E-CONTENT PREPARED BY

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NAAC Accredited "A" Grade College

(Recognized under Section 2(f) and 12(B) of UGC Act 1956)

E-Content prepared for students of

M.Sc.(Semester-II) in Conservation Biology

Name of Course:
Biodiversity Conservation

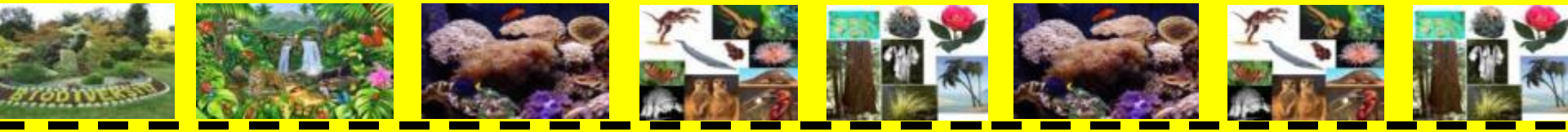
Topic of the E-Content:
Biodiversity: Definition, Concept and Values

Bio(logical)diversity

The term

'Biological diversity' - Raymond F. Dasmann
"A Different Kind of Country" (1968)

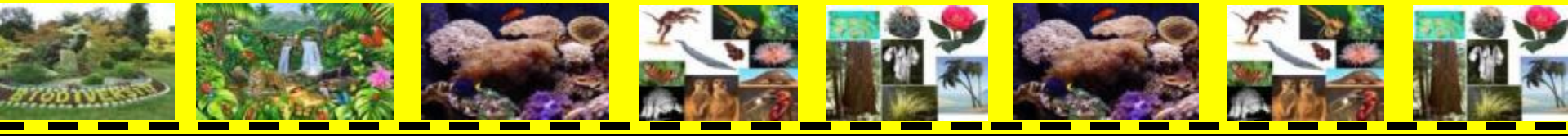
'**Biodiversity**' - Wilson & Peters (1988), Proceeding of the *National Forum on Biological Diversity*



Biodiversity

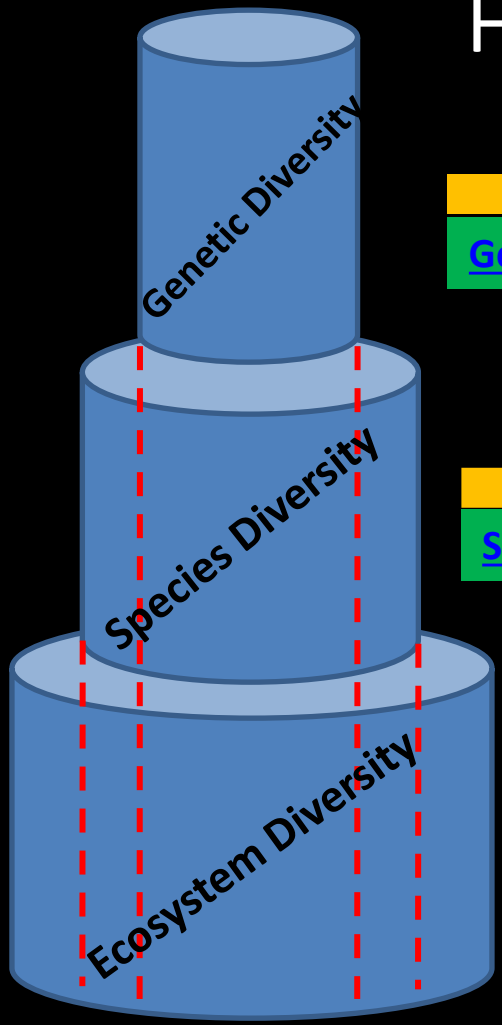
An “umbrella term” referring to organisms found within the living world

The variability among living organism from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and ecosystem (CBD, 1992)



Biodiversity

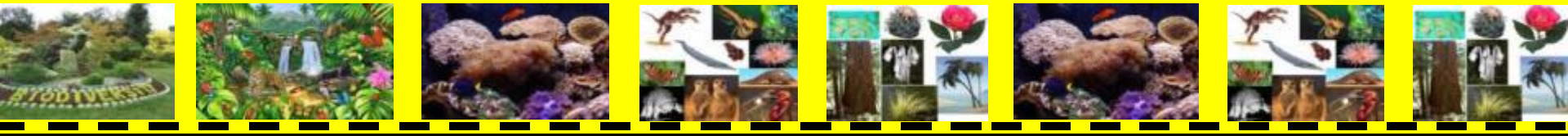
Hierarchical scales of biodiversity



Genes

Species

Ecosystem



Types of Biodiversity

1. Genetic diversity - genetic variability or diversity within a species, i.e. between the individuals of a species

   Example ; 5,000 recorded varieties of mango

   88,000 recorded varieties of *Oryza sativa*



2.Species diversity - diversity between different species

Example ; *Panthera tigris*

Panthera leo

3. Ecosystem diversity – diversity within a region

Grassland

Shola forest

Biodiversity Services

Genetic Diversity

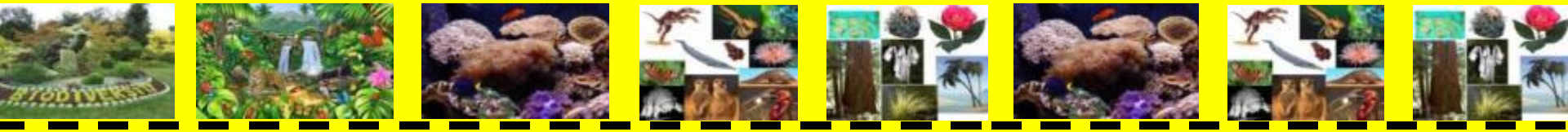
- Crop and livestock that can adapt to changes
- Basis for future food security

Species Diversity

- Goods for subsistence, health, barter and trade
- Material for income generating activities

Ecosystem Diversity

- Ecosystem services

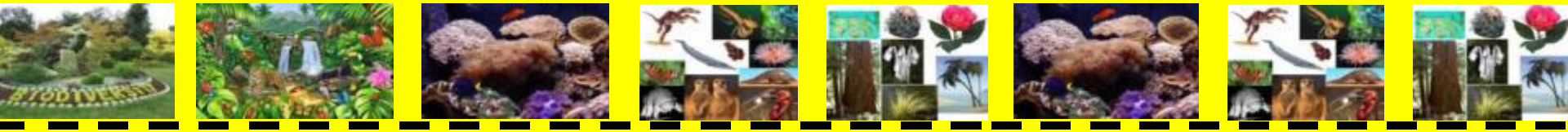


Why Biodiversity is Important ?

Ecosystem Services

Provisioning Services
(Providing products)

Medicinal products



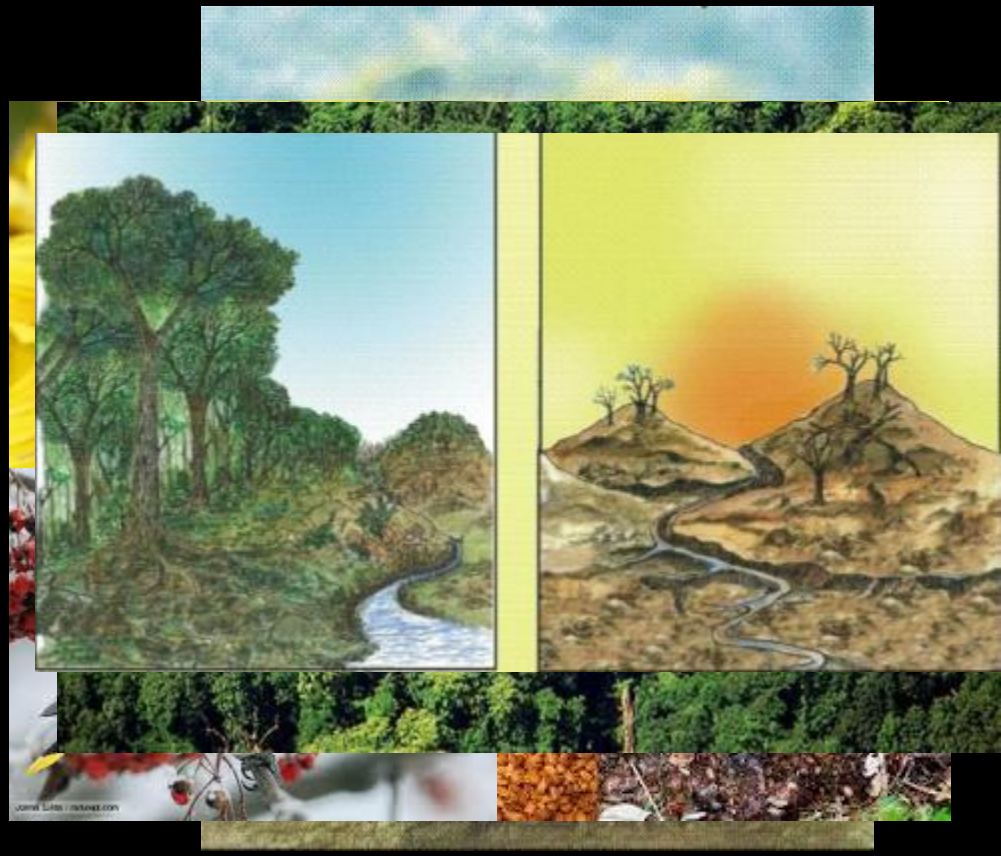
Why Biodiversity is important ?

