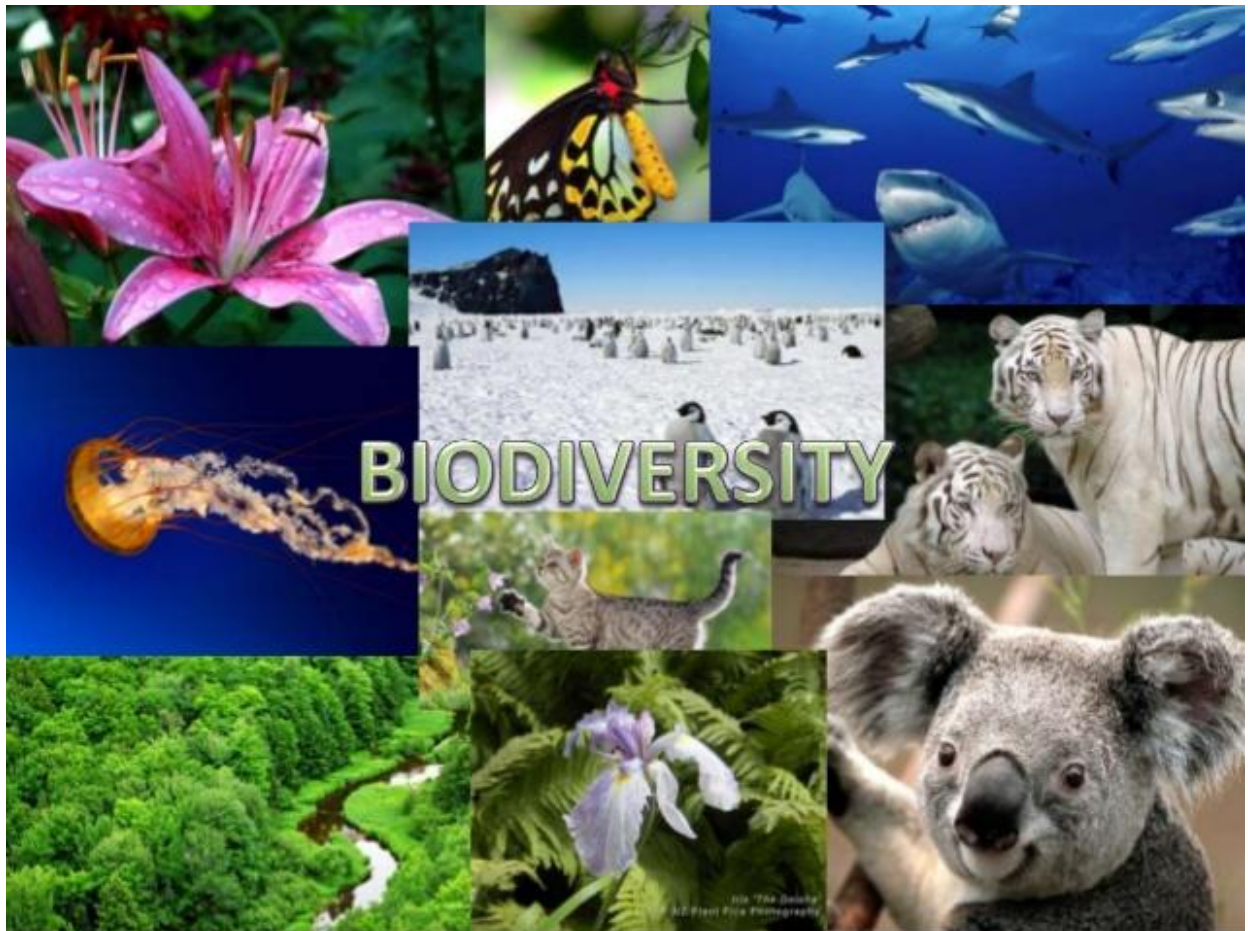


**TRAINING MATERIAL**  
**ON**  
**BIODIVERSITY CONSERVATION AND MANAGEMENT**



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## **BIODIVERSITY CONSERVATION AND MANAGEMENT- FRO Syllabus**

Theory –45

Practical- 10

### **Part I (10)**

Biodiversity: Definition, gene level, species level and ecosystem level. Value of Biodiversity, ecological, economic and other values. India as a mega diversity country, Biogeographic regions of India, Endemic centers of India and an overview of endemism in flora and fauna.( 5 )

Introduction to Plant and Animal Kingdom ( 5 )

### **Part II (5)**

Mega fauna of India, occurrence, distribution, present status and elementary ecology concerning Asian Elephant, Tiger, Rhinoceros, Musk deer, Gaur, Hoolock Gibbon, Nilgiri Tahr.

An overview of Avifauna in India and Ramsar wetlands in India.

### **Part III (5)**

-Conservation ethos of India. Wildlife Management definition, concept of carrying capacity, population structure, density and biomass, Home range and territory and an introduction to Ethology.

