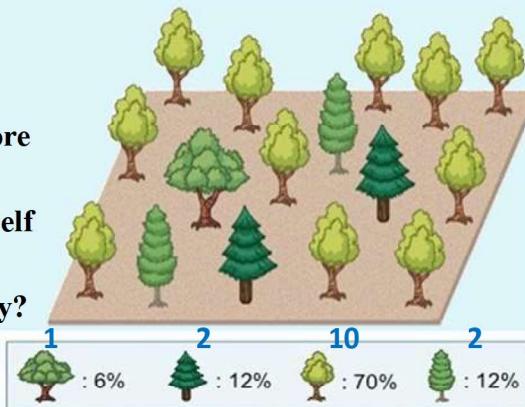


Community 1 and Community 2 have the same **species richness**, but they have **different species evenness**

➤Species richness and species evenness

- Species evenness is a description of the distribution of abundance across the species in a community.
- Species evenness is highest when all species in a sample have the same abundance.
- Evenness approaches zero as relative abundances vary.

The Second community as it does not satisfy the evenness of species.



Which is more likely to experience self sustenance and diversity?

When a large number of species share the same distribution proportion, **the species evenness increases; thus, the ecosystem's stability will improve.**

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Keystone Species

A **keystone** in an arch's crown secures the other stones in place.

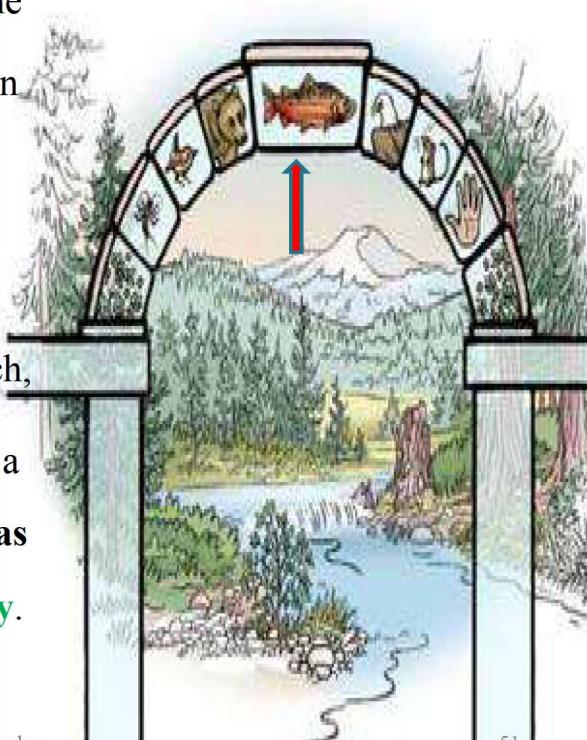
Keystone species play the same role in many ecological communities:

- **maintaining the structure** and
- **integrity of the community.**

While the keystone is under the least pressure of any of the stones in an arch,

The arch still collapses without it.

Similarly, an ecosystem may experience a dramatic shift if a keystone species is removed, even though that species was a small part of the ecosystem by **measures of biomass or productivity.**



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Keystone species

A **keystone species** is a plant or animal that plays a unique and crucial role in the way an ecosystem functions.

Keystone species plays critical role in ecosystems they inhabit.

- Affect the abundance and
- health of many other species.

Their loss from ecosystems directly endangers the success of other species.

Without **keystone species**, the ecosystem would be dramatically different or cease to exist altogether.

All **species** in an ecosystem, or habitat, rely on each other. Few apex predators.

A keystone species is an organism that helps define an entire ecosystem.

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Keystone species

A keystone species is a species that has a disproportionately large effect on its natural environment relative to its abundance.

This concept was introduced in 1969 by the zoologist **Robert T. Paine**.

The term **keystone species** was first coined by **Robert Paine (1966)** after extensive studies examining the interaction strengths of food webs in rocky intertidal ecosystems in the Pacific Northwest.

Keystone species play a critical role:

- in maintaining the structure of an ecological community,
- affecting many other organisms in an ecosystem and
- helping to determine the types and numbers of various other species in the community.

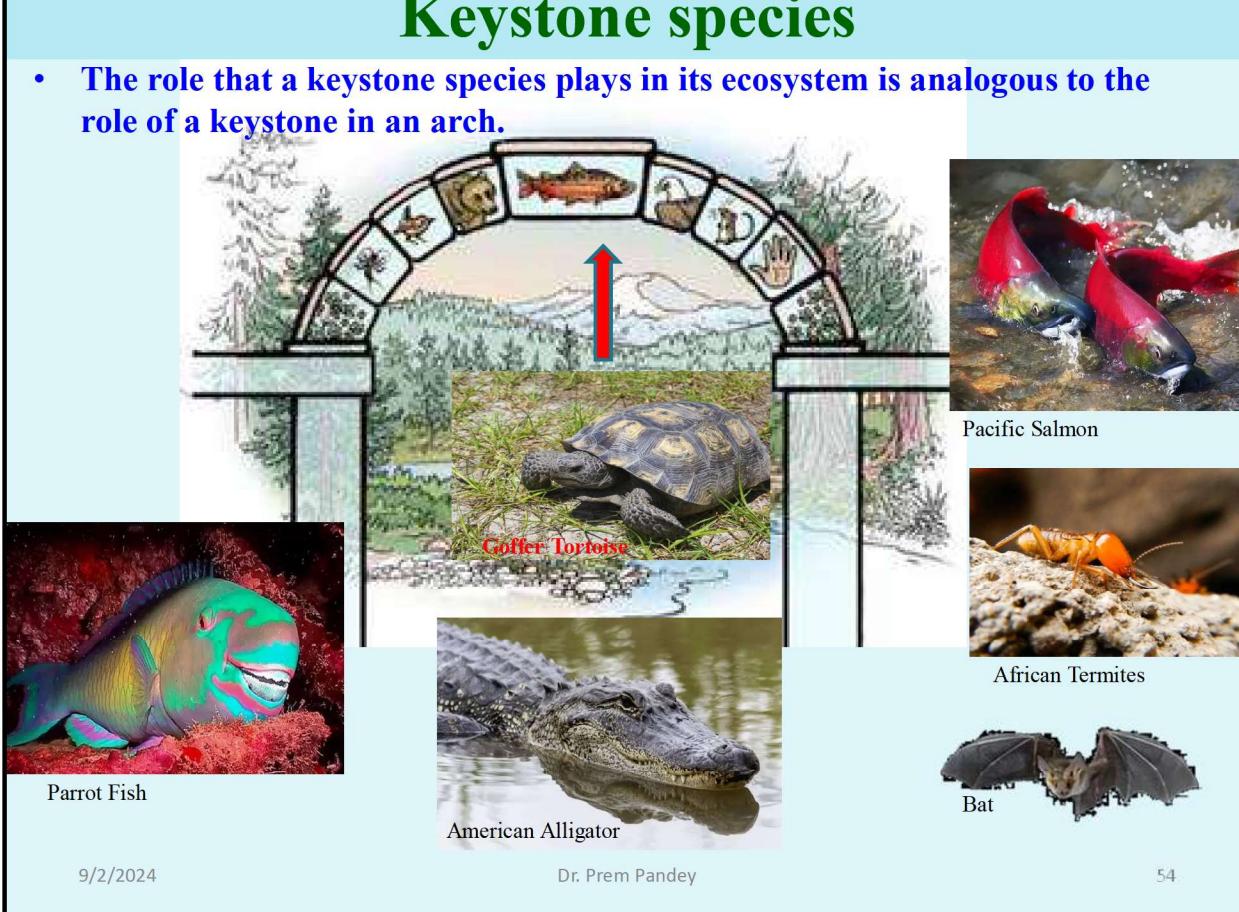
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Keystone species

- The role that a keystone species plays in its ecosystem is analogous to the role of a keystone in an arch.



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Few Examples of keystone species



Examples of Key Stone Species

Krill:

- Krill are still a major keystone species.
- They are the carrier of nutrients.
- These incredibly minute **crustaceans** feed on phytoplankton, which is extremely rich in nutrients such as amino acids, antioxidants, carotenoids, bioflavonoids and omega-3,6 fatty acids.
- Krill not only feed whales but many other animals too, such as seals, penguins, squid, fish and even humans.



Isn't it ironic that the largest animal to have ever existed on our planet eats one of the smallest animals on our planet? (The largest animal is a blue whale, in case you were wondering.)

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Examples of Key Stone Species

Bees: By pollinating plants, bees contribute to their survival.

The plants are shelter for insects, which are then eaten by other species, like birds.



Alligator: When the alligator abandons their burrow, the hole fills with fresh water, which is then utilized by other animals as a source of drinking water or for breeding.

If alligators were to be removed from their native ecosystem, it would affect countless other species.



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American Alligator

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Examples of Key Stone Species



• Elephants:

- By eating small trees, elephants preserve the grasslands,
 - because the grasses need plenty of sun to survive.
- If they were not there, the savanna would convert to a forest or scrublands.
- Elephants could be called **engineers of African savanna**.
- These great giants are a keystone species because of their ability to completely transform a landscape, bringing a variety of life alongside with them.
- They shape their environment:
 - by pushing down trees, and eating small shrubs, such as acacia,
 - creating and maintaining Africa's iconic grasslands.

This sustains grazing animals such as antelopes and zebras, as well as smaller animals such as mice that burrow in the warm, dry soil of the savanna. It also enables large predators like lions to have a bounty of prey to hunt.

- Elephants leave behind a path of destruction by creating corridors through woodlands and digging deep holes in the dry river beds, but both of these actions are highly beneficial. Corridors prevent the spread of wildfires and deep holes collect water for other animals.
- They are vital distributors of seeds from the Balanite tree. Many parts of this tree are used as famine food in some regions of Africa.
- Under normal conditions, just a fraction of seeds (less than 15 percent) turns into mature trees, but seeds digested by elephants are 50 percent more likely to start growing.

9/2/2024 Dr. Prem Pandey Elephants are important for people as well (not for ivory). In fact, they save lives! 19

Examples of Key Stone Species

• Saguaro Cactus:

- Can soak and store up to **757 liters of water** during a heavy downpour.
- If you ever find yourself stranded in a desert and come across one of these cacti, remember they have **life-sustaining water** inside of them.

But that's not why the saguaros are a keystone species.

- These cacti offer **nesting opportunities** to many different species of bird, such as red-tailed hawks, gila woodpeckers, purple martins, and elf owls.
- Alongside nesting quarters, the saguaro provide **juicy fruit** during the dry summer months, the only **moist food source** for animals during that time of year.

• Banyan/Peepal Tree:

- In tropical regions, they serve as keystone food resources.
- The trees **bear fruit throughout the year** making figs the key food source for a large number of birds and mammals who rely heavily on this small group of plant species during the times of the year when other food resources are scarce.

• Parrot Fish:

Keeping algae species in check is super important. Left untouched, **the algae would spread and dominate coral reefs**. Once this happens, the **healthy balance of coral reef systems** is irreversibly disrupted.

How do species get on the Red List?

Some of the questions scientists are asking when evaluating a species.

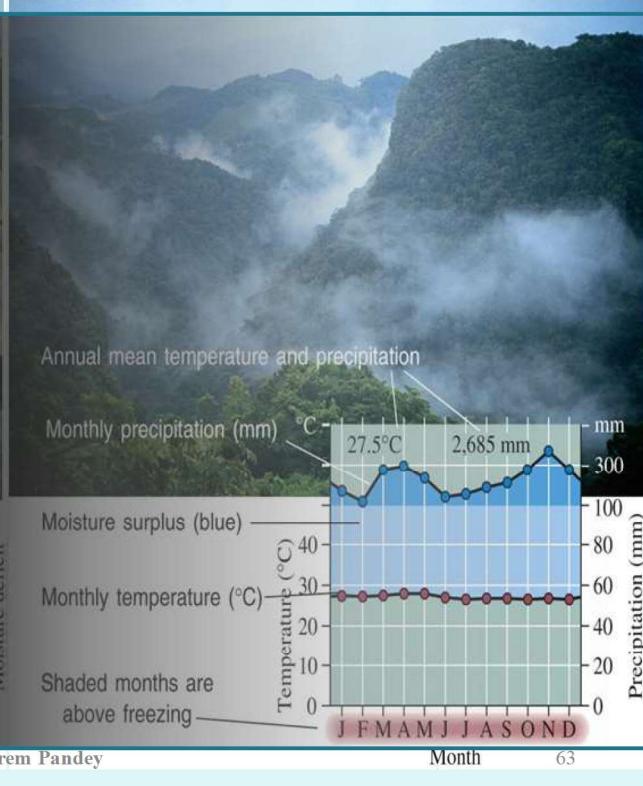
- What is the size of the population?
- How fast is it declining?
- How big of an area does this species live in?
- How has its habitat been affected?

Ecosystem Diversity



Ecosystem/Ecological Diversity

The range of different habitats in an ecosystem, community or biome associated with the variety of niches that may be exploited by different species.



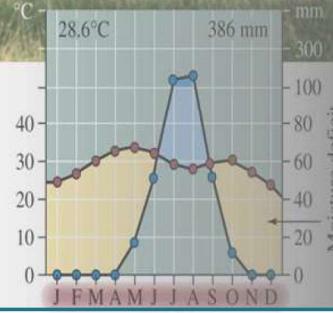
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Ecosystem/Ecological Diversity



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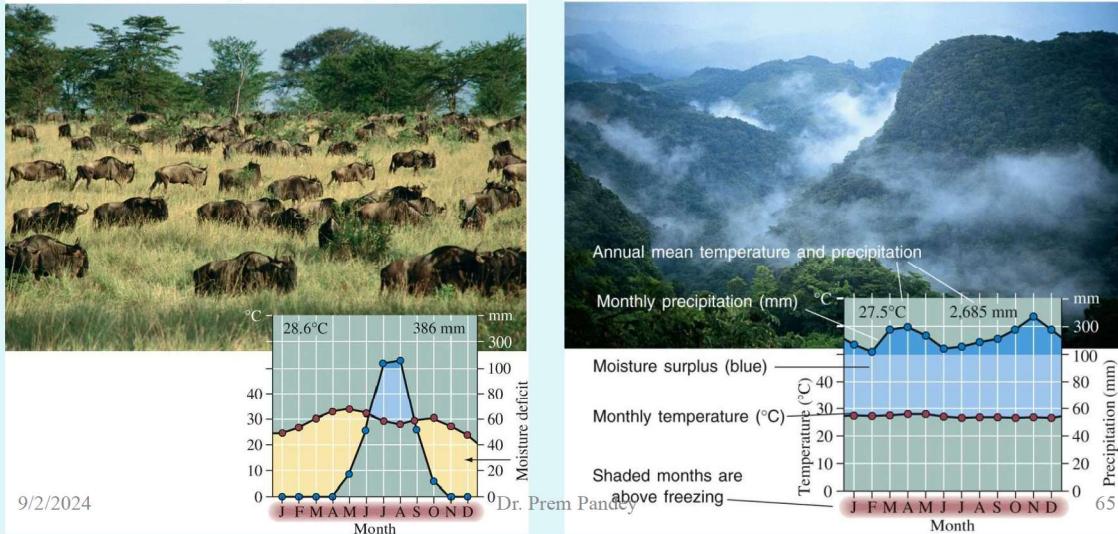
Depending largely upon the availability of abiotic resources and conditions of the environment an ecosystem develops its own characteristic community of living organisms –

e.g. different types of forests – rain forest, scrub forest, deciduous forests.