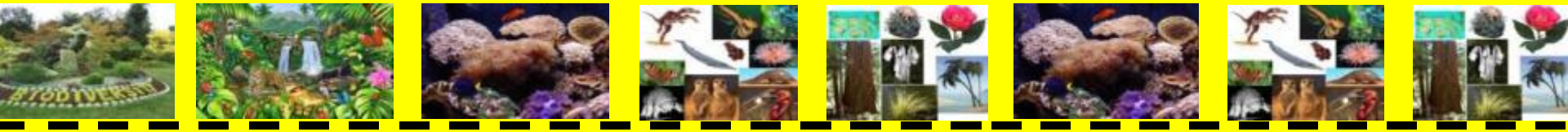
Ecosystem Services

Regulating Services

(Regulation of ecosystem processes)

Erosion control

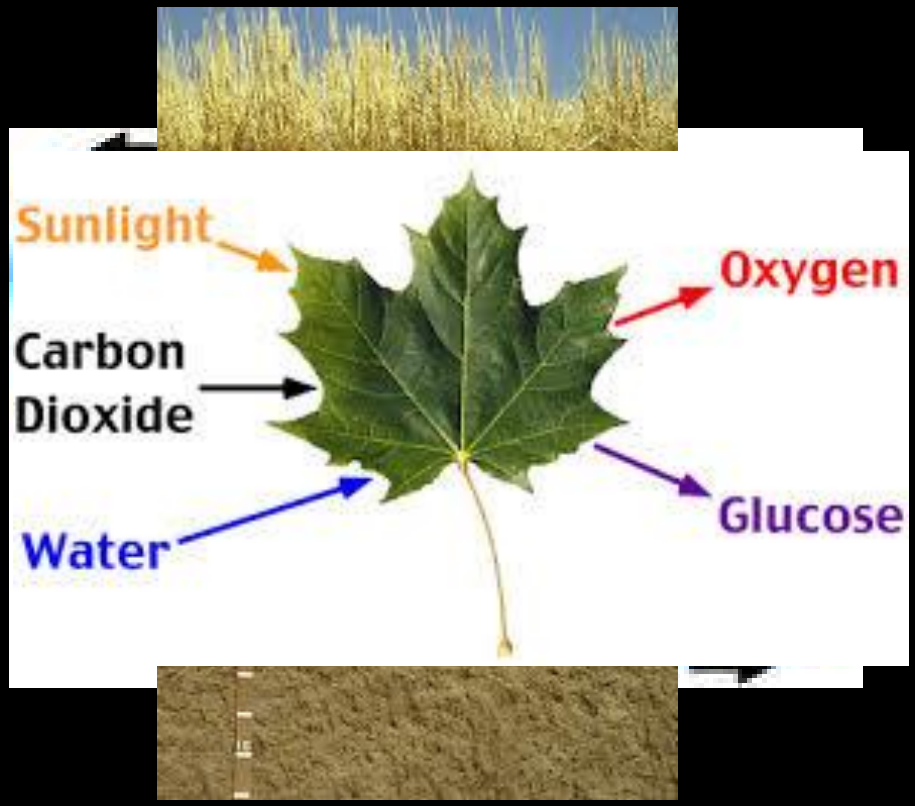




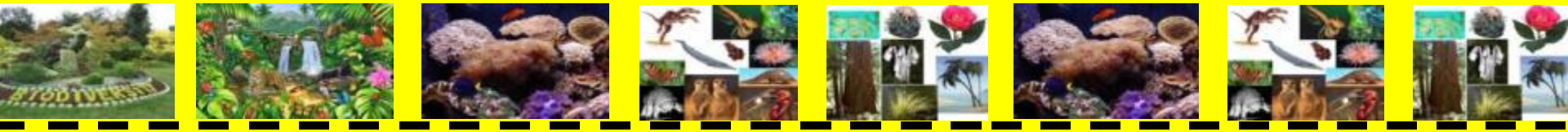
Why Biodiversity is important ?

Ecosystem Services

Supporting Services (necessary for producing all other services)



Primary Production

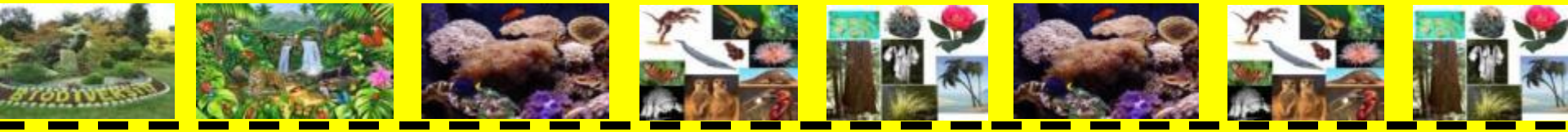


Why Biodiversity is important ?

Ecosystem Services

Cultural Services (Non-material benefits from ecosystem)