-Need for Protected Area Network, National Parks and Sanctuaries of India with special emphasis on Kanha-National Park, Keibul Lamjao of Manipur, Bandipur, Gir, Gulf of Mannar (Coral reef Management), Namdapha National Park, their location, extent, flagship species, habitat description, major conservation measures, man animal conflict and an assessment of sources of threats to those protected areas.

-The concept of Eco-development.

#### **Part IV (5)**

In situ and Ex situ conservation and the role of gene banks. Conservation breeding and Reintroduction. National Institutions involved in conservation. Role of NGOs in conservation of natural resources. Ecotourism.

#### **Part V (10)**

-Ecological sampling Techniques, belt, quadrat and point techniques for enumeration of plants. Line transect analysis and other popular census techniques for animals. Causes of extinction, habitat destruction and degradation, fragmentation of habitat, introduction of alien species and other factors.

-Examples of critically endangered biota of India.

#### **Part VI (5)**

International conventions concerning biodiversity CITES, CBD, intellectual property rights, Bio piracy. Wildlife(Protection) Act, 1972 and Forest Conservation Act, 1980 as corner stones of conservation in India. Biodiversity Bill/Act,

Environmental pollution, Environmental laws and Environmental Impact Assessment.

#### **Part VII**

##### **Biodiversity Conservation: (5)**

1. Ecological & geopolitical significance of biodiversity
2. Biosphere reserves, with special reference to India.

##### **Practicals- Ecological Census Techniques (10)**

## **CHAPTER: 1**

### **BIODIVERSITY: LEVELS, HOTSPOTS**

#### **What is Biodiversity?**

- Biodiversity is comprised of all life forms within a given ecosystem, biome or the entire Earth.
- Variation of life at all levels of biological organization.
- Totality of all genes, species and ecosystem in a region.
- Is a measure of the relative diversity among organisms present in different ecosystems.

#### **Definition**

“The variability among living organisms 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 of ecosystems”.

-Rio Earth Summit ('92) - adopted by the Convention on Biological Diversity (CBD).

It is regarded as the manifestation of ecological processes over space and time.

Hence Biodiversity is often regarded as a as a measure of the health of biological systems.

Biodiversity found on Earth today is the product of four billion years of evolution and consists of many millions of distinct biological species that are extant, still evolving or extinct.

Biodiversity is the result of:

- Co-evolution
  - Resilience
  - Adaptation.
- It is bio centric in origin but rather anthropocentric in direction.
- It is estimated that 70% of the Biodiversity exists within the forest ecosystems.

## **Biodiversity Originated from the words Biology and Diversity**

- The term “Natural diversity” and “*Biological diversity*” was used during 1970s by conservation scientists like Jenkins and Lovejoy
- The word “*Biodiversity*” itself may have been coined by W.G. Rosen in 1985
- Entomologist E. O. Wilson popularized the term in his book “Biodiversity”

## **LEVELS OF BIODIVERSITY**

- **Genetic Diversity** - Diversity of genes within a species. This is a genetic variability among the populations and the individuals of the same species such as varieties. It is the real diversity as gene controls speciation and evolution
- **Species Diversity** - Diversity among species in an ecosystem. It is most visible
- **Ecosystem Diversity** - Diversity at a higher level of organization, the ecosystem. Diversity of habitat in a given unit area. It related to interactions between species and environment

## **Types of Ecological Diversity**

**Alpha Diversity** refers to diversity within a particular area, community or ecosystem, and is measured by counting the number of taxa within the ecosystem (usually species)

**Beta Diversity** is species diversity between ecosystems; this involves comparing the number of taxa that are unique to each of the ecosystems.

**Gamma Diversity** is a measure of the overall diversity for different ecosystems within a region.

## **Sources of our Wildlife**

Our country consists of:

- **Two Realms:**
- Himalayan region from the **Pale arctic Realm**
- Rest of the Continent represented by the **Malayan Realm**

### **Five Biomes:**

- Tropical Humid Forests,
- Tropical Deciduous Forests,
- Conifer Forests,
- Warm Deserts and Semi-Deserts,
- Grasslands & Alpine Meadows

### **Ten Bio geographical Zones**

### **Twenty Six Biotic Provinces**

### **12 Mega diversity countries of the world - *Mc Neely et al (1988)***

| Countries   | No.of<br>Mammals | No.of<br>Birds | No. of<br>Reptiles | No. of<br>Amphibians | No. of<br>Angiosperms |
|-------------|------------------|----------------|--------------------|----------------------|-----------------------|
| Australia   | 255              | 740            | 686                | 197                  | 23,000                |
| Brazil      | 428              | 622            | 467                | 516                  | 55,000                |
| China       | 394              | 1195           | 270                | 265                  | 27,000                |
| Columbia    | 359              | 1721           | 383                | 407                  | 45,000                |
| Ecuador     | 280              | 1447           | 345                | 358                  | 15,000                |
| India       | 350              | 1200           | 353                | 197                  | 15,000                |
| Indonesia   | 515              | 1519           | 600                | 270                  | 20,000                |
| Madagascar  | 131              | 250            | 269                | 144                  | 10,000                |
| Malaysia    | 293              | 1200           | 294                | 171                  | 15,000                |
| Mexico      | 449              | 1010           | 717                | 282                  | 25,000                |
| Peru        | 361              | 1750           | 297                | 251                  | 20,000                |
| Congo/Zaire | 409              | 1086           | 280                | 216                  | 10,000                |