Ecosystem/Ecological Diversity

- It is not easy to define the elements of ecological diversity.
 - A large ecosystem may have several habitats, which in turn may have many microhabitats or niches.

An ecological niche is the role and position a species has in its environment; how it meets its needs for food and shelter, how it survives, and how it reproduces). How it survives, interact with organisms.



Ecosystem/Ecological Diversity

- Ecosystem diversity refers to the diversity of a place at the level of ecosystem.
 - Community diversity
 - Habitat diversity
 - Landscape diversity
 - The term differs from **biodiversity**, which refers to variation in species rather than ecosystems.

Ecosystem/Ecological Diversity

Some examples of ecosystems diversity are:

- Deserts
- Forests, Rainforests
- Coastal ecosystems
- Marine ecosystems
- Grasslands
- Tundra
- Coral Reefs
- Wetlands
- Mangroves

- Ecosystem diversity can also refer to the variety of ecosystems present in a biosphere, the variety of species and ecological processes that occur in different physical settings.

Diversity of Biotic Communities and Ecosystem Diversity

Variety of habitats / biotic communities.



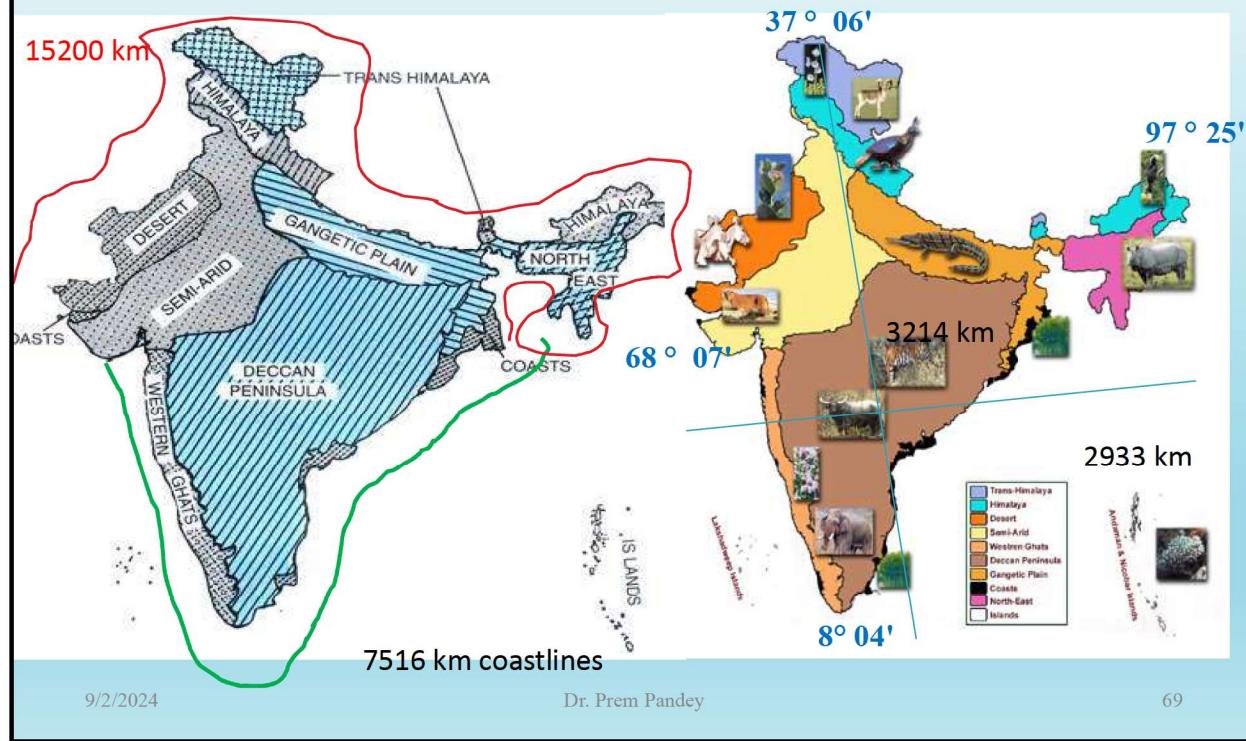
Typical agro-ecosystem with paddy and coconut in Kerala, Tamil Nadu



High altitude Grasslands and Shola forests in south India (Kerala, Tamil Nadu)

Bio-geographic classification/Zones of India

Wow INDia Has Ten Different Geographic Classification Systems



BIOGEOGRAPHICAL CLASSIFICATION OF INDIA

- **Biogeography** is the study of distribution of species, organism and ecosystems in geographic space and through geological time.
- Bio-geographic classification of India is the division of India according to **biogeographic characteristics**.

INDIA being a vast country, shows a great diversity in **climate , topography and geology** and hence the country is very rich in terms of biodiversity. It is termed as a **MEGA DIVERSITY COUNTRY**.

India occupies 10th place among plant rich countries of the world.

Bio-geographic classification of India

Bio-geographic classification of India was done by Rodgers and Panwar (1988), describing

- 10 bio-geographic zones in India,
- further divided into 25 Bio-geographic provinces.

The maps were further revised by Rodgers, Panwar and Mathur (2002), using GIS techniques into 10 zones and 26 provinces.

The classification was done using various factors:

- Altitude
- Moisture
- Topography
- Rainfall

Bio-geographic classification- Importance

The map also has codes for the zones and the provinces, along with the area (in sq. km) information.

Bio-geographic zones were used as a basis for planning wildlife management in protected areas in India.

Bio-geographic classification/Zones of India

The country has 10 different biogeographical zones and 26 biotic provinces.

S.No Biogeographic zones Biotic provinces

1. Trans-Himalaya	Ladakh mountains, Tibetan plateau
2. Himalaya	Northwest, West, Central and East Himalayas
3. Desert	Thar, Kutch
4. Semi-arid	Punjab plains, Gujarat Rajputana
5. Western Ghats	Malabar plains, Western Ghats
6. Deccan Peninsula	Central highlands, Chotta-Nagpur, Eastern highlands, Central Plateau, Deccan South
7. Gangetic plains	Upper and Lower Gangetic plains
8. Coast	West and East coast, Lakshadweep
9. North-East	Brahmaputra valley, Northeast hills
10. Islands present near the shore line	Andaman and Nicobar ; Lashwadeep

Source: Wildlife Protected Area Network in India: A Review, Wildlife Institute of India, 2000.

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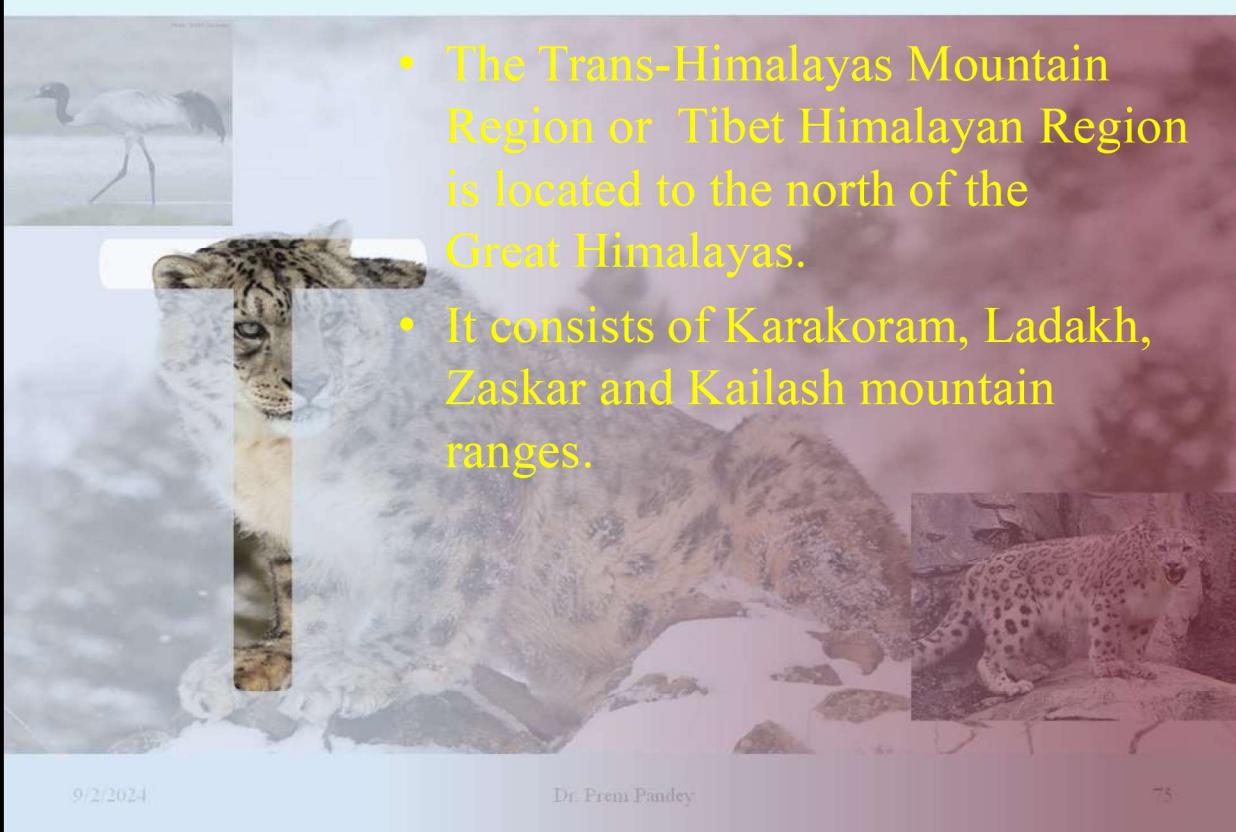
Bio-geographic classification of India

- W**ow - **Western Ghats**
I - **Islands**
N - **North-East India**
DIA - **Deserts**
Has - **Himalaya**
Ten - **Trans-Himalaya**
Different - **Deccan Plateau**
Geographic - **Gangetic Plains**
Classification - **Coasts**
Systems - **Semi-Arid Zones**



1. TRANS- HIMALAYAN REGION

- The Trans-Himalayas Mountain Region or Tibet Himalayan Region is located to the north of the Great Himalayas.
- It consists of Karakoram, Ladakh, Zaskar and Kailash mountain ranges.



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1. TRANS- HIMALAYAN REGION

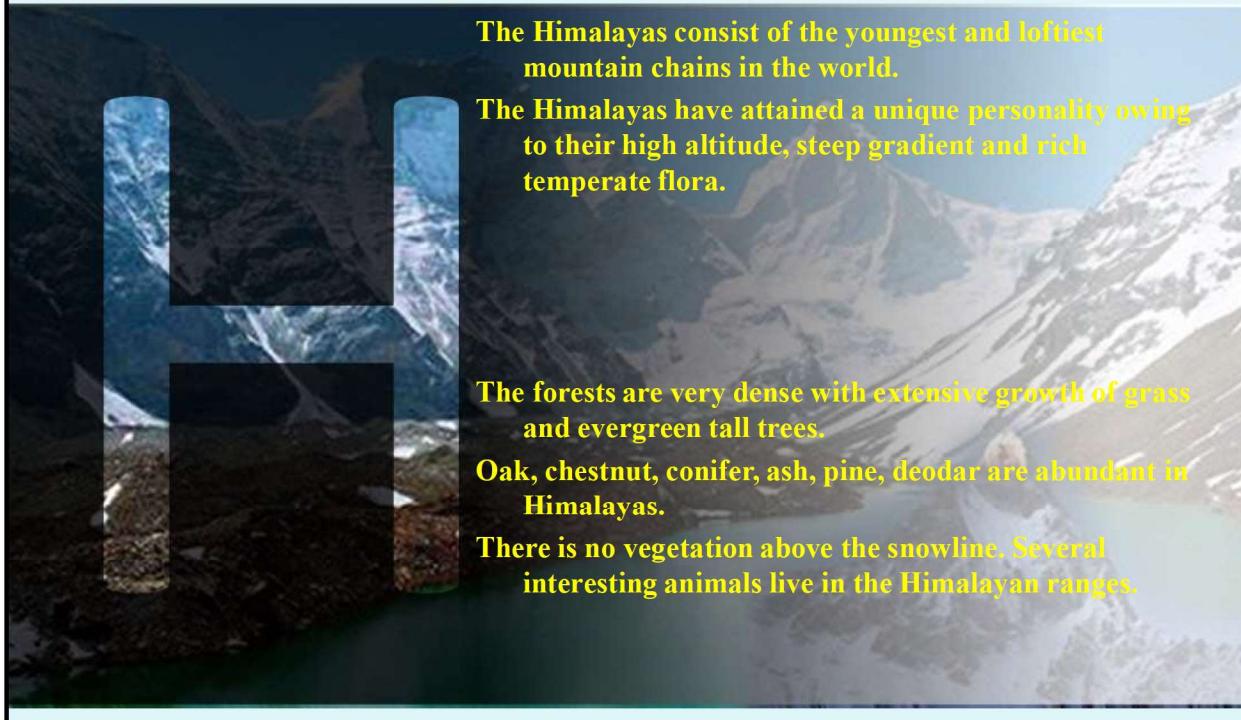
- The Himalayan ranges immediately north of the Great Himalayan range are called the Trans- Himalayas.
- Extension of Tibetan plateau.
- Ladakh (J&K) and Lahul Spiti(Himachal pradesh).
- Sparse vegetation
- Has richest wild sheep & goat community in world
- Snow leopard is found here, also the migratory bird Black-Necked crane.