Ethical / Philosophical values



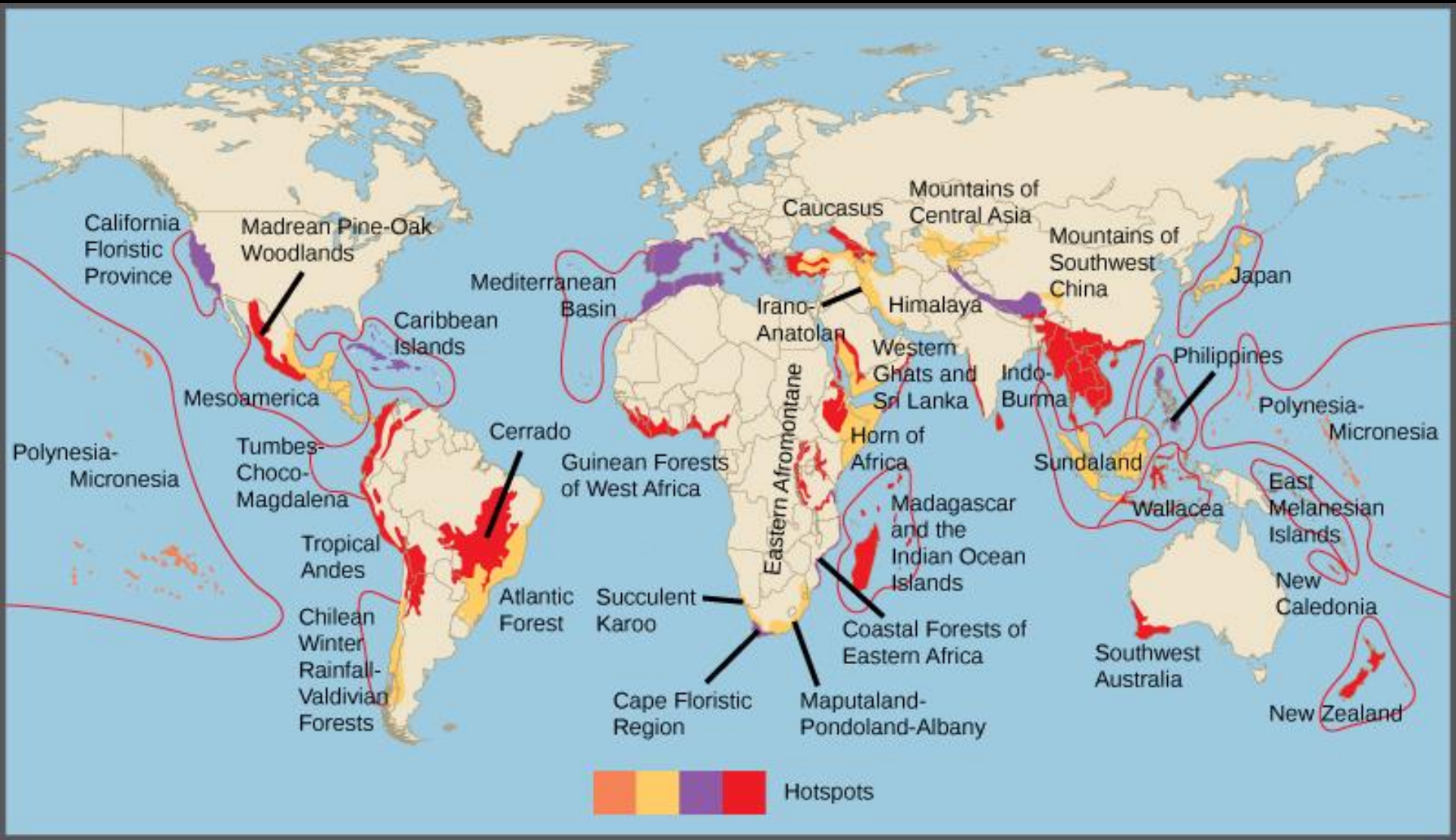
India’s Biodiversity

India's biodiversity

A Glimpse

- **2.4%** of the World's area
- **7.31%** of the global fauna (89,451 species)
- **30%** of the world's recorded flora (about 50000 plant species)
- Homeland of **167** cultivated species and **379** wild relatives of crop plants
- **44** endemic mammal species
- Two biodiversity hotspots

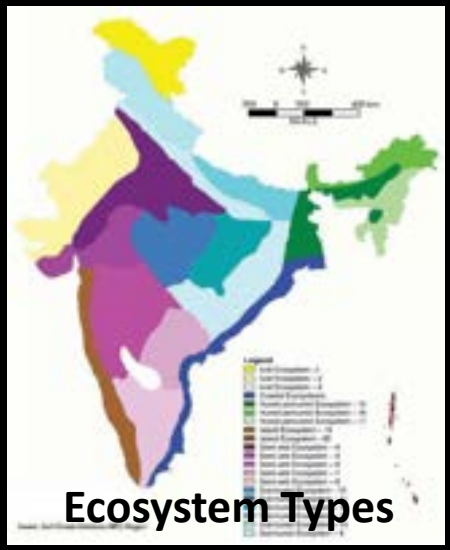
Hotspots: Must contain at least 0.5% or 1,500 species of vascular plants as endemics, and it has to have lost at least 70% of its primary vegetation



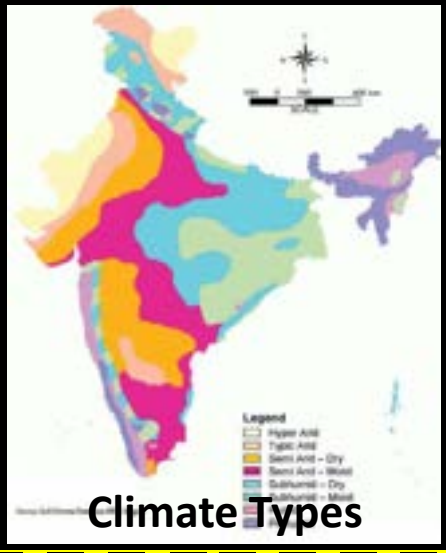
India’s biodiversity

Bio-geographic zones

Forest Types

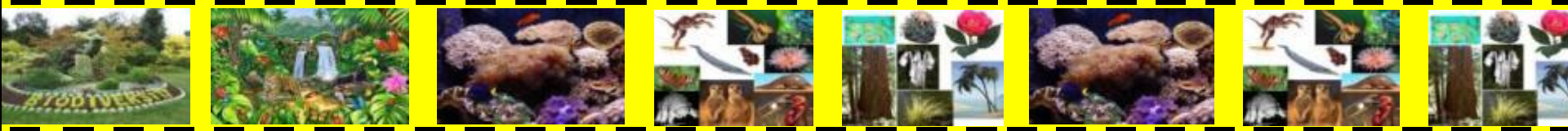


Ecosystem Types



Climate Types

Soil Types



India's biodiversity

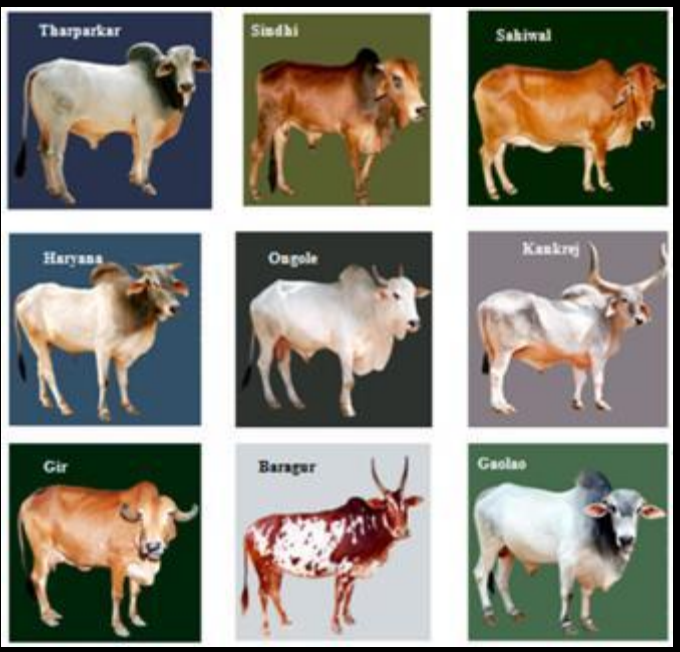
Number of Species in India and the World

Group	No. of Species in India (SI)	No. of Species in the World (SW)	SI/SW (%)
Mammals	350	4629	7.6
Birds	1224	9702	12.6
Reptiles	408	6550	6.2
Amphibians	197	4522	4.4
Fishes	2546	21730	11.7
Flowering Plants	15000	250000	6.0

UNEP – WCMC (2001)

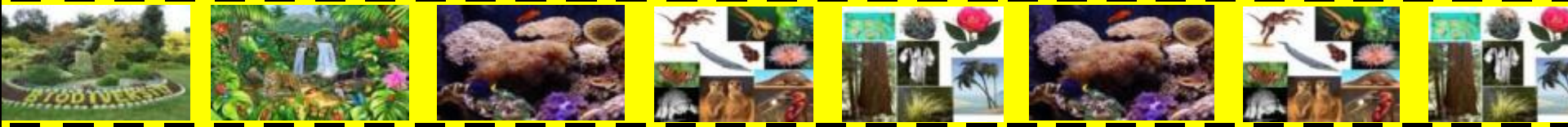
India's biodiversity

Livestock Diversity in India



Species	India
Cattle	30
Buffalo	10
Sheep	42
Goat	20
Donkey	2
Horse	6
Camel	9
Poultry	18
Total	178

Source: NBSAP (2008)



India's biodiversity

Wild relatives of crop plants in India

Crop	No. of Wild Relatives
Cereals and Millets	46
Pulses	81
Fruits	91
Spices and Condiments	28
Vegetables	76
Fibre Crops	15
Oilseeds	14
Miscellaneous plants	28
Total	**379**