### **Biodiversity Hotspots in India:**

- The **Eastern Himalayas** and the **Western Ghats** are amongst the 32 designated Biodiversity hotspots on Earth.
- The 12 Mega diversity nations hold **70% of our Biodiversity**.

### **Extent of Biodiversity: PLANTS ( ref: MoEF, 1998)**

|                |             |
|----------------|-------------|
| • Bacteria     | : 4,000     |
| • Fungi        | : 72,000    |
| • Algae        | : 40,000    |
| • Bryophyte    | : 16,000    |
| • Pteridophyte | : 13,000    |
| • Gymnosperms  | : 750       |
| • Angiosperm   | : 2, 50,000 |

### **Animals (ref: McNeely, 1990)**

|                            |           |
|----------------------------|-----------|
| • Protozoa                 | :30800    |
| • Sponges                  | :5000     |
| • Coelenterates            | :9000     |
| • Round worms & Earthworms | :24000    |
| • Crustaceans              | -38000    |
| • Insects                  | :7,51000  |
| • Other arthropods         | -1,32,461 |
| • Mollusks                 | :50,000   |
| • Echinoderm               | :6100     |

***Chordates (ref : MoEF, 1998)***

- Fishes : 21723
- Amphibians : 5145
- Reptiles : 5860
- Birds : 9672
- Mammals : 4629
- **Grand Total (Plants & animals) : 17, 19,183 species ( from MoEF, 1998)**

**Conservation Vs Preservation**

Conservation is the management of human use of the Biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspiration of future generation

Conservation is a utilitarian concept and includes

- Preservation.
- Maintenance.
- Sustainable utilization.
- Enhancement & Restoration of living resources.

**Conservation Vs Management**

- Conservation is the logic of intervention
- Management is the technology of intervention
- It is a process of manipulation of the specific system or say forest environment

## **CHAPTER: 2**

### **MEASUREMENT OF BIODIVERSITY**

- Species diversity has two components:
- **Species Richness**: refers to the total number of species in an ecosystem
- **Species Evenness**: refers to the relative equitability of the various species in the system or even allotment of individuals among species
- Although diversity can be measured directly, it is better expressed as an Index that incorporates both Richness and evenness into a single value for a community
- Major indices are:
  - Simpson Index
  - Shannon- Weiner Index

#### **SIMPSON INDEX**

The statistic, C is given by

$$C = \sum_i^{s_{obs}} p_i^2 \quad p_i^2 = \frac{N_i(N_i - 1)}{N_T(N_T - 1)}$$

where  $N_i$  is the number of individuals in the  $i$ th species and  $N_T$  the total individuals in the sample.

Index is given by  $D = \frac{1}{C}$

- the larger its value the greater the diversity.
- The statistic C gives a measure of the probability of the next encounter being with another species.

- Simpson's Index is heavily weighted towards the most abundant species in the sample and less sensitive to Spp. Richness.
- Nevertheless, it is one of the most meaningful and robust diversity measures available as it is based on the variance of the species abundance distribution.

### Calculation

Assume a community has 5 species and population of each represented by

S1 =100; S2 =150; S3 = 125; S4 = 175 and S5= 250

Total population N = 800

Simpson Index =  $100 \times 99 + 150 \times 149 + 125 \times 124 + 175 \times 174 + 250 \times 249 / 800 \times 799$

$= 9900 + 22350 + 15500 + 30450 + 62250 / 639200 = 140450 / 639200$

### Shannon- Weiner Index

Index is given by H

$$H' = - \sum_{i=1}^S p_i \ln p_i$$

- $S$  The number of species; also called species richness.
- $p_i$  The relative abundance of each species, calculated as the proportion of individuals of a given species to the total number of individuals in the community  $n/N$
- $N$  The total number of all individuals
- $n_i$  The number of individuals in species  $i$ ; the abundance of species  $i$ .