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2. HIMALAYAN REGION



2. HIMALAYAN REGION

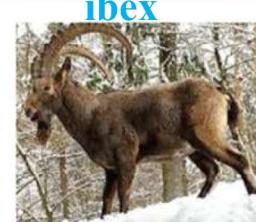
- Northern boundaries of India, Kashmir to Assam.
- There is no vegetation above the snowline. Several interesting animals live in the Himalayan ranges.
- High altitude, steep gradient and rich temperate flora.
- Evergreen tall trees – oak, chestnut, conifer, pine, deodar etc.
- No vegetation above snow line.
- Chief species – wild sheep, mountain goats, ibex, shrew and tapir. Panda and snow leopard.



ibex



mountain goat



tapir



3. SEMI ARID REGION

- Adjoining the desert are the semi-arid areas, a transitional zone between the desert and the denser forests of the Western Ghats.
- **The natural vegetation is thorn forest.**
- This region is characterized by discontinuous vegetation cover with open areas of bare soil and soil-water deficit throughout the year.
- **Transitional zone** between desert and western ghats.



3. SEMI ARID REGION

- Thorny scrubs, grasses and some bamboos are present in some regions.
- A few species of xerophytic herbs and some ephemeral herbs are found in this semi-arid tract.
- Discontinuous vegetation – thorny scrubs, grasses and some bamboos.
- Chief species – lion , caracal, wolf, fox, jackals, leopards, eagles, snakes, fox, buffaloes etc.
- Cervid species like **Sambar** and **Chital** are restricted to better wooded hills and moister valleys.



4. WESTERN GHATS

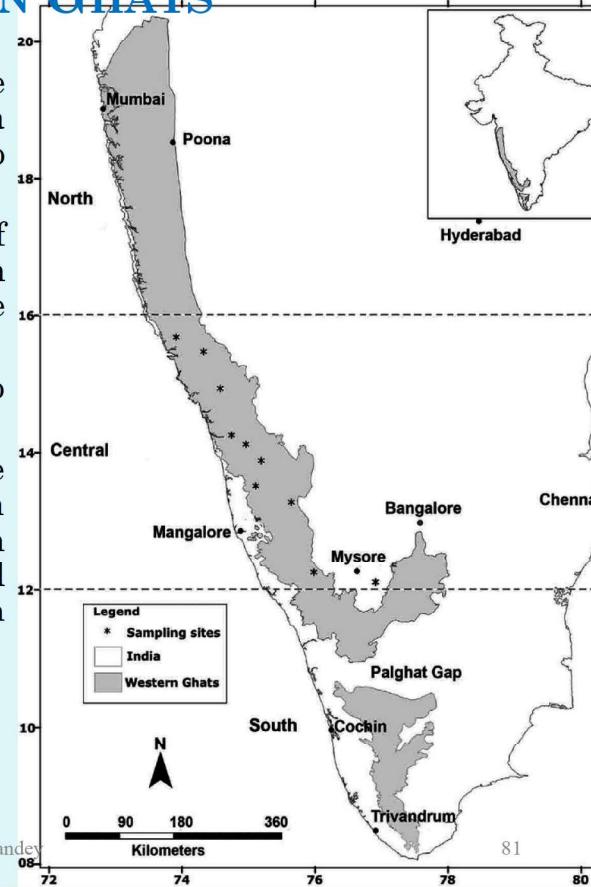
- The Western Ghats extend from the **southern tip of the peninsula** (8°N) northwards about 1600 km to the mouth of the river Tapti (21°N).
- The mountains along the west coast of peninsular India are the Western Ghats, which constitute one of the unique biological regions of the world.
- Southern tip of Gujarat to Kanyakumari
- The mountains rise to average altitudes between 900 and 1500 m above sea level, intercepting monsoon winds from the southwest and creating a rain shadow in the region to their East in Tamil Nadu.



- Tropical evergreen forests.

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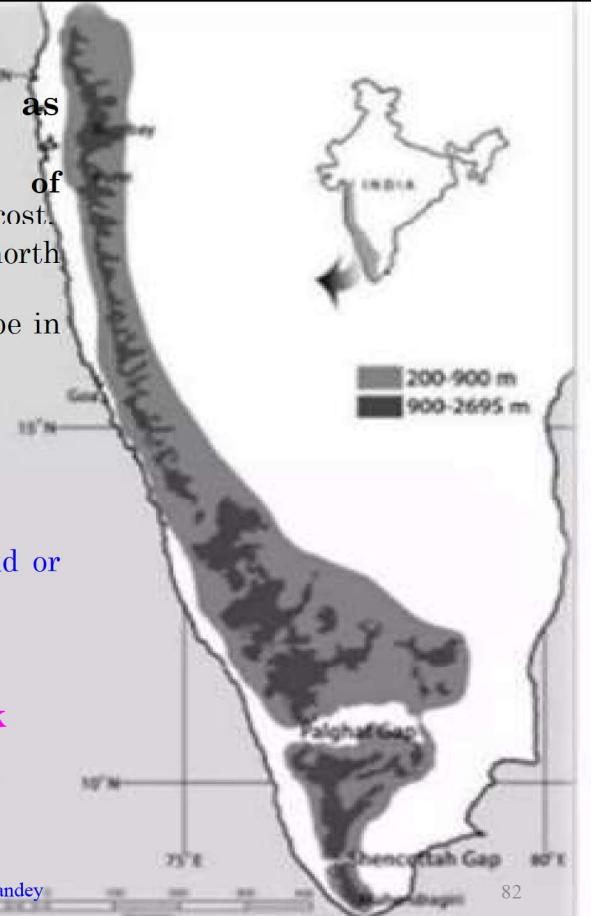


4. WESTERN GHATS (WG)

- Western ghats (also known as Sahyadris hills) are formed by –
 - Malabar plains and the chains of mountains running parallel to western cost.
 - Run parallel to eastern coastline from north to south
 - Steep slopes in the west and gentle slope in East. - total area – 138,600 sq. Km.
- Traverses the states of:
 - Gujarat
 - Maharashtra
 - Goa
 - Karnataka (here WG referred as Malnad or Land of Hills)
 - Kerala
 - Tamil Nadu
- **Interrupted only by a 30 km break**
 - **Palghat gaps** in Northern Kerala.
 - **Shencottah gap**
 - **Goa Gap**

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4. WESTERN GHATS

- Endemic species –

- nilgiri langur,
- lion tailed macaque,
- nilgiri tahr,
- malabar grey hornbill.



- Two endangered species found here:

- Travancore tortoise,
- Cane turtle are



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4. WESTERN GHATS



- The varied climate and diverse topography create a wide array of habitats that support unique sets of plant and animal species.

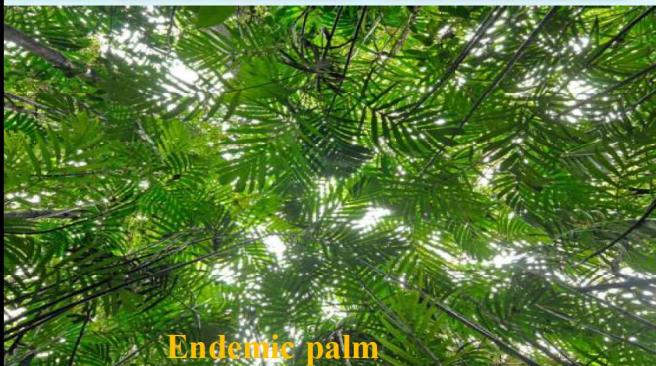
- Apart from biological diversity, the region boasts of high levels of cultural diversity, as many indigenous people inhabit the tropical rain/ evergreen forests.



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4. WESTERN GHATS



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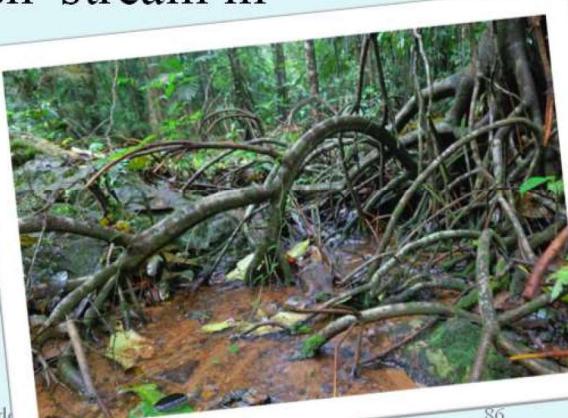
- The Western Ghats are home to more than 5000 species of plants and about 35% of these are endemic to this area.
- Some plants have been discovered very recently in the last decade.
 - *Semicarpus Kathalekanensis*

4. WESTERN GHATS

The Ghats are also home to special kind of fresh water swamps known as **Myristica swamps** (wild nutmeg).

An Indicator of these swamps is an endemic palm found along sluggish stream in elevations below 100m.

Myristica swamps

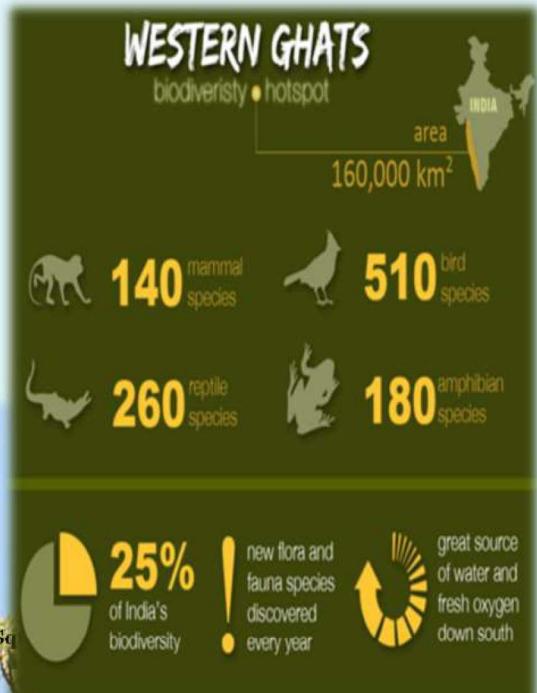


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4. WESTERN GHATS



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4. WESTERN GHATS

- **The Western Ghats, now a UN World Heritage Site**
- Western Ghats are amongst the 36 biodiversity hot-spots recognized globally. These hills are known for their high levels of endemism expressed at both higher and lower taxonomic levels.
- Most of the Western Ghats endemic plants are associated with evergreen forests.

Taxonomic Group	Critically Endangered	Endangered	Vulnerable	Total
Mammals	3	7	21	31
Birds	2	1	12	15
Reptiles	0	1	3	4
Amphibians	11	28	13	52
Fish*	-	-	1	1
Plants	39	111	79	229

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Bio-geographic Zones of INDIA- Western Ghats Tribals

The hill tribes or Adivasis (original inhabitants).

-Account for barely **5% of the area population** in the Western Ghats.

The tribals have coexisted with nature for centuries in quiet harmony with rich traditional knowledge and cultural life.

The Western Ghats is home to various ethnic tribal groups like

- The Gowlis,
- Halakki Vakkala,
- Kare Vakkala,
- Kunbi, and
- Kolvadi.

The Nilgiri Hills, which is a region of mountains, forests and tea plantations located in southern India where the states of Tamil Nadu, Kerala and Karnataka all come together, is home to tribes.

TRIBES OF THE NILGIRI HILLS

1. Badaga
2. Irula
3. Kota
4. Kurumbas
5. Nayaka
6. Hill Pandaram
7. Kani (for their Magic Berry)

Bio-geographic Zones of INDIA- Western Ghats Tribals

- The changing times have hold on the lives of the tribal and they have to make a hard choice;
 - Accept development with its positive and negative features or perish.
- In recent years, the **lives of the tribals have been highly disturbed because of:**
 - **the reduction in forest area,**
 - **imposition of forest regulations,**
 - **construction of dams,**
 - **constructions of highways ,**
 - **setting up factories etc.**
- **Hunger, ignorance and exploitation** have forced them to leave their traditional forest living and take to (probable crimes), migrate or seek employment in rural and urban areas.

Bio-geographic Zones of INDIA- Western Ghats Tribals

Nilgiris (in 1818) - the western civilisation, they were the preserve of four tribes:

1. The Kotas, who gave their name to Kotagiri, made tools and music;

2. The Badagas, who cultivated the land,

3. The forest dwelling Kurumbas who collected honey and wood and also performed sorcery; and

4. The Todas, who with their herds of sacred buffalo, provided milk and ghee.



Bio-geographic Zones of INDIA- Western Ghats Tribals

Tribals of Wayanad- Wayanad district is predominantly a tribal district and the major tribes are :

- Paniya
- Kuruchiya
- Adiya
- Kathinayaka
- Kuruma tribes.



1. The Paniya,:-
a major tribal community in Kerala live in the hills of Wayanad.

- The headman of Paniya settlement is called **Kuttan**, and
- the head of the family is **Mudali**.



2. The Kuruchiyans are:

- an agricultural tribal community.
- excellent archers
- They live in small clean houses and do not encourage drinking alcohol except on festive occasions.

3. The Adiyas:

This tribe and the community is divided into subgroups:

- Mandu.
- The headman of the Mandu is called Peruman.
- Polygamy is not a taboo among them and sex offender is not ostracized.

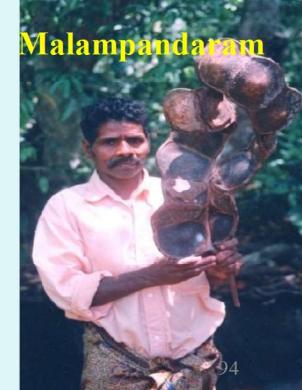
4. The Kattunayakans:

- a primitive tribe
 - live in jungles
 - engaged in collecting forest produce and honey.
 - do not mingle with other tribes.
 - The headman is called Muthan
 - whose decisions are always final.
 - worship animals, birds, trees and other Hindu deities and
 - firmly believe in black magic and sorcery

Bio-geographic Zones of INDIA- Western Ghats Tribals



- The region also shares several plant species with Sri Lanka.
- The higher altitude forests were, if at all, sparsely populated with tribal people.
- Rice cultivation in the fertile valley proceeded gardens of early commercial crops like areca nut and pepper.



Venkatappa, a Goudlu tribal

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Bio-geographic Zones of INDIA- Western Ghats Tribals



Venkatappa is a Goudlu tribal.