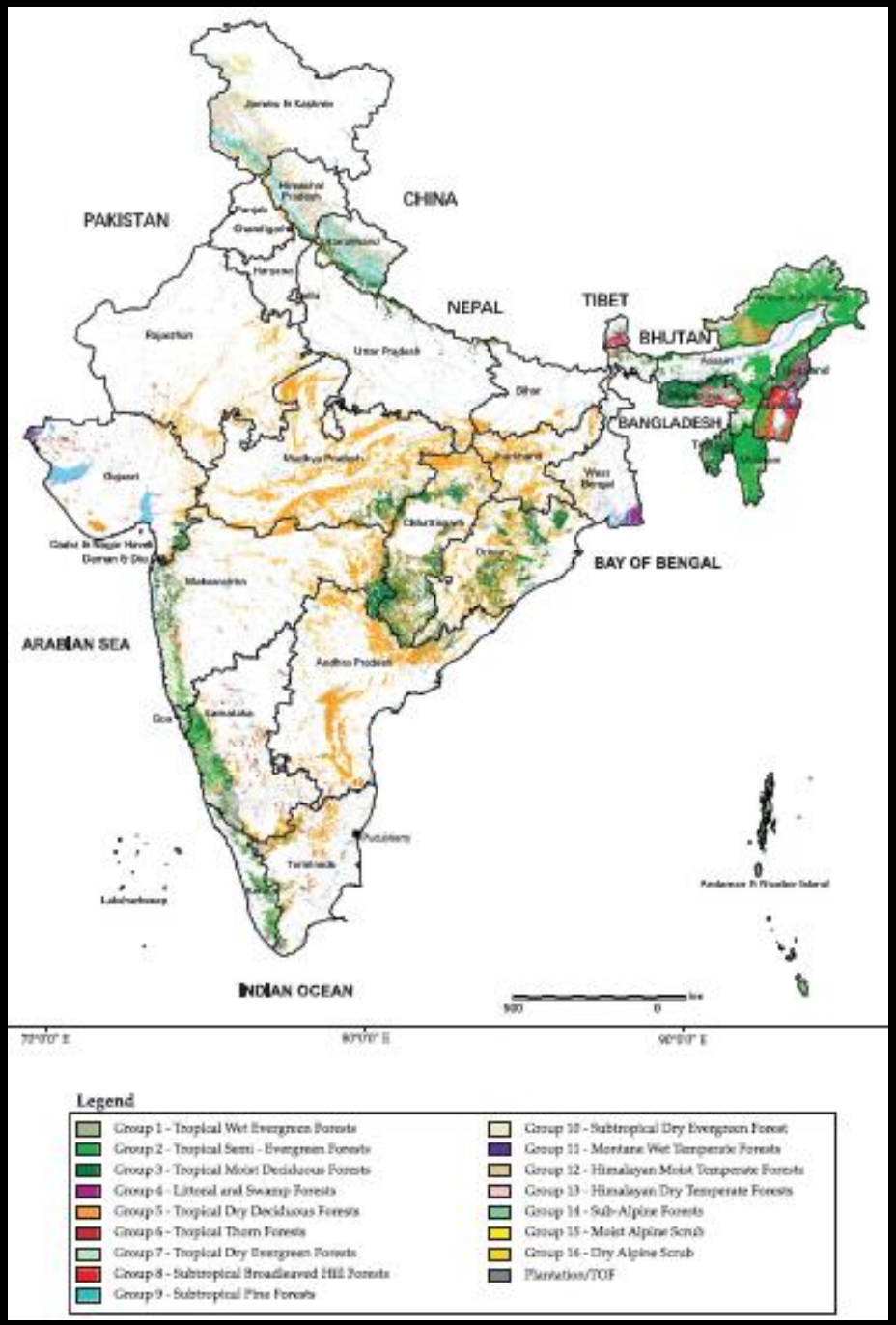
National Symbols: India

Biogeographic zones

Biogeographic Region	Zone	Area (km^2)	% of India's total Geographical Area
Trans-Himalaya	1	1,84,823	5.62
Himalaya	2	2,10,673	6.41
Desert	3	1,97,451	6.01
Semi-Desert	4	5,27,691	16.05
Western Ghats	5	1,32,179	4.02
Deccan Peninsula	6	13,80,339	41.99
Gangetic Plain	7	3,54,848	10.79
Coasts	8	1,19,67	3.64
North-East	9	1,71,340	4.21
Islands	10	8,249	0.25

Forest types: India

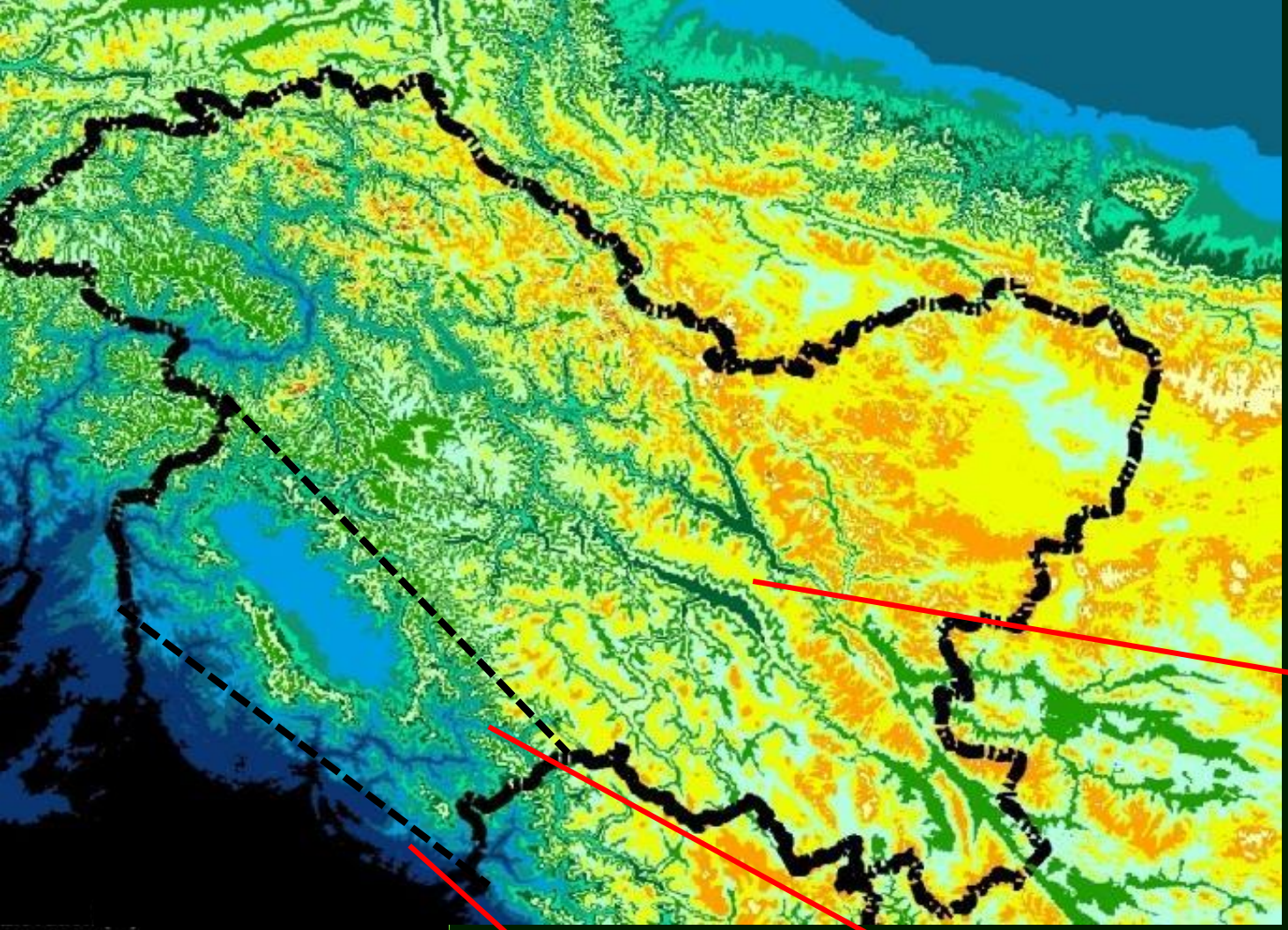
178 Forest types



Plant Diversity: India

Groups of Plant kingdom	No. of Species in World	No. of Species in India
Algae	40,000	7,182
Fungi	72,000	14,588
Lichens	13,500	2,268
Bryophytes	16,600	2,451
Pteridophytes	10,000	1,236
Gymnosperms	650	69
Angiosperms	2,50,000	17,643
Total	4,02,750	45,437

India’s Biodiversity: A Virtual Tour


Trans Himalaya
Siwalik
Greater Himalaya
1 - 500
500 - 1,000
1,000 - 1,500
1,500 - 2,000
2,000 - 2,500
2,500 - 3,000
3,000 - 3,500
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5,500 - 6,000
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6,500 - 7,000
7,000 - 7,500
7,500 - 8,000
8,000
8,500





Floral Diversity




Flora – Endangered, Rare & Threatened

Ponerorchis chusua
Red Data Book

Saussurea costus
Red Data Book

Lichens

Other wildlife resources

YARTSA GOMBU *Cordyceps sinensis*

Morel Mushroom (Guchi)

Trans-Himalaya

Area of Biogeographic Zone (*in sq.km*.)	1,84,823
% of Geographical Area	5.62
Major Conservation Significance	Highly specialized high altitude cold and arid areas of Ladakh, J&K, Lahul & Spiti areas of HP and North Sikkim. Home to a wide range of mountain ungulate species and plants of medicinal importance. Habitat for the biggest wild sheep and goat of the world, snow leopard and black necked crane
Major Conservation Threats	Habitat degradation due to overgrazing by livestock; Conflicts along international borders; plantation of exotic species; unregulated tourism.