### **Shannon –Weiner Index and Evenness**

- It is said to be an insensitive measure of the character of the S:N relationship and is dominated by the abundant species.
- The value of the Shannon-Wiener Index usually lies between 1.5 and 3.5 for ecological data and rarely exceeds 4.0

- Evenness Index =  $H / \ln S$

### **Calculation:**

- As in earlier example,  $p_1 = n_1/N = 100/800 = 0.125$ ;  $p_3 = n_3/N = 125/800 = 0.156$ ;  $p_2 = n_2/N = 150/800 = 0.187$ ;  $p_4 = 175/800 = 0.219$ ;  $p_5 = 250/800 = 0.313$ .
- ShannonIndex =  $0.125 \times \ln 0.125 + 0.187 \times \ln 0.187 + 0.156 \times \ln 0.156 + 0.219 \times \ln 0.219 + 0.313 \times \ln 0.313$

### **Biodiversity Values**

#### **DIRECT VALUES**

- Consumptive Use value (Non-market value)
- Productive Use value (Commercial value)

#### **INDIRECT VALUES**

- Non-consumptive Use Value (scientific research etc.)
- Option Value (value of maintaining options available for the future)
- Existence Value (value of ethical feelings of existence of biodiversity)

### **Direct Values**

- Concerned with the satisfaction received directly by consumers of biological resources.
- Consumptive use value is concerned with products that are consumed directly without passing through a market.
- Firewood and dung provide over 90% of the energy needs in Nepal, Tanzania etc (Pierce et al 1987), although seldom appear in National Income computations.
- In African countries like Botswana, Ghana etc. more than 50% of the protein needs met from wild life meat.

- Study in Malaysia: wild boars harvested by hunters had a market value of over \$ 100 million per year (Caldecott,1988) – computed through assigning a price on the product that would have fetched if sold.

### **Direct Value- Productive Use Value**

- Related to products that are commercially harvested for exchange in markets.
- Timber, Fuel wood, fish, animal articles, fruits, dyes etc. 27 million tons in 2006 in India.
- Extent of international wildlife trade annually is estimated to be worth us\$ 20 billions— about 30% being illegal which is next only to trade in narcotics and arms.
- International annual trade to the tune of:
  - 40,000 monkeys and other primates
  - 2-5 million live birds: falcon, parrots, myna
  - 2-3 million live reptiles
  - 10-25 million reptile skins
  - 500-600 million ornamental fish
  - 1000-2000 tonnes of corals
  - 7-8 million cactii
  - 9-10 million orchids

### **Non-Consumptive Use**

- Photosynthetic fixation of solar energy by green plants and its transfer to the food chain
- Ecosystem functions like pollination, gene flow, cross fertilization, species with genetic traits useful for economic species, maint. of evolutionary processes for continued survival of life
- Water cycles, protecting water sheds and buffering the extremes
- Regulation of climate at both micro and macro levels
- Soil protection and production

- Storage and recycling of essential nutrients
- Absorption and break down of pollutants
- Provision of recreational-aesthetic, socio cultural, scientific, educational, spiritual and historical values Eg: Ecotourism

- Viewing value of elephants in Kenya is estimated to be \$ 25 million per yr

(Brown & Henry, 1993)

- The East Calcutta wetlands covering 10,685 ha support a population of one lakh, provides direct employment to 70,000 people, produces 1.28 lakh Qtl of paddy, 69000 Qtl of fish, 7.3 lakh qtl of vegetables ( ISI, 1999)

- Recreational use of forests is estimated to be \$ 79.5 million per year in UK

(Willis, 1991)

### **Option Value**

- Assigning a value to risk aversion in the face of uncertainty
- The best preparation to face any unpredictable events is to have a safety net of diversity.
- Natural habitats preserve a reservoir of continually evolving genetic material – irrespective of whether their values are recognized yet.
- Hence the society as a whole may be willing to pay to retain the option of having future access to a given species or level of diversity.
- Hence the conventional cost-benefit relationships need to incorporate the higher future values and the irretrievability of lost opportunities of biological resources and natural environments.
- Philosophy behind spending on NP and WLS?

## **Existence Value**

- Related to the ethical value which reflects the sympathy, responsibility and concern that some people feel towards preserving species and ecosystems.
- People may get the satisfaction that the oceans holds the whales, Himalayas have snow leopards, African Savannah has Antelopes, although they have no intention of ever visiting these places.
- Accurate economic evaluation is impossible.
- But the sizable voluntary contribution by many conservation and philanthropic agencies is a pointer to its magnitude.
- WWF alone receives more than \$ 100 million per year as donations.

## **THREAT TO BIODIVERSITY**

### Habitat alteration and fragmentation

- monoculture and conversion
- degradation

### Over-harvesting

- exploitation by man
- over grazing by livestock
- poaching (illegal harvesting)

### Pollution

- By direct chemical pollutants
- Pollution through indirect means

### Introduced Species

- wreak havoc in island ecosystem
- weeds like Parthenium spp.

## Population pressure

- Currently about 5 Billion
- more pressure on natural resources

## Climate change

- CO2 Build up
- Vegetation shift at regional level

- Extent of tropical forest remaining is between 800 million to 1200 m.ha
- On an average about 11.1 m ha are eliminated every year (UNEP). Globally about 0.6% are destroyed every year and Indian figure stands at 0.3%. Nepal :4.3%, Sri Lanka: 3.5%, Malaysia: 1.2%, Paraguay: 4.7%, Costa Rica: 4% Nigeria : 5%

## **Population Pressure**

Over last 100yrs ( in India).....