The Goudlu tribe is one of the last traces of pure Malnad culture in the Indian Western Ghats, farming is their primary occupation.

The tribe is no longer protected from urbanization, the plastic sheet he wears has replaced the traditional rain blanket "KAMBLI".

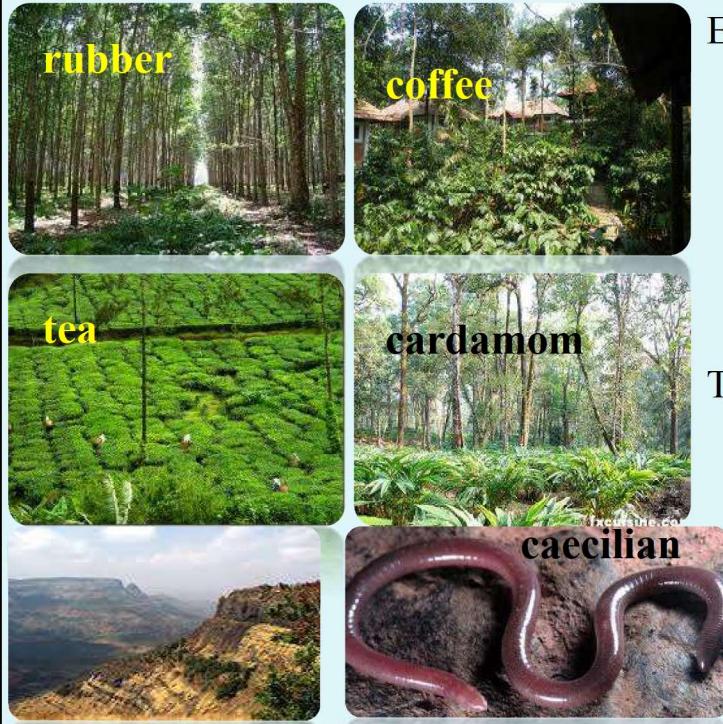
All is not lost, "MUTTALE" - the Arecanut leaf headgear still remains.

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Bio-geographic Zones of INDIA- Western Ghats



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Expansion of traditional agriculture and the spread of particularly rubber, tea, coffee, cardamom and forest tree plantations would have wiped out large pockets of primary forests in valleys.

The **Western Ghats** are well-known for harboring 14 endemic species of caecilians (i.e., legless amphibians) out of 15 recorded from the region so far.

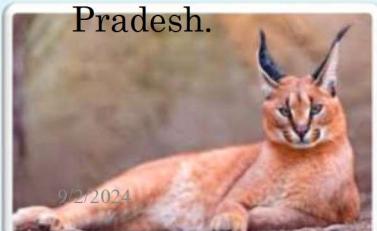
5. DESERT REGION

DESERT Zones

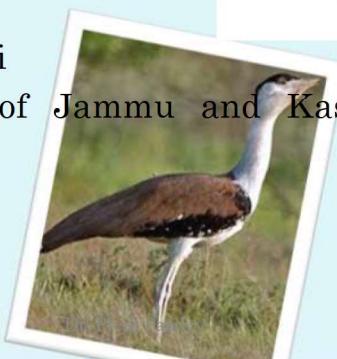


- Found in:

- Desert of western Rajasthan
- Desert of Gujarat
- Kutch, and parts of Delhi
- High altitude deserts of Jammu and Kashmir and Himachal Pradesh.



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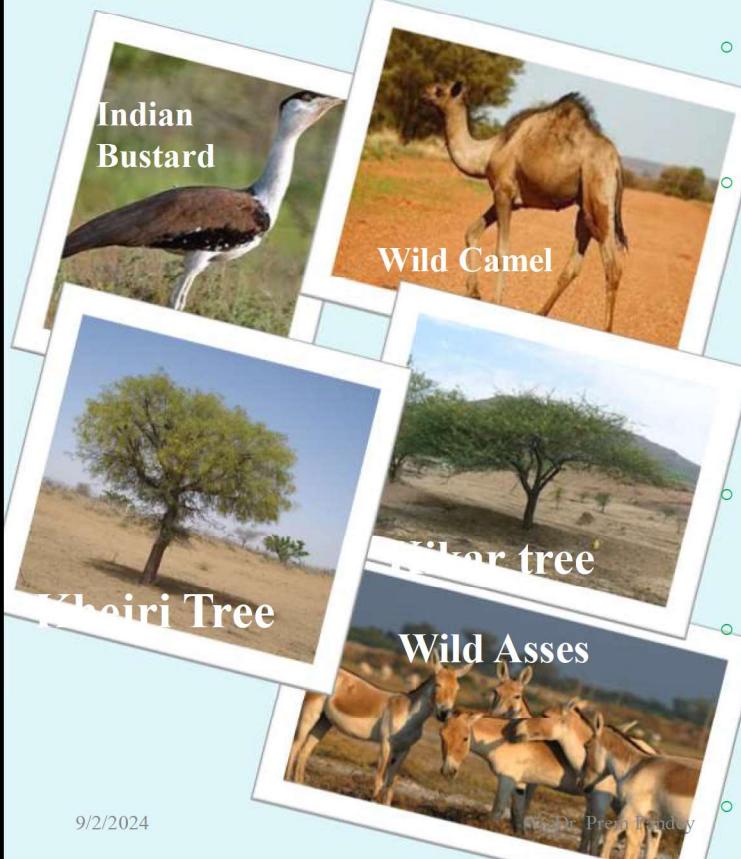


The Great Indian Bustard



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5. DESERT REGION



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- Plants are Xerophytic – babul, Khejri, kikar, wild palm etc
- Regions Supports
 - wolf, caracal, desert cat, birds like houbara bustard, camels, scorpions, foxes, snakes, great Indian bustard etc. in hot and dry regions
- Indian bustard, a highly endangered bird is found here.
- The climate is characterized by very hot and dry summer and cold winter. Rainfall is less than 70 cm.
- Areas of moderate rainfall.

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5. DECCAN PLATEAU

- Beyond the Ghats is Deccan Plateau,
 - a semi-arid region lying in the rain shadow of the Western Ghats.
 - This is the largest unit of the Peninsular Plateau of India.
- Highlands of the plateau are covered with different types of forests, which provide a large variety of forest products.
- Deccan Plateau is a large plateau in southern India.
 - It rises to 100 metres in the north, and
 - to more than 1,000 metres in the south,
 - It forms a raised triangle within the South-pointing triangle of the Indian subcontinent's coastline.



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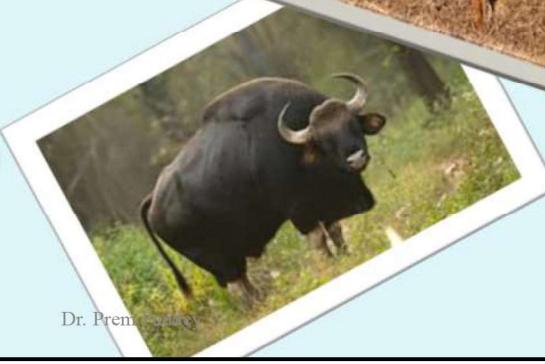
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5. DECCAN PLATEAU

- North – satpura hills, west side – western ghats east side – eastern ghats
- Deciduous forests
- Chital, sambar, nilgai, chousingha, barking deer. Gaur , elephants, wild buffalo, swamp deer etc are chief species.



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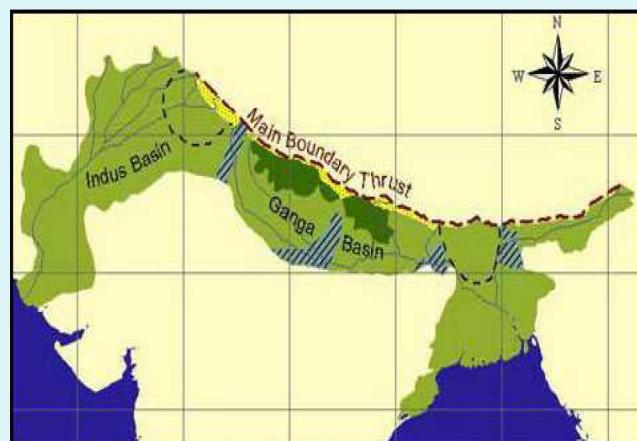


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7. GANGETIC PLAIN

- In the North, is the Gangetic plain.
- extending up to the Himalayan foothills.
- largest unit of the Great Plain of India.
- Ganga is the main river after whose name this plain is named.
- The gradational Great Plains cover about **72.4 mha** area with the Ganga and the Brahmaputra forming the main drainage axes in the major portion.



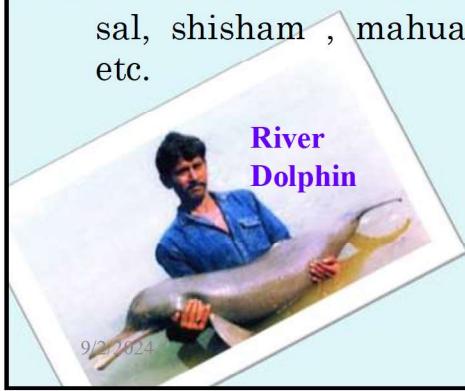
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7. GANGETIC PLAIN

- Between south Himalayas and tropic of cancer.
- Formed by Ganges river systems
- Characteristic fauna – Rhino, Elephants, Buffalo, Swamp Deer, Hog Deer, Hispid Hare etc
- The trees in forests – teak , sal, shisham , mahua, khair etc.



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7. GANGETIC PLAIN

- The Indo-Gangetic Plain also known as The North Indian River Plain.
- A large and fertile plain encompassing most of northern and eastern India, the most populous parts of Pakistan, parts of southern Nepal and virtually all of Bangladesh.
- The region is named after the Indus and the Ganges, the twin river systems that drain it.

7. GANGETIC PLAIN



Teak



Sal forest



Mahuca (*Madhuca indica*)



Shisham (*Dalbergia sissoo*)

FlowersInIsrael.com

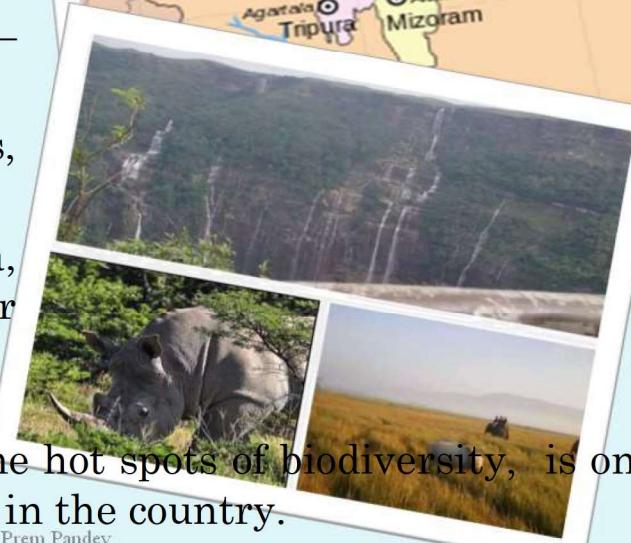
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8. NORTH EAST INDIA

- Meeting point of himalayan mountains and Indian peninsula.
- Gateway for much of India's flora and fauna
- Biodiversity hotspot – eastern himalayas
- Several species of orchids, bamboos, ferns
- Wild relatives of banana, mango, citrus and pepper can be found



- North-east India, one of the hot spots of biodiversity, is one of the richest flora regions in the country.

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8. NORTH EAST INDIA

- **51 forest types** are found in the region broadly classified into six major forest types —

- tropical moist deciduous forests,
- tropical semi evergreen forests,
- tropical wet evergreen forests,
- subtropical forests,
- temperate forests and
- alpine forests.

- These forests harbor 8,000 out of 15,000 species of flowering plants.

- In floral species richness, the highest diversity is reported from the states of :

- Arunachal Pradesh (5000 species) and
- Sikkim (4500 species) amongst the North Eastern States.

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8. NORTH EAST INDIA

- Of the 1500 endangered floral species, 800 are reported from North East India.

- According to the Indian Red data book published by the Botanical Survey of India, **10 percent** of the flowering plants in the country are endangered.

- It has several species of orchids, bamboos, canes, ferns and other plants.

- Here the wild relatives of cultivated plants such as:
 - Banana,
 - mango,
 - citrus,
 - black cardamom and
 - pepper

- It supports some of the highest bird diversities in the orient with about 850 bird species.

- **It is the center of origin of citrus fruits.**

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9. ISLANDS

- The two groups of islands,
 - the Arabian Sea islands and
 - Bay Islands

Both differ significantly in origin and physical characteristics.

- Andaman and Nicobar islands – 300 islands
- Five only inhabited.
- Centre of high endemism
- Evergreen forests
- Wide variety of corals.



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9. ISLANDS

(i) The Arabian Sea Islands are the foundered remnants of the old land mass and subsequent coral formations.

- **Lakshadweep**, formerly known as the Laccadive, Minicoy, and Amindivi Island,
- It is a group of islands in the Laccadive Sea, 200 to 440 km off the S-W coast of The Lakshadweep Archipelago forms a terrestrial ecoregion together with the Maldives and the Chagos.

Arabian Sea



9. ISLANDS

- It has over
 - 600 species of marine fishes,
 - 78 species of corals,
 - 82 species of seaweed,
 - 52 species of crabs,
 - 2 species of lobsters,
 - 48 species of gastropods,
 - 12 species of bivalves,
 - 101 species of birds.
- It has **one of the four coral reef regions of India.**
- **Pitti Island**, is an important breeding place for sea turtles and for a number of pelagic birds such:
 - the Brown Noddy (*Anous stolidus*),
 - Lesser Crested Tern (*Sterna bengalensis*) and
 - Greater Crested Tern (*Sterna bergii*).
- The island has been declared a bird sanctuary.
- Endemic fauna – **Narcondam hornbill, south Andaman krait etc.**

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9. ISLANDS

(ii) Andaman and Nicobar Islands in Bay of Bengal

lay only 200 km away from the nearest point on the main land mass and extend about 590 km.

With a maximum width of **58 km** the **island** forests of Andaman and Nicobar Islands in the Bay of Bengal have some of the best-preserved evergreen forests of India.

Some of the islands are fringed with coral reefs.

Many of them are covered with thick forests and some are highly dissected.