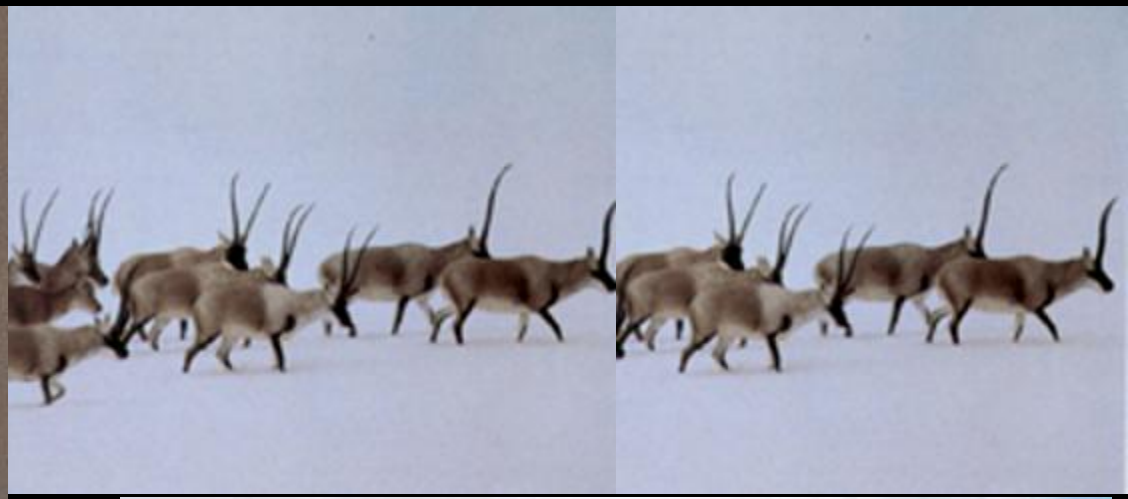
The Trans-Himalaya

Carnivores

Small carnivores

Mountain Ungulates

Tibetan Antelope *Pantholops hodgonii*

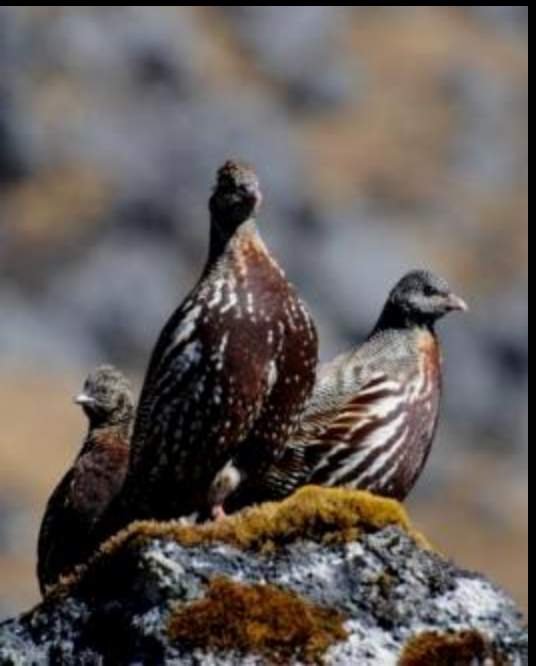


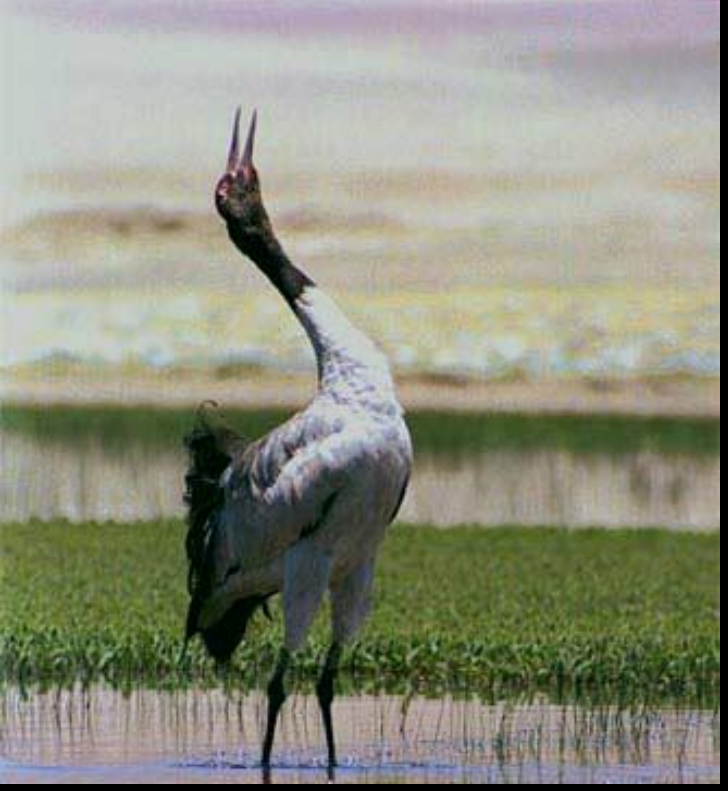
Poaching remains: Tibetan Antelope killed and then skinned by poachers for their fine hair, which is plucked from the hide and then woven into shahtoosh.

Mountain Ungulates

Small Mammals

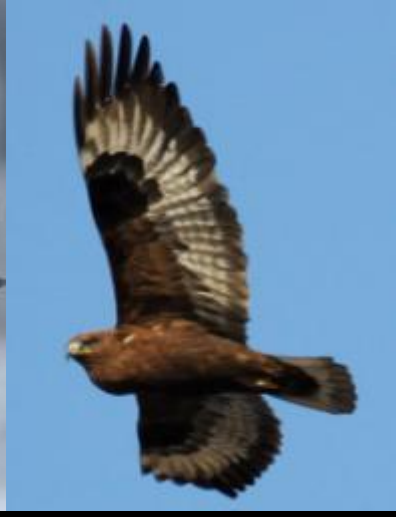
Galliformes





Wetland birds








Other birds

Himalaya

Area of Biogeographic Zone (*in sq.km*.)	2,10,673
% of Geographical Area	6.41
Major Conservation Significance	Unique mountain system of global significance. Repository of wide array of endemic plant and animal species including high agro biodiversity. Habitat for endangered species such as bharal, ibex, thar, takin, hangul and musk deer
Major Conservation Threats	Developmental projects especially hydropower, mining and unplanned tourism; unsustainable shifting cultivation; poaching; overexploitation of medicinal plants.