- Human population increased by four times
- Economy grew by 14 times
- Energy needs grew by 15 times
- Green house gas emission increased by 17 times
- Reduction in forest cover by 20 percent
- Area under agriculture doubled and best areas and wetlands were converted to Agri. Lands.
- Development projects, roads, canals etc.
- Demand for Timber and Firewood is ever increasing.
- Current production is 27 million tonnes and by 2010 demand is expected to grow to 82 million tonnes.

- Average CAI is about 2 c.m./ha/yr vis-à-vis annual withdrawal of about 5-6 in highly populous areas.

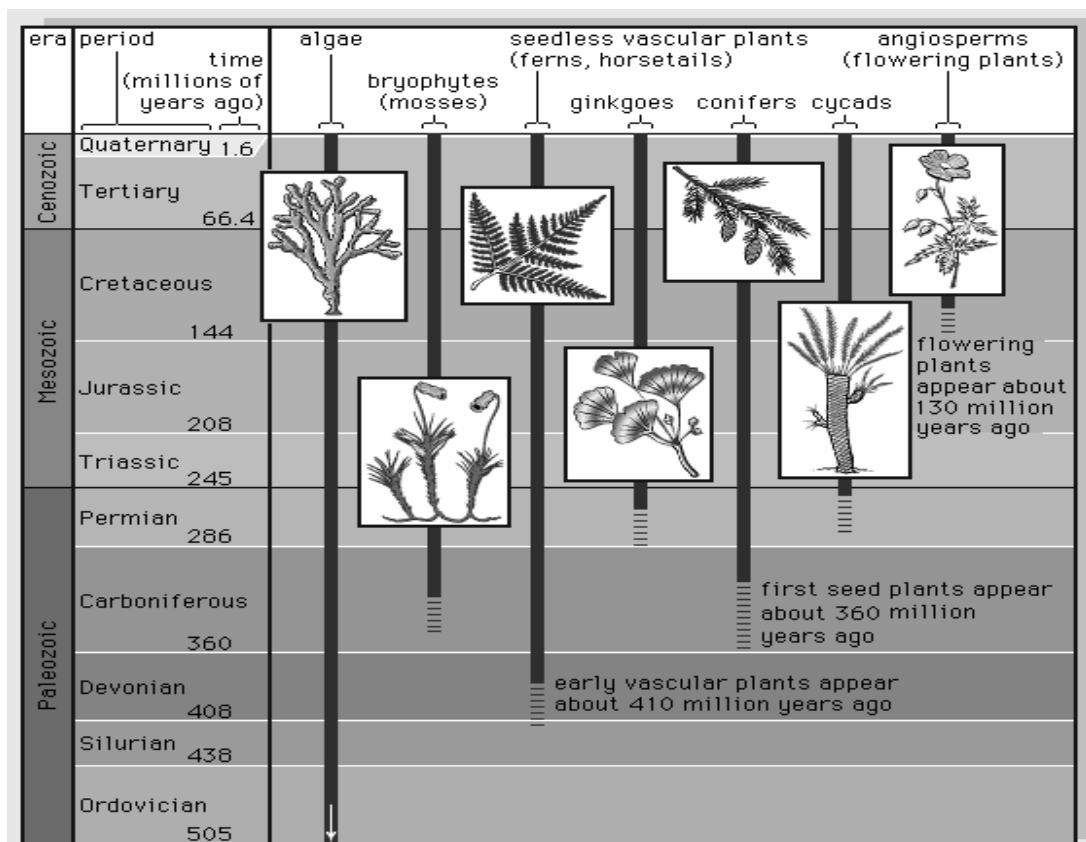
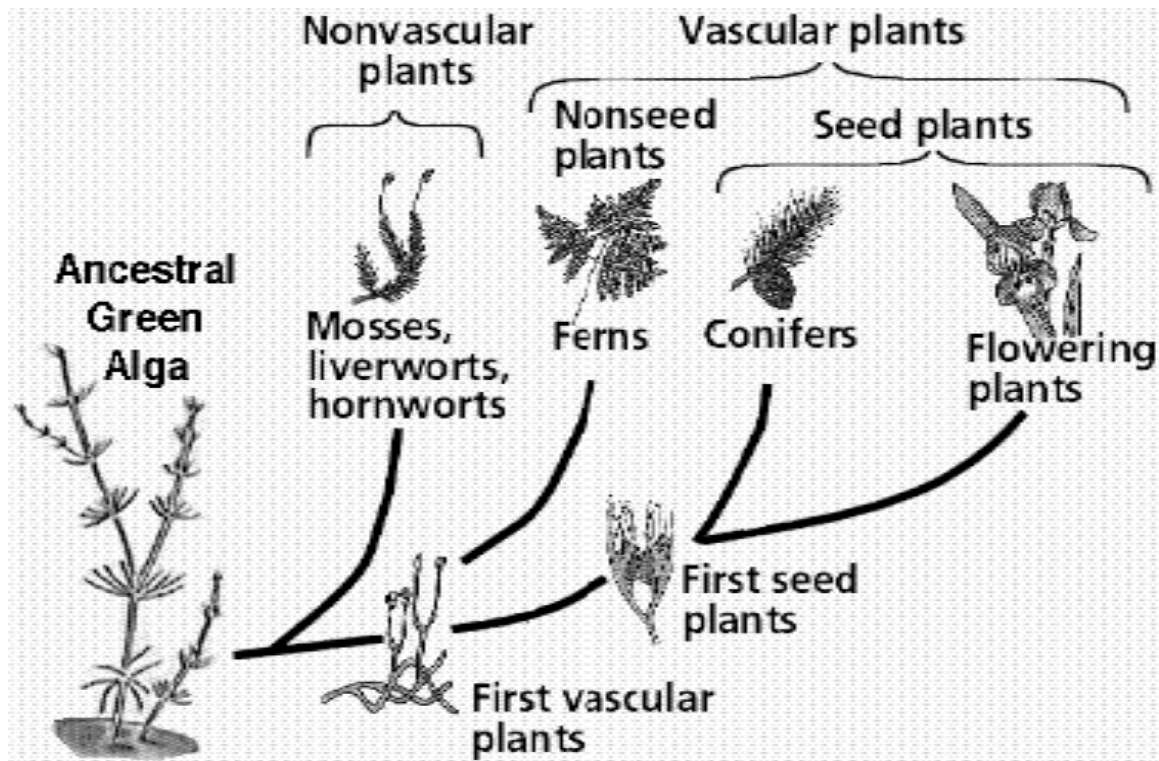
### **Biotic Pressure**