- **Andaman Padok**, a tree native to islands is found here

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9. ISLANDS

TRIBALS IN ANADAMAN & NICOBAR ISLANDS

The Andaman Islands are home to four 'Negrito' tribes:

- The Great Andamanese,
- Onge,
- Jarawa and
- Sentinelese.



The Nicobar Islands are home to two 'Mongoloid' tribes

- the Shompen, and
- Nicobarese.

The 'Negrito' tribes are believed to have arrived in the islands from Africa up to 60,000 years ago.

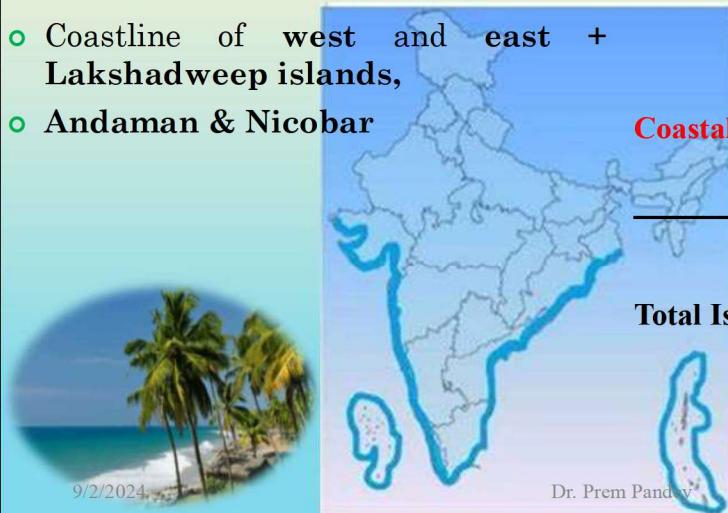


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10. Coasts



- Coastline of west and east + Lakshadweep islands,
- Andaman & Nicobar



Coastal States: 9

Coastal UTs: 4

Coastline : 7517 Km

Main land coastline: **5,423 kms.**
Offshore Islands: **2,094 kms.**

Total Islands: 1382

Mainland islands: **514**
Lakshadweep: **: 32**
Andaman & Nicobar: **836**

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10. COASTS

- The Indian coasts vary in their characteristics and structures.
- The **east coast is Wide and sandy**.
- The **west coast is narrow except around the Gulf of Canbary and the Gulf of Kutch**.
- In the extreme south, however, it is somewhat wider along the south Sahyadri.
 - The backwaters are the characteristic features of this coast. The east coast plains, in contrast are broader due to depositional activities of the east-flowing rivers owing to the change in their base levels.



Coconut Lagoon

A photograph showing several coconut trees standing in a shallow, calm body of water, likely a lagoon.

Back waters of Kerala

A photograph of a backwater scene in Kerala, featuring palm trees and a sunset over the water.

10. COASTS

- Mangrove vegetation is characteristic of estuarine tracts – mangrove vegetation. i.e. at Ratnagiri in Maharashtra.
- Rice is main crop, coconut trees are grown more along the coasts.
- Larger parts of the coastal plains are covered by fertile soils on which different crops are grown.

- Extensive deltas are the characteristic features of this coast.
 - the Mahanadi,
 - Godavari,
 - Krishna and
 - Kaveri.
 - (Narmada and Tapti flows towards western coast)
- Sandy beaches, mangroves, mud flats, coral reef and marine angiosperm pastures make them wealth and health zones of India.

Mangroves -Pichavaram

A photograph of a dense mangrove forest, specifically at Pichavaram, showing the intricate root system of the mangrove trees.

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10. COASTS



- An estuary is a partially enclosed, coastal water body where freshwater from rivers and streams mixes with salt water from the ocean.
- Estuaries, and their surrounding lands, are places of transition from land to sea.
- A backwater is a part of a river in which there is little or no current.
- It can refer to a branch of a main river, which lies alongside it and then rejoins it, or to a body of water in a main river, backed up by the sea tide or by an obstruction such as a dam.

4. MAGNITUDE AND LEVELS OF BIODIVERSITY

Global biodiversity

Biodiversity has grown and shrunk in earth's past due to:

- Changes in abiotic factors such as mass extinction,
- changes in temperature and oxygen levels
- Sea levels.

A **cooling** and **drying** resulted in catastrophic rainforest collapse and subsequently a great loss of diversity, especially of amphibians.

Climate change **299 million years ago** was one such event.

Magnitude and Levels of Biodiversity

Biologists are engaged in the identification and naming of species for the past 250 years.

Still, they are able to describe far less number of species than actual numbers present.

- Presently, the known and described number of species of all organisms on Earth
 - **about 1.9 million**
- but this number is thought to be a significant underestimate of the total number of species.
- It has been predicted that the total number of species varies from
 - **5 to 50 million.**

Current threats to global biodiversity include

1. **Natural extinction**, an event that occurs to species yearly, as well as
2. human actions – **anthropogenic factors** such as pollution, deforestation, etc.

Invasion of **non-native species**, **invasive species** (also called as **Alien species** new to the place where it is not found), can also have a negative effect on global biodiversity.

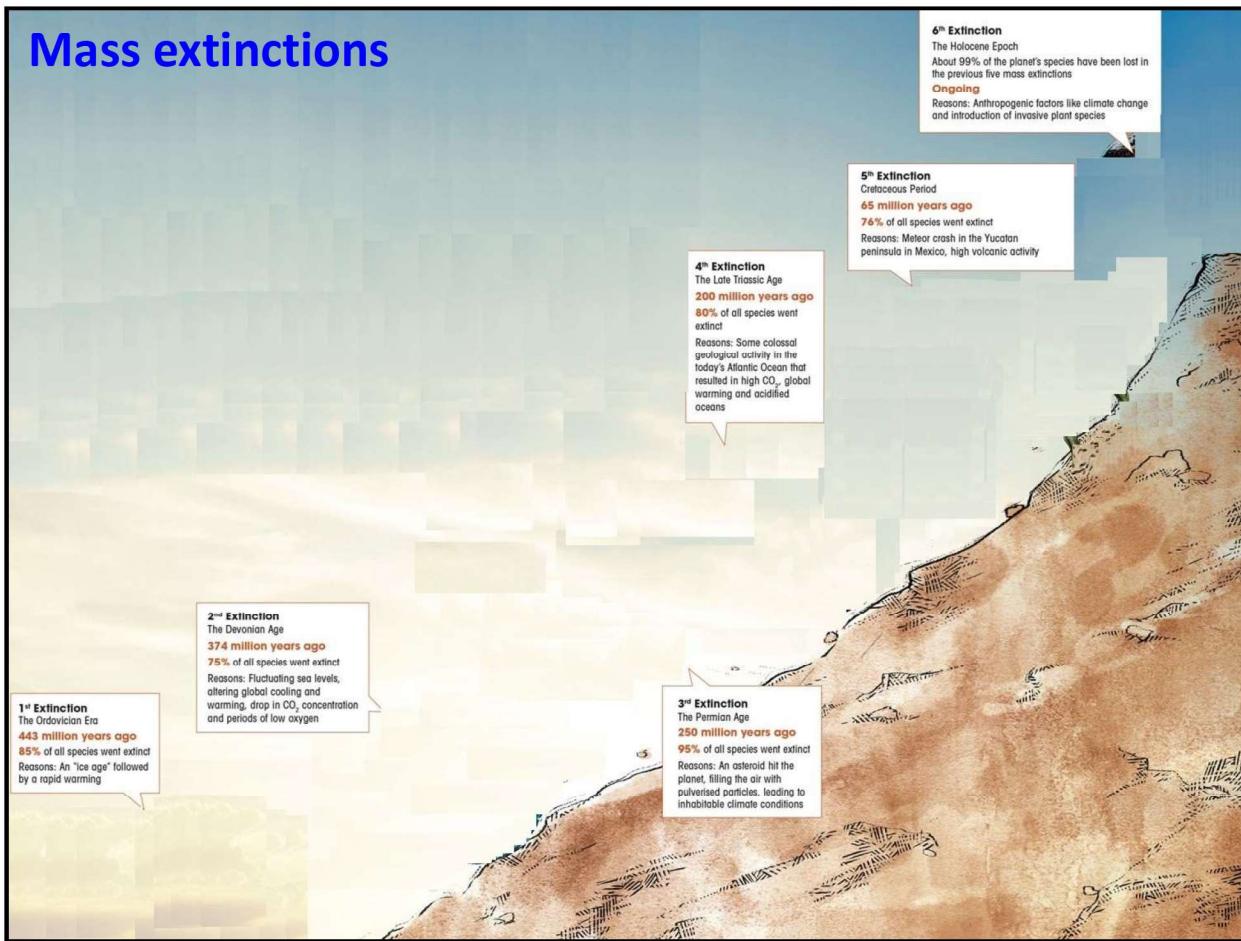
Magnitude and Levels of Biodiversity

About **2,70,000 species of plants** and only **4650 species of mammals** are known to science.

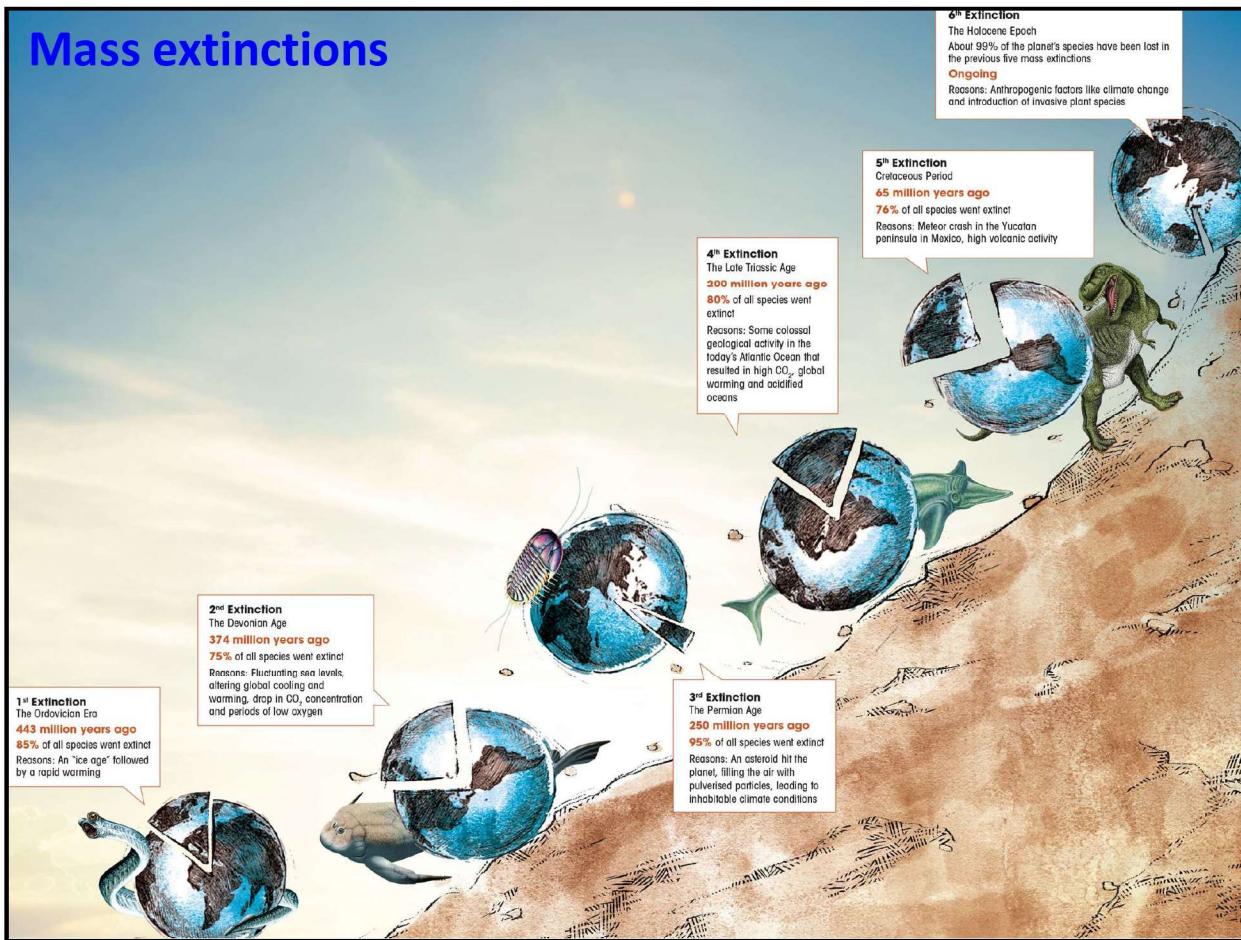
Approximately **61%** of the known species are **Insects**.

As mentioned earlier only fragmentary information is available about **micro-organisms**, including bacteria, viruses and lower groups of animal kingdom.