The Greater Himalaya

Large carnivores

Small carnivores

Mountain Ungulates

Other mountain ungulates

Primates

Mammals of Eastern Himalaya






Galliformes

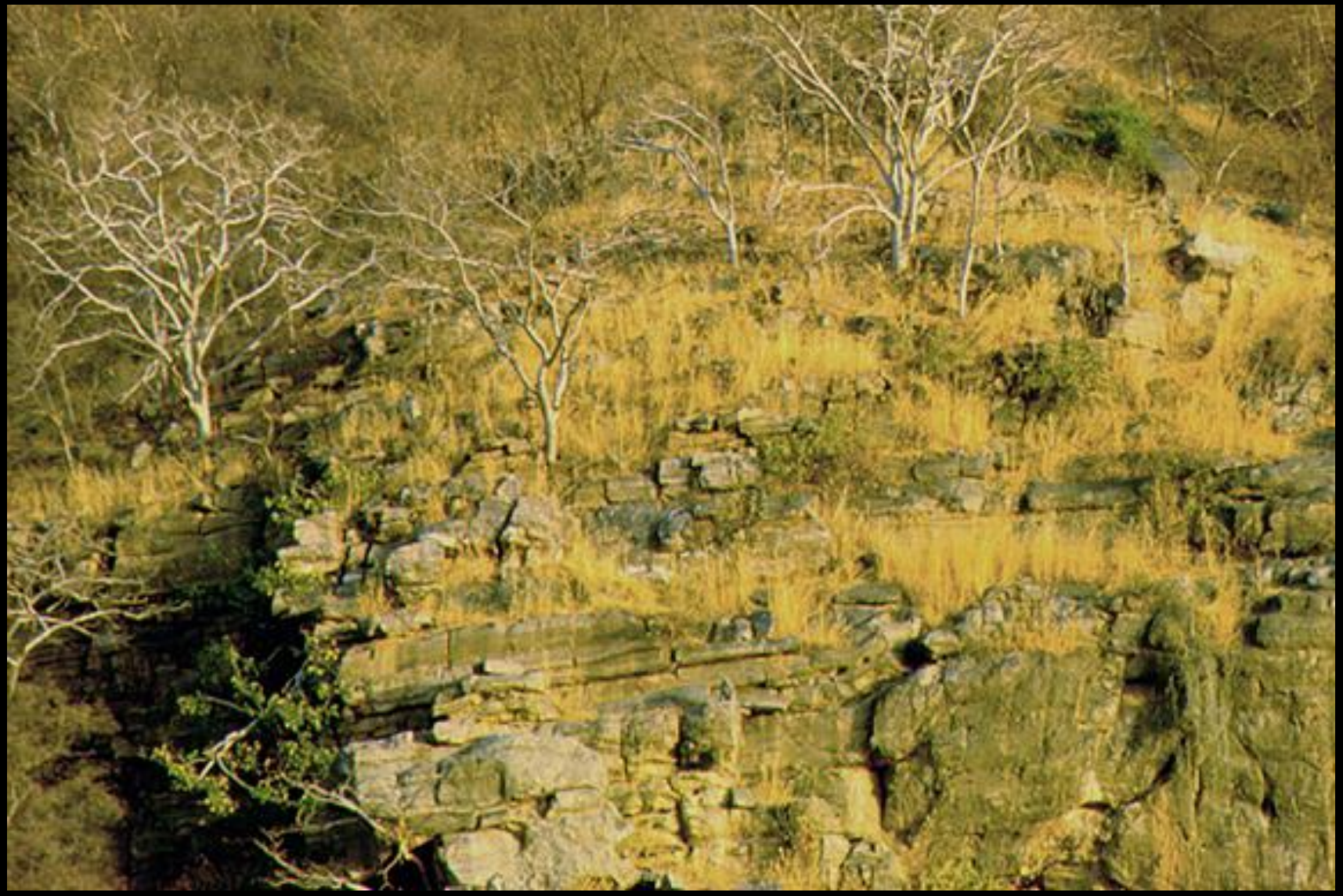
Desert

Area of Biogeographic Zone (*in sq.km*.)	1,97,451
% of Geographical Area	6.01
Major Conservation Significance	Highly specialized desert ecosystem including the desert area of West Gujarat and West Rajasthan. Home to a varieties of desert flora and fauna – wild ass, wolf, caracal, desert cat, houbara bustard and great Indian bustard.
Major Conservation Threats	Overgrazing by domestic livestock; developmental projects especially salt mining and oil/ natural gas exploration, conflicts along international border.


Great Indian Bustard

Semi-Desert

Area of Biogeographic Zone (*in sq.km*.)	5,27,691
% of Geographical Area	16.05
Major Conservation Significance	A transition zone between desert and dense forest of western ghats. Habitat for a variety of ungulate and carnivore species. Biogeographic affinities with Western Asia.
Major Conservation Threats	Intensification of agriculture and mining activities; poaching; overgrazing by livestock grazing.



Western Ghats

Area of Biogeographic Zone (*in sq.km*.)	1,32,179
% of Geographical Area	4.02
Major Conservation Significance	The zone stretches from the hills south of river Tapti in the north to Kanyakumari in the south. One of the two global biodiversity 'hot spot' of India. Very high level of plant endemic species. Habitat for nilgiri langur, lion tailed macaque, malabar hornbill, cane turtle, giant squirrel
Major Conservation Threats	Forest fragmentation; forest fires; Tea/ coffee, rubber and other commercial projects especially hydropower and road transportation.

Deccan Peninsula

Area of Biogeographic Zone (*in sq.km*.)	13,80,339
% of Geographical Area	41.99
Major Conservation Significance	A semi arid region that falls in the rain shadow of western ghats. Covers India's finest forest in the state of Madhya Pradesh, Maharashtra and Orissa. Repository of a wide array of endemic and endangered species including high agro-biodiversity. Habitat for gaur, black buck, wild buffalo, hard ground barasingha
Major Conservation Threats	Forest fragmentation; developmental projects especially industrial and road transportation; invasive species including genetically modified organisms.

Gangetic Plain

Area of Biogeographic Zone (*in sq.km*.)	3,54,848
% of Geographical Area	10.79
Major Conservation Significance	Conserves a wide range of river ecosystems and aquatic fauna; high agro-biodiversity in the flat alluvial region lying north and south of ganges and its tributaries .
Major Conservation Threats	Habitat degradation due to overpopulation and overgrazing by domestic livestock; developmental projects especially industrial and road transportation; spoil erosion.

Coasts

Area of Biogeographic Zone (*in sq.km*.)	1,19,670
% of Geographical Area	3.64
Major Conservation Significance	Repository of a wide array of endemic and endangered coastal and marine species.
Major Conservation Threats	Developmental projects especially aquaculture and ports; unsustainable resource exploitation especially mining of coral limestone and beach sands; Pollution, siltation and erosion.

North-East

Area of Biogeographic Zone (*in sq.km*.)	1,71,340
% of Geographical Area	4.21
Major Conservation Significance	Gateway for much of India's flora and fauna. Represents transition zone between Indo-Malayan and Indo-Chinese region. One of the two global biodiversity 'hot spots' of India. Significant levels of endemism in all animal and plant groups. Diverse set of habitats for primates, hornbills, elephants, rhino *etc.*
Major Conservation Threats	Forest fragmentation; unsustainable shifting cultivation; illicit felling; poaching.

Islands

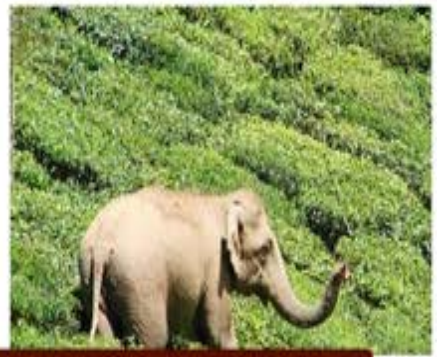
Area of Biogeographic Zone (*in sq.km*.)	8,249
% of Geographical Area	0.25
Major Conservation Significance	Representative of a fragile island ecosystem. Areas of high endemism containing finest evergreen forest and supporting wide diversity of corals. Andamans has Biogeographic affinities with Myanmar and Nicobar have biogeographic affinities with Indonesia.
Major Conservation Threats	Forest fragmentation; developmental projects especially road transportation and excessive tourism; invasive species.

Biodiversity under threat

Indian dolphin, elephant among top 100 mammals facing extinction: Zoological society of London

Kounteya Sinha, TNN | May 20, 2013, 04.10 PM IST

READ MORE » The River | Zoological Society Of London | Wild Elephants | Mammals Extinction | Indian Dolphin



LONDON: India's Gangetic river dolphin and wild elephants figure in the latest 100 top mammals on the verge of extinction.

The Zoological Society of London have for the first time scored the world's mammals according to how Evolutionarily Distinct and Globally Endangered (EDGE) they are.