- India occupies 2.4% of the global space but holds 16% of the world's population and 9% of the global biodiversity.
- In India, the cattle population is about half of human population.
- FRI Study - cattle carrying capacity of Indian forests is 60 cattle /100ha  
( 4 crores -ideal Vs 40cr. - actual)
- Cattle on an average consume about 5 kg fodder
- we have seldom any grazing lands in India and most cattle are forest dependent.
- Religious sentiments in eliminating unproductive cattle.

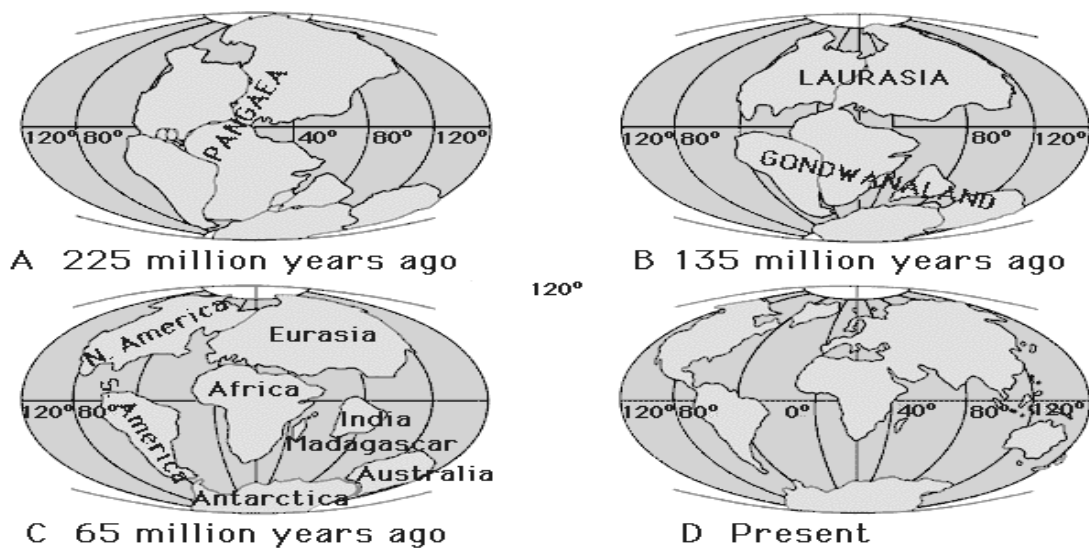
## CHAPTER: 3

### PLANT LIFE FORMS

#### Evolution of Plant Kingdom:



### *Evolution of plants over ages*



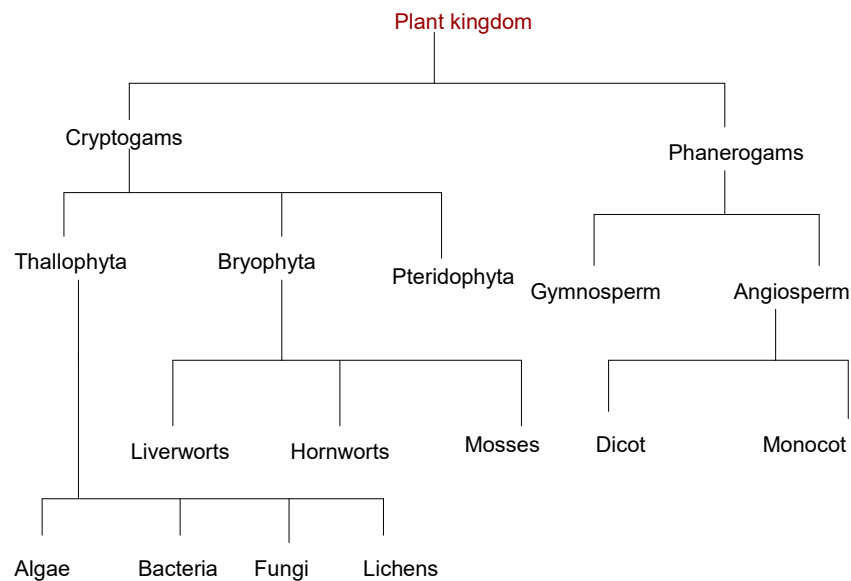
### *Theory of Continental Drift and dispersion of wildlife*

#### **Floristic Diversity of India**

| Organisms    | Species Described |          | %     |
|--------------|-------------------|----------|-------|
|              | India             | World    |       |
| Bacteria     | 850               | 4000     | 21.25 |
| Algae        | 6500              | 40,000   | 16.25 |
| Fungi        | 14,500            | 72,000   | 20.14 |
| Lichens      | 2000              | 17,000   | 11.80 |
| Bryophytes   | 2850              | 16,000   | 17.80 |
| Pteridophyte | 1100              | 13,000   | 8.46  |
| Gymnosperms  | 64                | 750      | 8.53  |
| Angiosperm   | 17,500            | 2,50,000 | 7.00  |

(MoEF, 1998)

- Area of the country is only 2% of the world's total landmass, but India harbours about 45,000 plant species ( 0.4 million are known in the world), representing as much as 11% known world flora.
- Overall, including animals it is 7.36%
- Total flowering plants : 17,500
- Genera : 4000
- Families : 315
- Largest family – Poaceae : 260 genera, 12,00 species.
- 2 Biodiversity Hot Spots – Eastern Himalayas & Western Ghats
- India have over 40 sites which are known for high endemism & genetic diversity



**Cryptogams** = Non Seed bearing plants;

**Phanerogams**= Seed bearing plants;

**Gymnosperms**= seed is not covered with a fruit;

**Angiosperms**= Seed is covered (within a fruit)

## **ALGAE**

- Plant body is not differentiated into root stem & leaves
- Autotrophic plants and has chlorophyll
- Grow in water & are of various forms
- study of algae- Phycology
- Algae show tremendous diversity of form, habitat, and lifestyle  