Mass extinctions



Mass extinctions

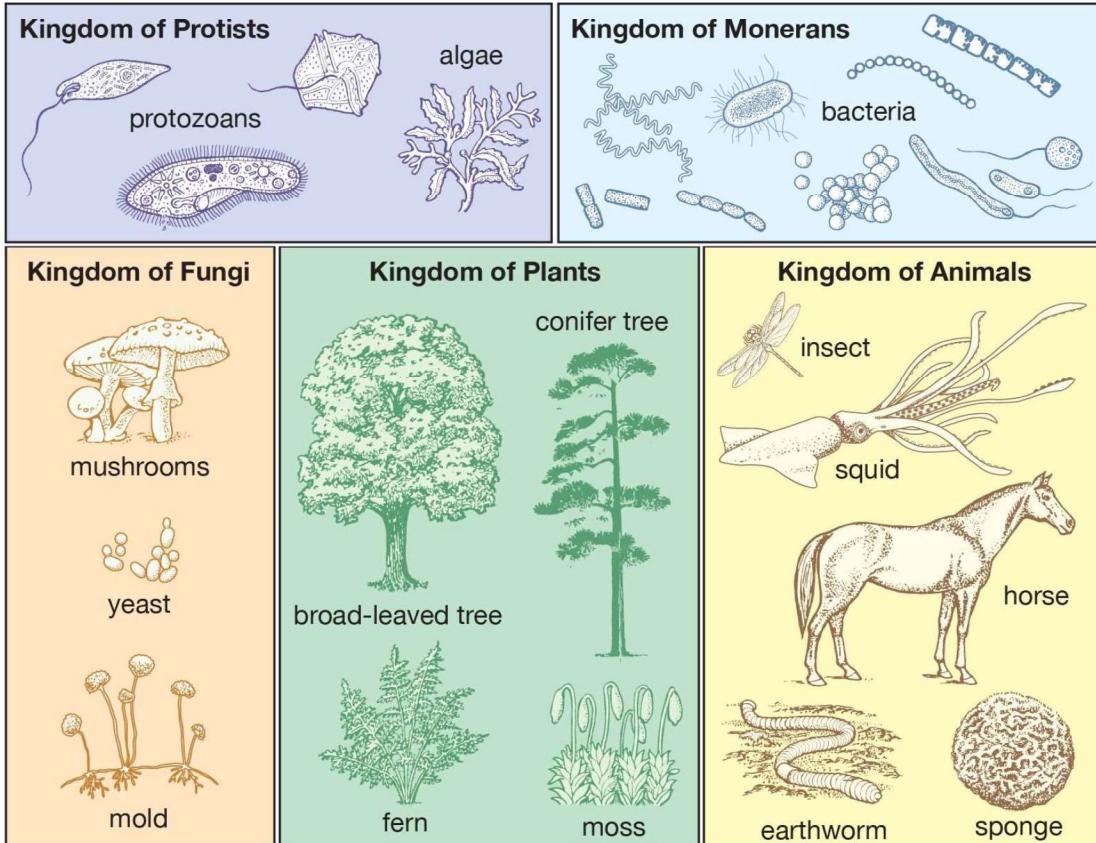


DIFFERENT LEVELS OF BIODIVERSITY IN PLANT AND ANIMAL KINGDOM

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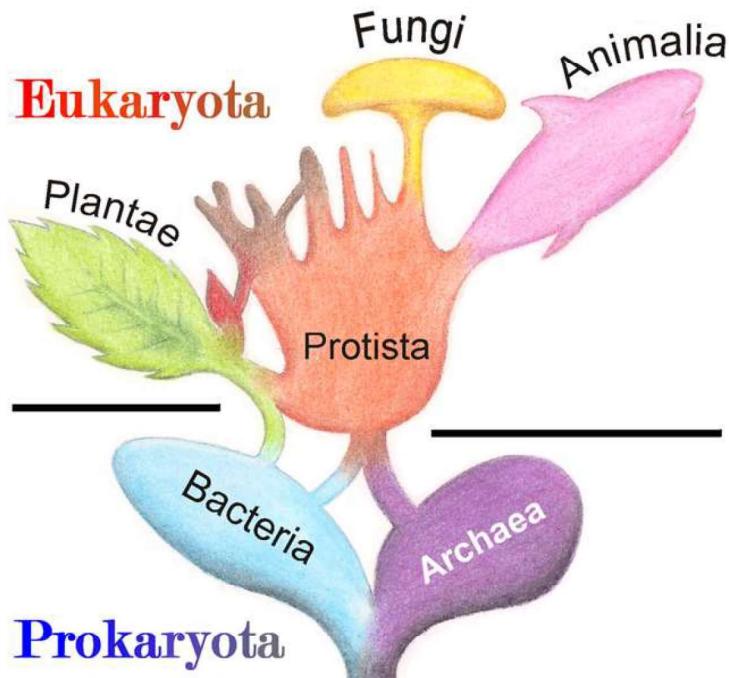
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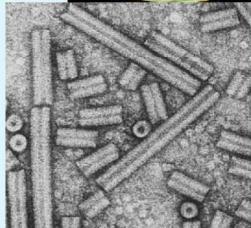
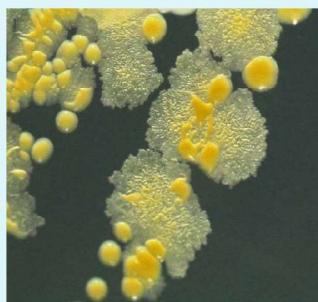
- Structure of cell,
- mode of nutrition,
- source of nutrition,
- interrelationship,
- body organization, and reproduction -

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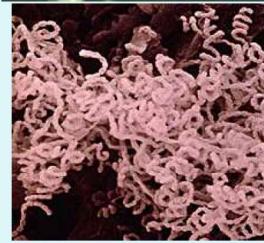
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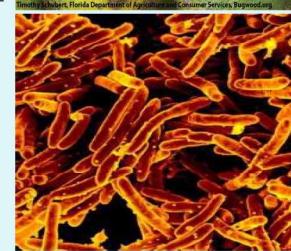
KINGDOM



Plant Viruses



Actinomycetes



Bacteria

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Algae



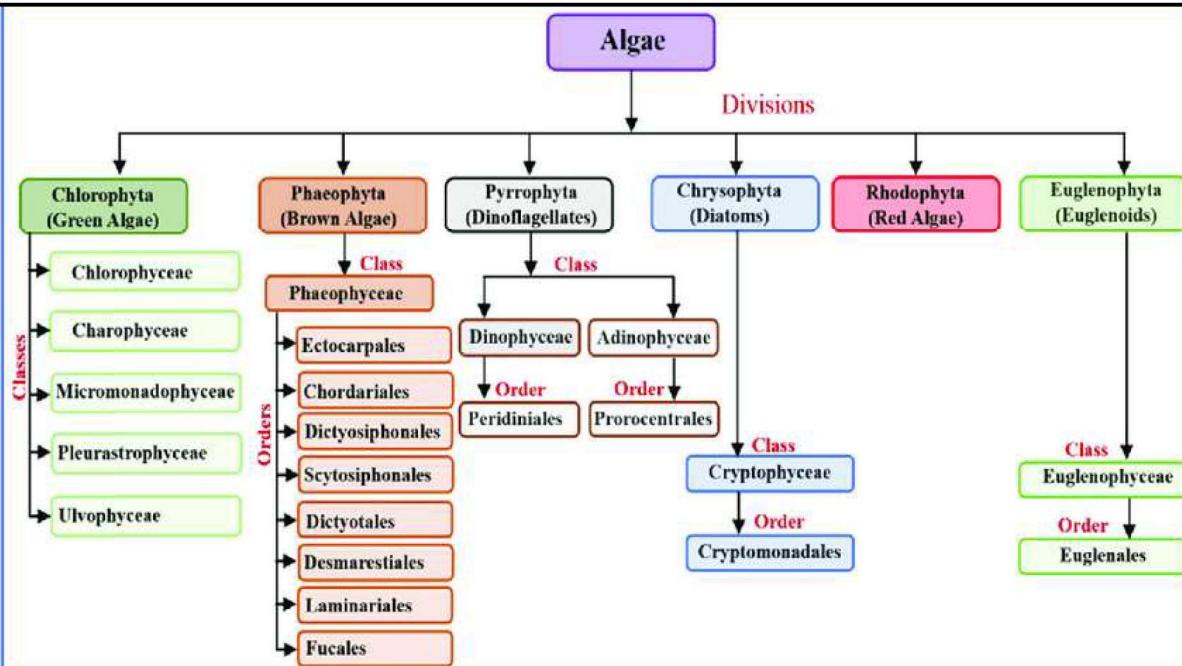
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Fungi



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LICHENS- symbiotic relationship of Algae and Fungi

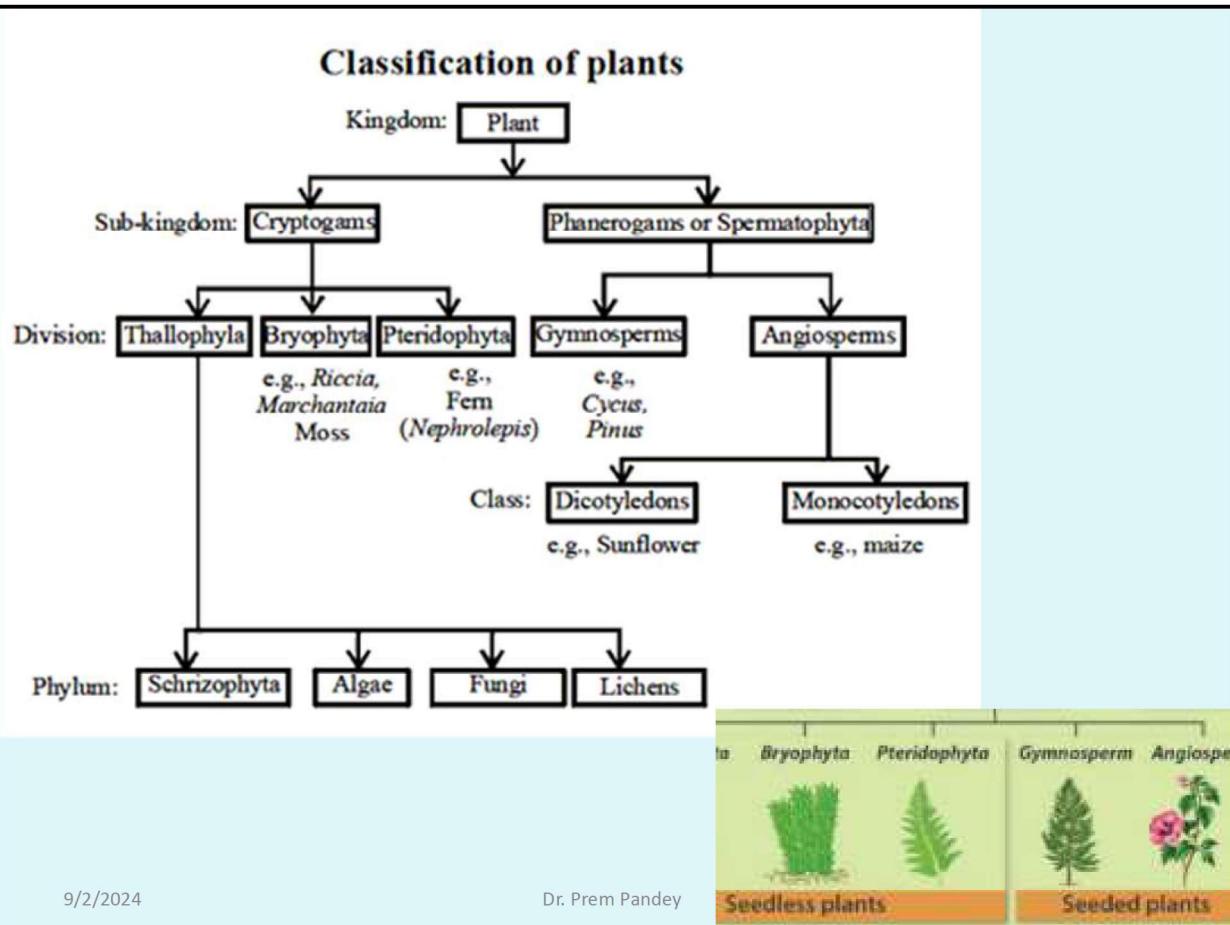


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Physcia



BRYOPHYTES- Liverworts

- Non vascular seedless plants-
- Means no roots and no vascular tissues-
- Absorb water from air
- *Cryptogams—that reproduces through spores rather than seeds*



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PTERIDOPHYTES- ferns and allies

Division Pteridophyta

Likewise Pteridophyta is derived from Greek words
Pteris= fern + Phyta = a plant.

So the plants body is commonly differentiated into
root, stem and leaf.

There is specialised tissue to conduct water and
minerals from one part of the plant body to the
other part.

Vegetative reproduction (fragmentation/ gemme/ vegetative growth

and sexually-



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PTERIDOPHYTES- ferns and allies



Tree Fern - *Cyathia*



Climbing Fern - *Lygodium*

Vascular plants that reproduces using spores-
They do not have flowers and seed-
Cryptogams (another name)
includes ferns, horsetail

Reproduction- through spores.



Lady Fern

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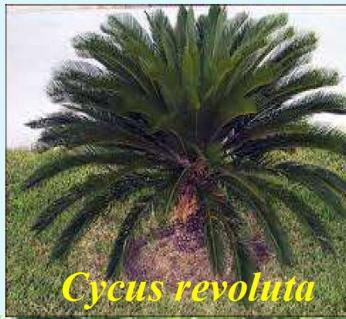
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Gymnosperms *first plants to have seeds*



Gymnosperms

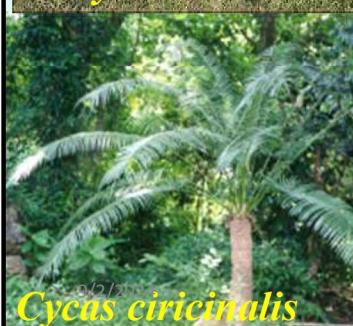
Reproduce by means of
Open seed-



Cycas revoluta



Pine tree - *Pinus*



Cycas circinalis

Similarly, Gymnosperm is derived from Greek words
Gymnos = naked + spermos = seed.

Gymnosperms are most primitive plants and their
seeds are simple and naked i.e. seeds are not
enclosed inside a fruit.