The list that includes the world's most

Threats to Biodiversity

Habitat destruction

- Overpopulation
- Deforestation
- Pollution
- Climate change













Threats to Biodiversity

Overexploitation

- Overhunting
- Excessive logging
- Poor farming methods

Threats to Biodiversity

Invasive species

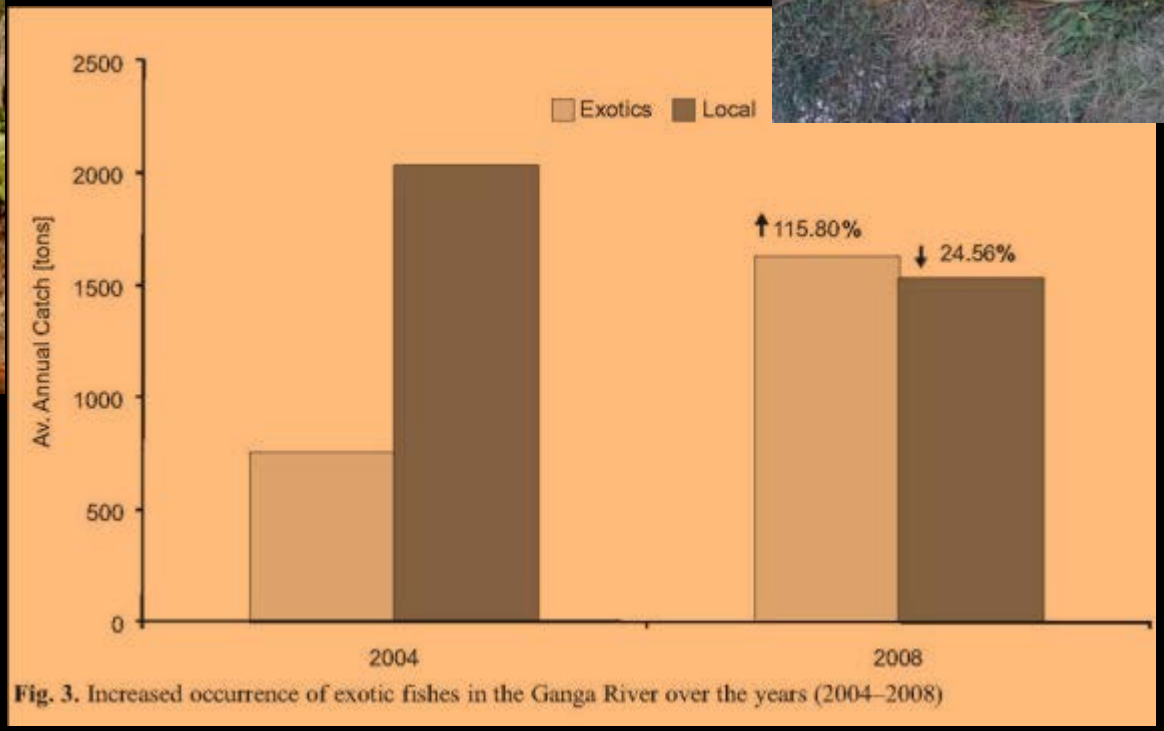


Fig. 3. Increased occurrence of exotic fishes in the Ganga River over the years (2004–2008)

Source: Singh et al. (2010)

Threats to Biodiversity

Poaching causes early extinction!!!














Threats to Biodiversity

Hybridization / genetic erosion

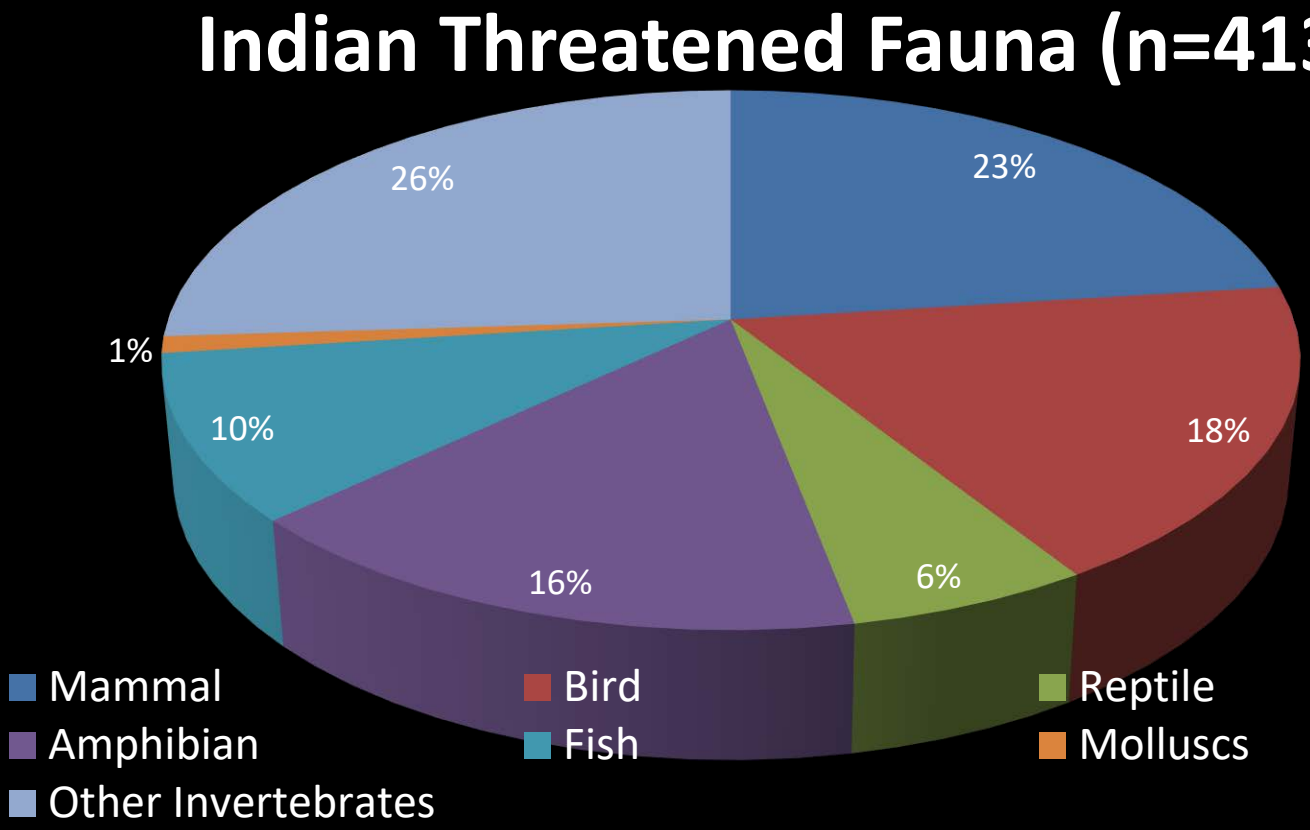
- Hybridization of plants and animals causes loss in genetic diversity
- GM crops have become a common source for genetic pollution

Threats to Biodiversity

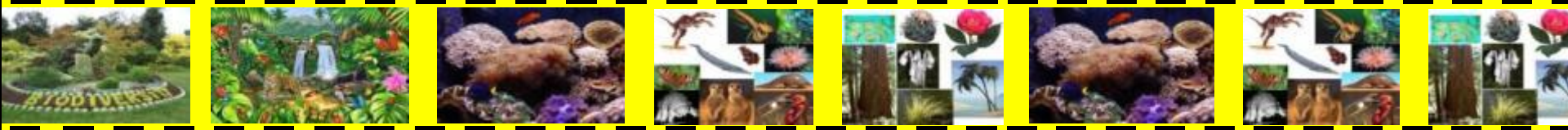
Climate change

- Change in vegetation pattern
  - In India, 68-77% forest areas are likely to undergo vegetation change.
- Mangroves and coral reefs are particularly vulnerable
- Decrease in productivity is likely to represent additional stress on farmlands
- Climate change mitigation measures may also affect biodiversity

Threatened Biodiversity in India



Source: MoEF (2009)



Threatened Biodiversity in India

Breeds Facing Extinction Among Different Livestock Animals in India

Animals	Breeds Facing Extinction
Cattle	Bachaur , Dangi , Kenkatha , Siri , Kherigarh, Rathi, Krishna Valley, Red Sindhi , Sahiwal , Tharparkar , Punganur* , Vechur *, Malnad Gidda, Amrithmahal, Umbalacherry, Kangeyam, Nar
Buffalo	Toda , Nili ravi , Bhadawari, Jaffarabadi, Pandharpuri
Sheep	Nilgiri , Bhakarwal ,Poonchi , Karnah , Gurez, Changtahngi , Muzafarnagari , Chokal , Munjal , Jaisalmeri , Kheri, Bonpalo, Hassan, Bannur (Mandya), Changthangi , Vembur,Kachakatty black
Goat	Jamna pari , Barbari , Surti , Beetal , chegu , Changthangi , Jhakrana, Sangamneri, Tellicheri (Malabari), Gohelwadi, Kanchu Mekha
Camel	Double humped camel , Jaisalmeri , Sindhi
Poultry	All indigenous breeds Aseel, Kadakanth, Chittagang and Maly

Species count below 5000,

Source : Zhihua Jiang (1992)

Conserving Biodiversity

Conserving biodiversity: How?