unicells, colonies, filaments, foliose....to more complex.....

### **Major Groups of ALGAE** ( *Alga is singular and Algae is plural*)

- Cyanophyceae : Blue Green Algae
- Chlorophyceae : Green Algae
- Bacillariophyceae : diatoms
- Phaeophyceae : Brown Algae
- Rhodophyceae : Red Algae

## **Fungi**

- Non green thallophytes containing no chlorophyll.
- Grow mostly on land as parasites or as saprophytes.
- It is classified as :-
- Myxomycetes (Slime fungi)
- Phycomycetes (Alga like fungi)
- Ascomycetes (Sac fungi)
- Basidiomycetes (Club fungi)
- Deuteromycetes (Imperfect fungi)

## **Lichens**

Symbiotic association between Algae and Fungi ( in complex interwoven mesh of filaments) in which algae provide food and fungi provide nutrients.

**Lichens follow 3 different patterns:-**

- Crustose lichens
- Foliose
- Fruiticose

## **Bryophyta**

Higher cryptogams and amphibious nature;

These are called the Ambhhibians of Plant kingdom

- plant body may be thalloid or leafy
- Have root like structures called rhizoid
- Conducting tissue is simple
- Grows on damp wall or moist ground & on the bark of trees.

**It is divided into:**

1. Liverworts
2. Hornworts
3. Mosses

## **Pteridophyta (Fern like plants)**

- Class 1- Psilotopsida  
order – Psilotales
- Class 2 – Lycopsidea , order –Lycopodiales, Selaginellales, Isoetales

- Class 3 – Sphenopsida

order – Equisetales

- Class 4 - Pteropsida

Sub class – Eusporangiate

order – Ophioglossales , Osmundales, Marattiales

Sub class – Leptosporangiate

order – Filicales, Marsileales, Salviniales

### **Gymnosperms**

- Naked Seeds”
- • Seeds borne on open surfaces (cones)
- • Male and female structures are separate
- (male/female cones)
- Mostly wind pollinated

Orders

- **Cycadales**
- **Coniferales**
- **Ginkgoales**
- **Gnetales**

**Cycadales:** *Cycads are dioecious i.e. Male & female flowers are borne by two separate plants. Male flower is a cone borne on the apex of the stem, which then grows by a lateral bud.*



Cycas- female cone



Pine with cone

Gingo biloba, a living Fossil



**Coniferales** - 6 families

- Taxaceae
- Pinaceae
- Cupressaceae
- Podocarpaceae
- Taxodiaceae
- Araucariaceae

*Gnetum* are very large climbers seen in evergreen forests and looks similar to Angiosperms in leaves and fruits.