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Delonix regia



Cassia fistula

vascular plants – with covered seeds



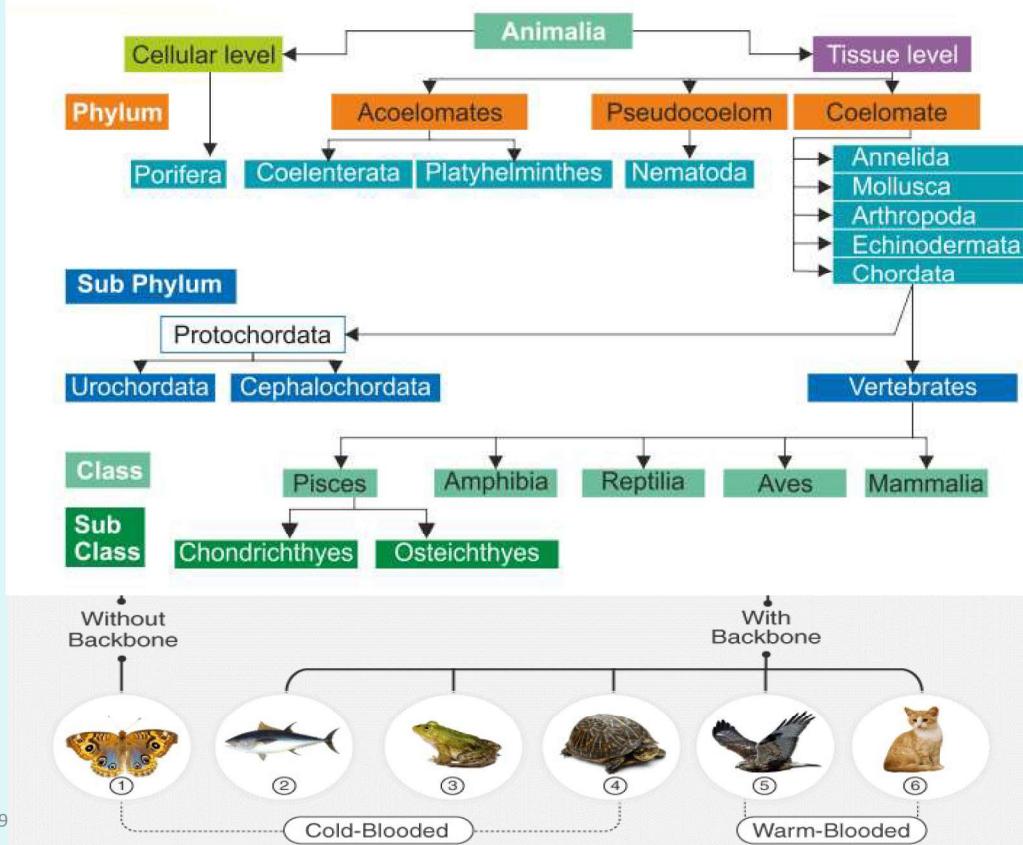
Angiosperms



Jacaranda mimosifolia

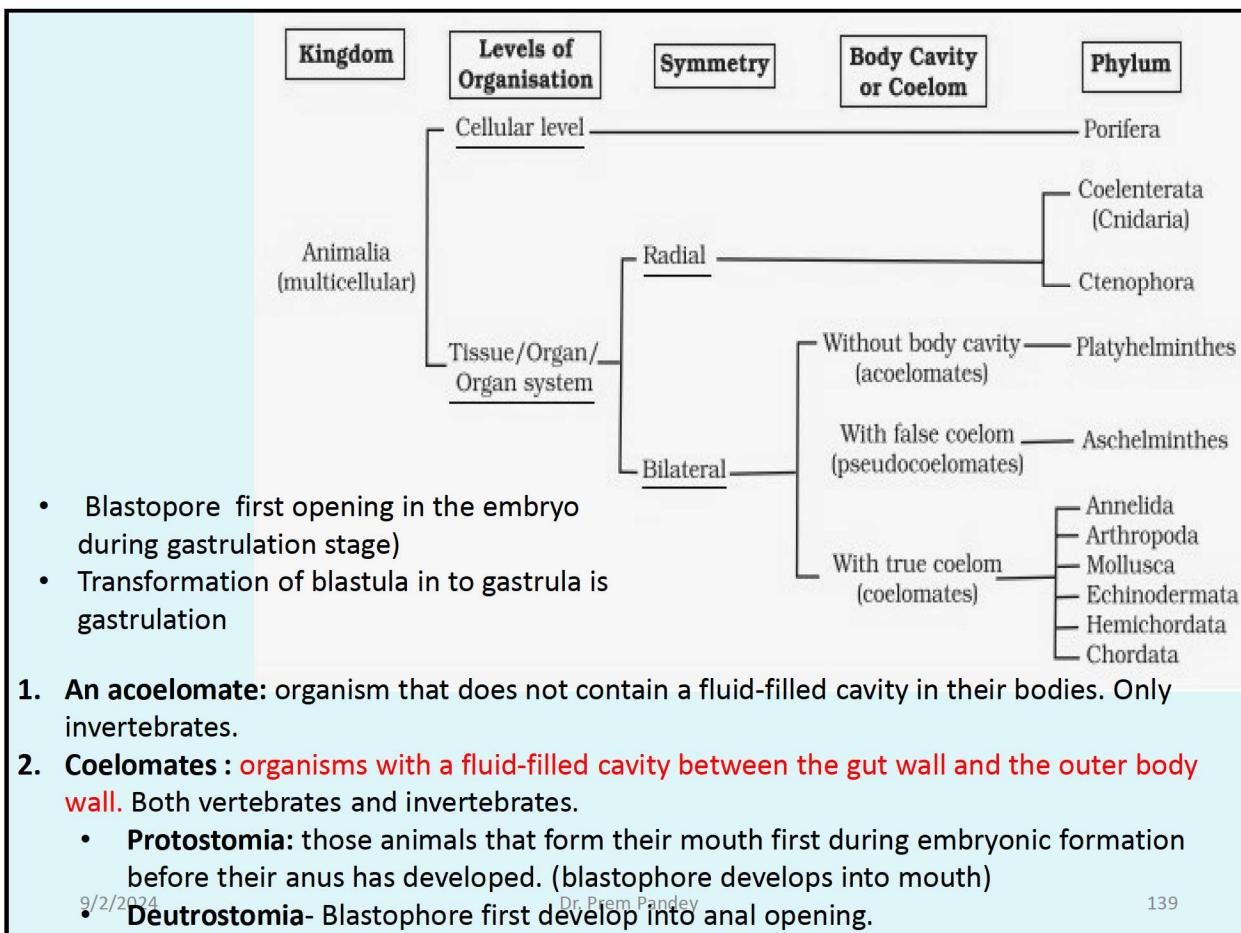
Animal Kingdom

Classification of Kingdom Animalia



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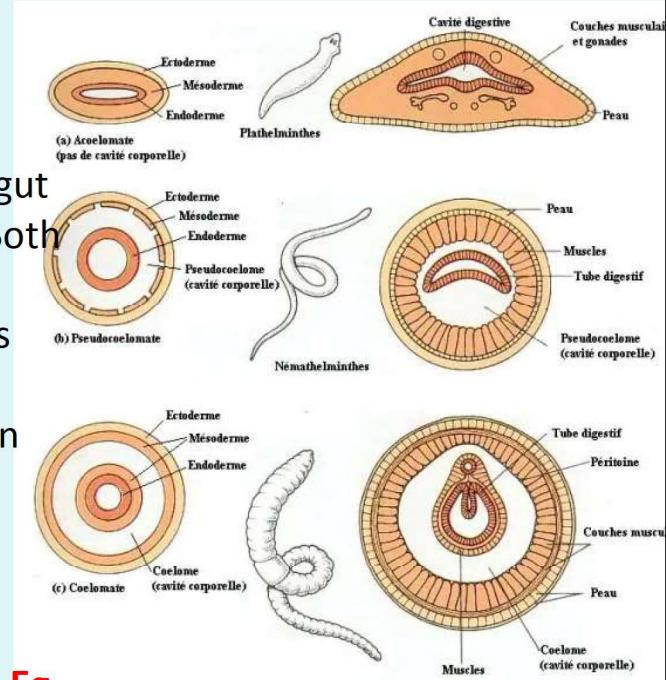
- **Blastopore:** first opening in the embryo during gastrulation stage)
- Transformation of blastula into gastrula is **gastrulation**
- Now what is the fate of the FIRST Opening
- Will define the organisms as,
 - **Protostomia**— Mouth first
 - **Deutrostomia**— Anal opening first

1. An acelomate: organism that does not contain a fluid-filled cavity in their bodies. Only invertebrates.

2. Coelomates : organisms with a fluid-filled cavity between the gut wall and the outer body wall. Both vertebrates and invertebrates.

- **Protostomia:** those animals that form their mouth first during embryonic formation before their anus has developed (**blastopore** develops into mouth)
- **Deutrostomia**— Blastopore develops into anal opening. **Eg.**

Humans are Deutrostomes.



Invertebrates

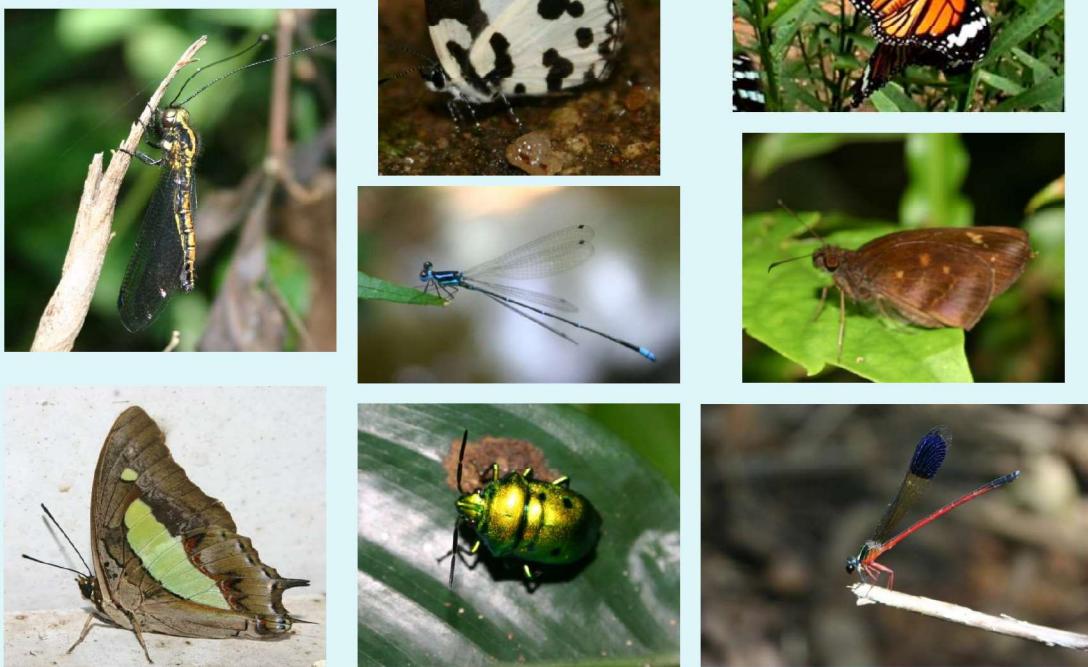


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ARTHROPODS



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FRESHWATER AND MARINE FISHES



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AMPHIBIANS



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Reptiles



Birds



Mammals



Lion-tailed macaque



Tiger



Indian Bison



Spotted deer

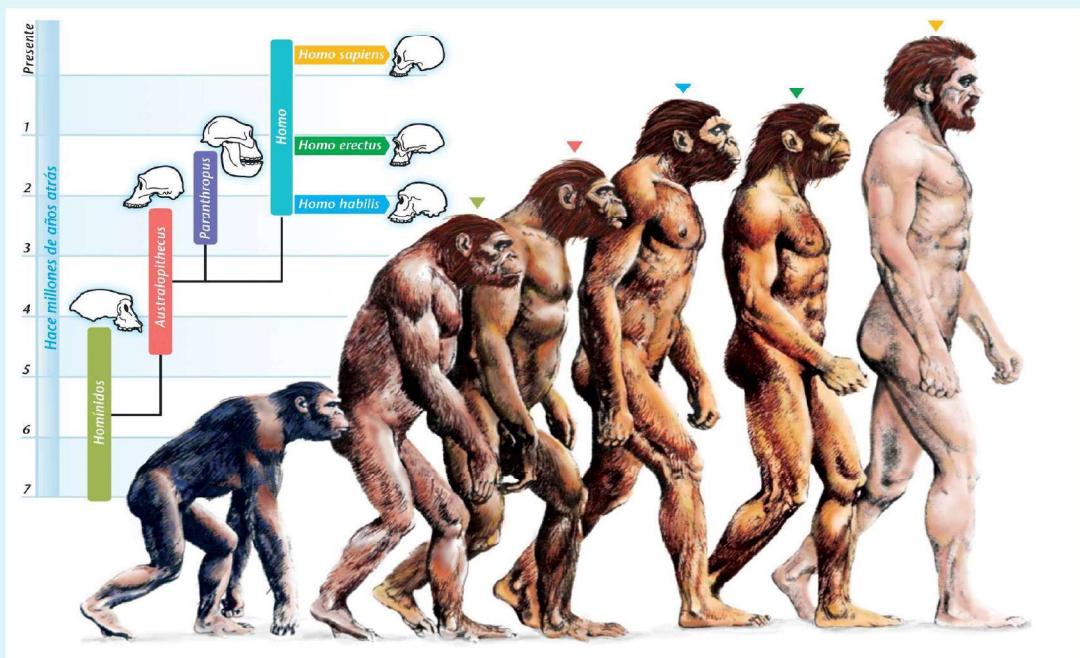


Malabar spiny dormouse



Slender loris

Mammal- Human



Approximate numbers of species from major taxonomic groups so far described in the World

TAXONOMIC GROUP	NUMBER OF SPECIES
PLANTS	
1. Higher plants	270,000
2. Algae	40,000
3. Fungi	72,000
4. Bacteria (including Cyanobacteria)	4,000
5. Viruses	1,550
ANIMALS	
1. Mammals	4,650
2. Birds	9,700
3. Reptiles	7,150
4. Fish	26,959
5. Amphibians	4,780
6. Insects	1,025,000
7. Crustaceans	43,000
8. Mollusks	70,000
9. Nematodes and Worms	25,000
10. Protozoa	40,000
11. Others	110,000

Number of Plant and Animal Species in different Groups Recorded in INDIA

PLANTS	ANIMALS
1. Angiosperms - 17,500	1. Mammalia - 390
2. Gymnosperms - 64	2. Aves - 1,232
3. Pteridophytes - 1,200	3. Reptilea - 456
4. Bryophytes - 2,850	4. Amphibia - 209
5. Lichens - 2,075	5. Pisces - 2546
6. Fungi - 14,500	6. Protochordata - 119
7. Algae - 6,500	7. Other Invertebrates - 8329
8. Bacteria 850	8. Arthropods - 68,389
	9. Mollusca - 5070
	10. Protozoa - 2577

Endemic Species Endemism

Endemic species

- Some species **remain confined** to a particular locality due to some or the other reasons.
- One important reason behind this is the **habitat** that alone favors the development and survival of these species.
- *The endemic species are those taxa whose distribution is confined to a restricted area due to their specific ecological niches and edaphic (soil) gradients.*

Endemic species

- Therefore, the habitats of **endemic species** are far more **vulnerable** than other species.
- Endemic species once lost, it is a loss of biodiversity of these species for ever.

Restricted distribution of Endemic species

The reasons for endemic species to remain restricted to a small area are:

- Endemic species of plants and animals remain **poor in adaptation** to different types of environmental conditions,
- Suitable/ specific ecological niche
- These remain restricted to a particular place due to **geographical barriers** like sea, mountain etc.,
- Endemic species produce **less efficient propagules, seed, etc.** due to which they become unable to disseminate up to far off places.