1. Legislation: Acts and Policies

- Environment Protection Act, 1986
- Fisheries Act, 1897
- Indian Forest Act, 1927
- Forest (Conservation) Act, 1980
- Wildlife (Protection) Act 1972
- Biodiversity Act, 2002
- National Forest Policy
- National Agriculture Policy
- National Land-use Policy
- National Fisheries Policy

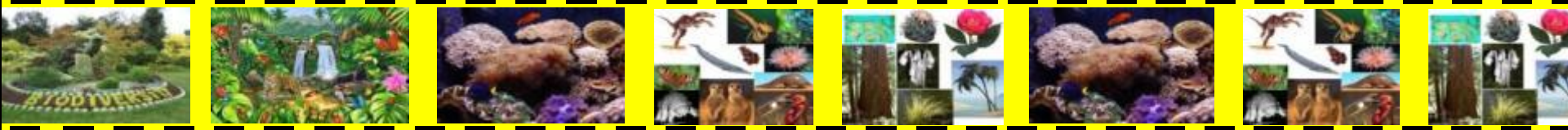
Conserving biodiversity: How?

2. *In-situ* Conservation

- **Establishing Protected Areas**
- **Protected Areas in India**

	Number	Area (Km^2)	% of Geographical Area of India
National Parks	102	39,918.54	1.21 %
Wildlife Sanctuaries	516	1,20,158.13	3.66%
Conservation Reserves	49	1515.60	0.04 %
Community Reserves	4	20.69	0.0 %
Protected Areas	671	161612.96	4.92 %

- **Corridors to connect fragmented habitats**
- **Restoration of degraded habitats**



Conserving biodiversity: How?

3. *Ex-situ* Conservation

- Establishing botanical and zoological gardens; wildlife safaris; agriculture research centre, germplasm bank etc.
- National Bureau of Plant Genetic Resources
- National Bureau of Fish Genetic Resources

Conserving biodiversity: How?

3. Reduction of biotic pressure

- Use alternate resources
- Cultivate / farm the resources outside natural habitat

Conserving biodiversity: How?

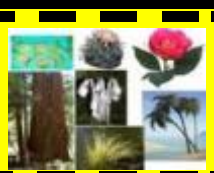
4. Rehabilitation & Reintroduction

- Restocking of depleting population
- Reintroducing the vanished population
- Rehabilitating the displaced individuals from wild
- Reforestation of important species



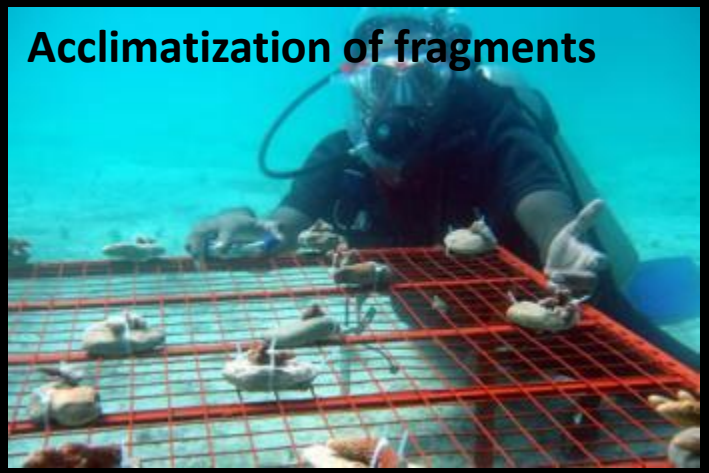


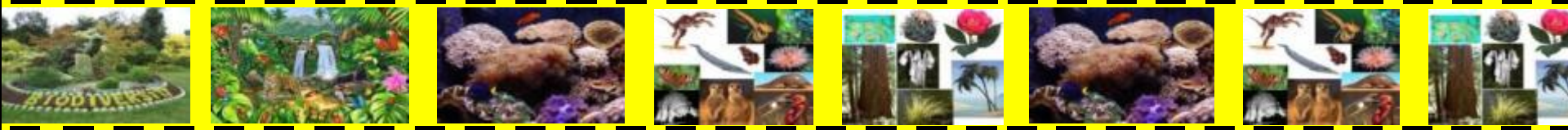





Conserving biodiversity: How?

Coral Transplant in Gujarat: An Example

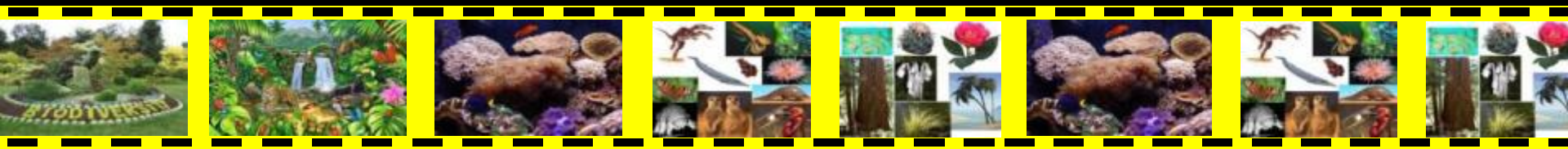




Conserving biodiversity: How?

5. Knowing what's all around?

- Inventory on biodiversity
- Assessment of status
- Assess the threats

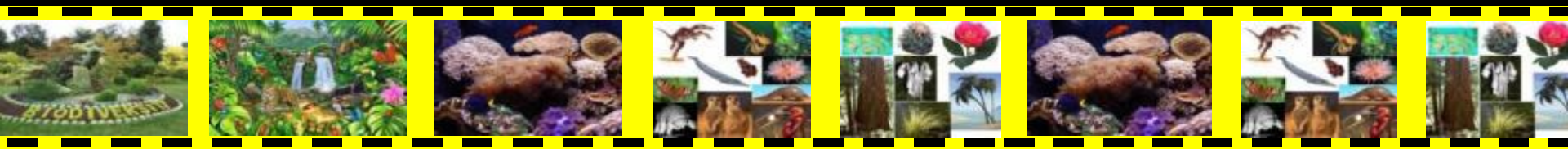


Conserving biodiversity: How?

6. Respect traditions and traditional knowledge

Festivals play important role in conservation of local biodiversity

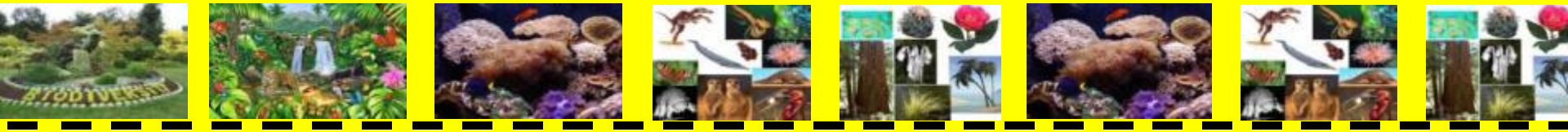
Document the traditional knowledge of communities on local flora and fauna…before it gets lost



Conserving biodiversity: How?

7. Ensure community participation in biodiversity conservation

- Involve local communities in planning, management and monitoring of conservation programs
- Successful conservation strategies will have to have the confidence and participation of the local communities.



Conserving biodiversity: How?

Sacred Groves

Conserving biodiversity: How?

8. International Conservation Strategies

- Conserving biodiversity is a crucial global concern

The Convention on Biological Diversity (1992)

The Convention on International Trade in Endangered Species of Wild Flora and Fauna (1975)

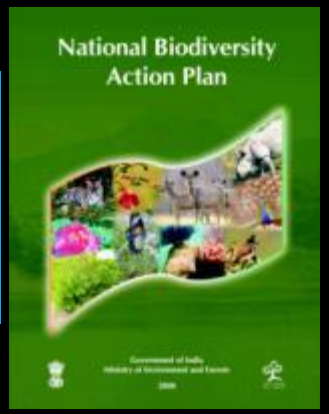
The Convention on Wetlands of International Importance (1971)

World Heritage Sites

Conserving biodiversity

India's Initiatives

- Enactment of Biological Diversity Act (2002)
- Notification of Biological Diversity Rules (2004)
- Preparation of National Biodiversity Action Plan



- Establishment of National Biodiversity Authority
- Establishment of State Biodiversity Board
- Constitution of Biodiversity Management Committee at local level

We should preserve every scrap of biodiversity as priceless while we learn to use it and come to understand what it means to humanity.

– E.O. Wilson