Restricted distribution of endemic species

The above reasons combined with certain environmental factors cause the living Gymnosperm the *Metasequoia* to remain endemic to China;

The *Sequoia* or the red wood tree to remain endemic to the coastal valleys in California (USA);

The *Primulla* and the *Potentilla* remain endemic to high altitudes of Himalayas;

and the *Ginkgo biloba* (*also known as Maiden hair tree*) to remain endemic to Japan and China.

Metasequoia endemic to China and *Sequoia* or the red wood tree endemic to the coastal valleys in California (USA)



Metasequoia endemic to China



Sequoia or the red wood tree endemic to California (USA)



Ginkgo biloba endemic to Japan and China



***Ginkgo biloba* endemic to Japan and China**
Also known as maiden hair fern

only existing species within its group. It is one of the best-known examples of a living fossil.

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Primula and the *Potentilla* endemic to high altitudes of Himalayas



Primulla



***Potentilla* (*sadabahar* in hindi)**



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Bali Mynah

- For example **Bali Mynah** is distributed and endemic to the island of Bali, where it is the **island's only surviving endemic species**.
- This rare bird was discovered in 1910 and is one of the world's **most critically endangered birds**.
- In fact, it has been on the verge of nearing extinction in the wild for several years.
- The endemic species are prone to extinction due to several reasons.

Endemism

- *The phenomenon of occurrence of particular species only in a particular habitat is called as **Endemism**.*
- Endemism is the ecological state of being unique to a defined geographic location, such as an island, nation or other defined zone, or habitat type; **organisms that are indigenous to a place are not endemic to it if they are also found elsewhere.**
- Physical, climatic, and biological factors can contribute to endemism.
- This makes the habitats in which endemic species thrive very important.

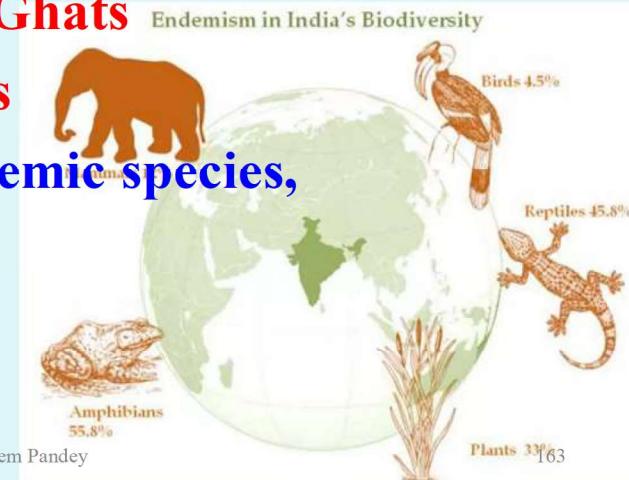
Endemic species of India

In India, there are about 5,725 endemic taxa of Angiosperms (33.5% of Indian flora).

The major hotspots in India which contain largest number of endemic plant species are

- the Southern Western Ghats
- and Eastern Himalayas

with 1,286 and 1,808 endemic species, respectively.



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PLANT DIVERSITY OF INDIA (including fungi, but excluding virus/bacteria)

Taxonomic group	No. of Species			% of World Flora
	India	(Endemic)	World	
Angiosperms	17,500	(5,725)	2,70,000	6.48
Gymnosperm	48*	(10)	836	5.74
Pteridophytes	1,200	(193)	13,125	9.14
Bryophytes	2,850	(938)	16,000	17.81
Algae	6,500	(1924)	40,000**	16.25
Fungi	14,500 #27,000	(3,500)	79,000 #	50.4 #33.3
Lichen	2,075	(518)	13,500	15.37
Total	44,673 * Additionally there are 27,000 species	(12,808)	4,23,461	10.54

* According et al (2004) there are about 27,000 species of Fungi in India and 74,000 in the world, see MOEF 2005

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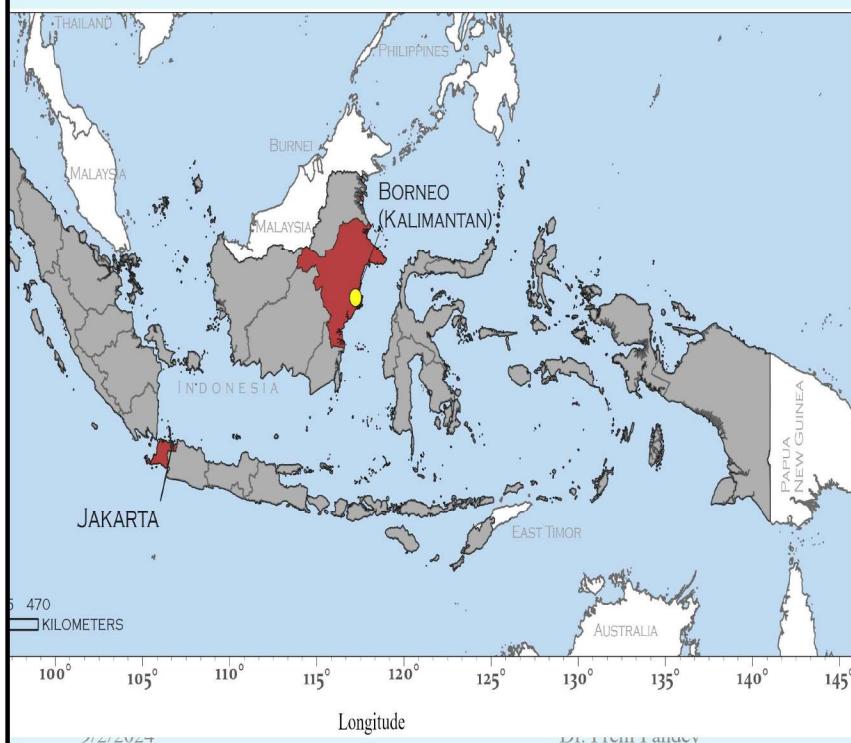
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ENDEMISM- Eco-regions with high % of endemic plants

According to the World Wildlife Fund, the following eco-regions have the highest percentage of endemic plants:

- Fynbos (South Africa)
- Hawaiian Tropical Dry Forests (United States)
- Hawaiian Tropical Rainforests (United States)
- Kwongan Heathlands (Australia)
- Madagascar Dry Deciduous Forests (Madagascar)
- Madagascar Lowland Forests (Madagascar)
- New Caledonia Dry Forests (New Caledonia)
- New Caledonia Rain Forests (New Caledonia)
- Sierra Madre de Oaxaca Pine-oak Forests (Mexico)
- Sierra Madre del Sur Pine-oak Forests (Mexico)
- Luzon Montane Rainforests (the Philippines)
- Luzon Rainforests (the Philippines)
- Luzon Tropical Pine Forests (the Philippines)
- Mindanao Montane Rain Forests (the Philippines)
- Mindanao-eastern Visayas Rain Forests (the Philippines)
- Palawan Rain Forests (the Philippines)

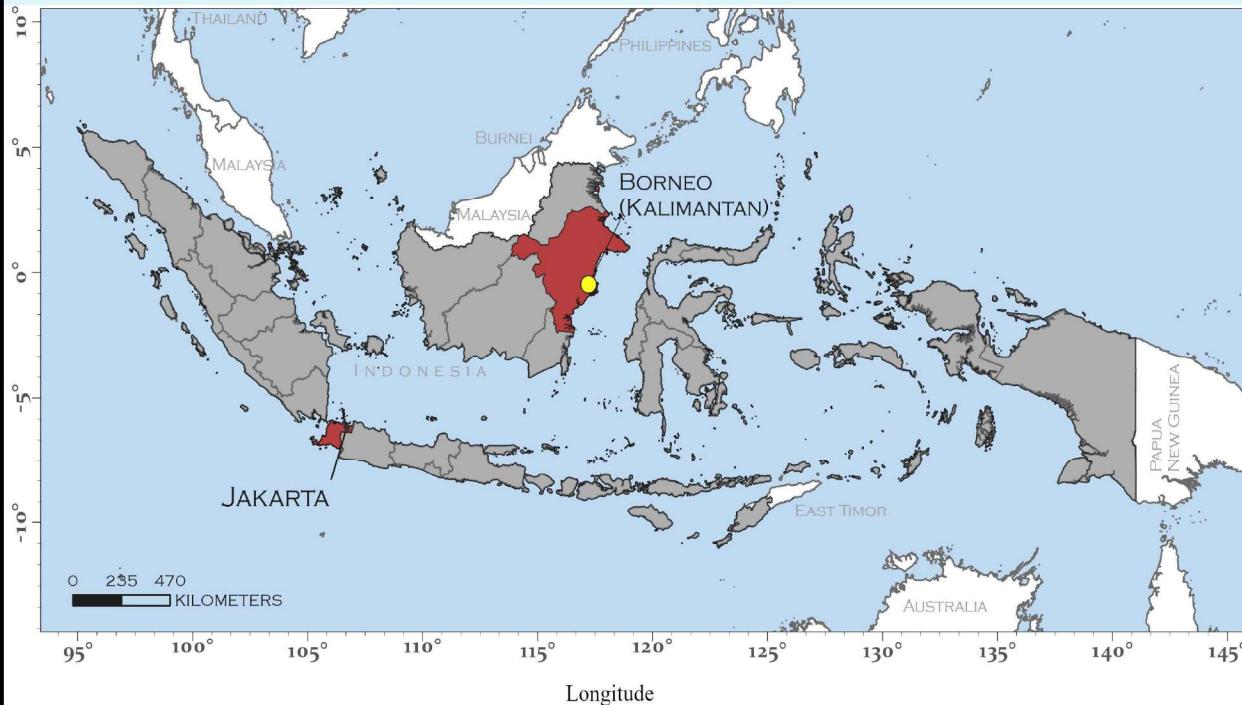
Borneo Island in Indonesia



Borneo is estimated to be home to around 222 mammals (including 44 endemic – meaning they are not found anywhere else in the world), 420 birds (37 endemic), 100 amphibians and 394 fish (19 endemic).

Just in the Heart of Borneo, a 220,000-km² region in the mountainous centre of the island, there are 10 primate species, over 350 bird species & 150 reptile and amphibian species.

Borneo Island in Indonesia



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Borneo's incredible biodiversity

- At least 15,000 plants, of which 6,000 are found nowhere else in the world, can be found in the swamps, mangroves, and lowland and montane forests of the island.
- The Heart of Borneo is home to around 10,000 of these.

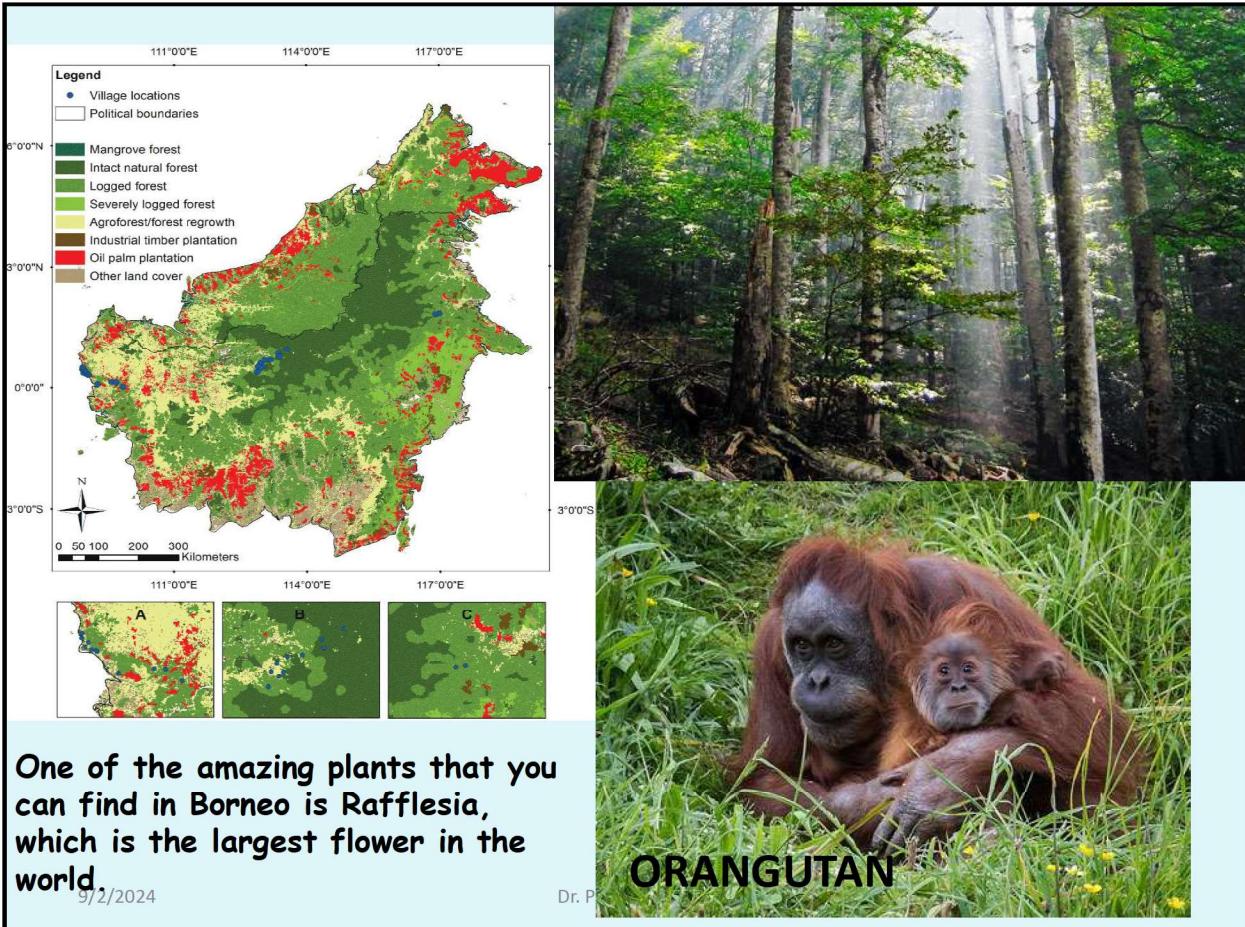
Borneo's incredible biodiversity

- Borneo's tropical rainforests and climate provide the ideal conditions for a wide variety of species to thrive.
- Dipterocarp trees hold the greatest insect diversity on Borneo - as many as 1,000 species can be found in just 1 tree.

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Rafflesia arnoldii-Stinking corps Lilly



The Largest Flower in the World





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