### **Classification of Angiosperms (Bentham & Hooker)**

#### ***I. DICOTYLEDONS***

##### **1. POLYPETALAE**

###### **i) HALAMIFLORAE**

- DILLENACEAE
- MAGNOLIACEAE
- ANNONACEAE
- BERBERIDACEAE
- NYMPHACEAE.
- PAPAVERACEAE
- CRUCIFERAE

###### **ii) DISCIFLORAE**

- MALPIGHIACEAE;
- GERANIACEAE;
- RUTACEAE;
- MELIACEAE

###### **iii) CALYCIFLORAE**

- LEGUMINOSAE
- ROSACEAE
- RHIZOPHORACEAE
- COMBRETACEAE
- MYRTACEAE
- LYTHRACEAE

## **2. GAMOPETALAE**

### **i) INFERRAE**

- CAPRIFOLIACEAE
- RUBIACEAE
- COMPOSITAE
- CAMPANULACEAE.

### **ii) BICARPELLATAE**

- APOCYNACEAE
- ASCLEPIADACEAE
- CONVOLVULACEAE
- SOLANACEAE
- SCROPHULARIACEAE
- BIGNONIACEAE
- ACANTHACEAE.
- MYOPORACEAE
- VERBENACEAE
- LABIATAE

### **iii) HETEROMERAE**

- ERICACEAE
- PRIMULACEAE
- MYRSINACEAE
- SAPOTACEAE
- EBENACEAE

### ***3. MONOCHLAMYDEAE***

- NYCTAGINACEAE
- AMARANTHACEAE
- POLYGONACEAE.
- NEPENTHACEAE
- RAFFLESACEAE.
- ARISTOLOCHIACEA
- PIPERACEAE
- MYRISTICACEAE
- LAURACEAE
- LORANTHACEAE
- SANTALACEAE.
- EUPHORBIACEA
- URTICACEAE
- JUGLANDACEAE
- CASUARINACEAE
- BETULACEAE
- SALICACEAE

### ***II. MONOCOTYLEDONS***

- ORCHIDACEAE
- ZINGIBERACEAE
- BROMELIACEAE
- IRIDACEAE

- AMARYLLIDACEAE

- LILIACEAE

PALMAE.

TYPHACEAE

ARACEAE;

CYPERACEAE

GRAMINEAE

| Family        | Genera | No. of species |
|---------------|--------|----------------|
| Poaceae       | 260    | 1200           |
| Fabaceae      | 191    | 1152           |
| Orchidaceae   | 166    | 1141           |
| Asteraceae    | 167    | 950            |
| Rubiaceae     | 105    | 659            |
| Cyperaceae    | 38     | 545            |
| Euphorbiaceae | 84     | 528            |
| Acanthaceae   | 92     | 510            |
| Rosaceae      | 40     | 492            |
| Lamiaceae     | 72     | 454            |

- About 2560 sps.(15%) of the known species are trees, including highly valued timber sps. of the world. Some of the predominant families are : -

- Euphorbiaceae

- Lauraceae

- Annonaceae
- Rubiaceae
- Moraceae
- Fabaceae
- Arecaceae etc.

### **Insectivorous Plants**

- Lentibulariaceae (36 spp.)
- Droseraceae (3 spp.)
- Nepenthaceae (1 sp.)

### **Parasitic plants**

- Orobanchaceae (54 spp.)
- Loranthaceae (46 spp.)
- Santalaceae (10 spp.)
- Cuscutaceae (12 spp.)
- Balanophoraceae (6 spp.)
- Rafflesiaceae (1 sp.)

### **Mangroves**

Avicennia

Rhizophora

Bruguiera

Heritiera

### **Invasive species**

These are mostly introduced species and has adapted well in the new environment threatening the survival of the local species

Parthenium from USA

Lantana Camera from Mexico

Eupatorium

Salvinia, a floating fern spreading on the water bodies

### **Endemic plants**

*Out of 17,500 families over 5000 species (33%), 140 genera & 147 families are endemic to India.*

- India harbours maximum number of endemic species in the world after Australia.
- Areas rich in Endemism
- North-eastern India: 3500 spp out of 8000 known
- Western Ghats : 1600 spp. out of 5000 known
- North Western Himalayas :1600 spp. out of 4500 known
- Andaman & Nicobar Islands : 195 spp. out of 2200 kn

## CHAPTER: 4

### ANIMAL LIFE FORMS

#### *Zoological Diversity of India and World compared (MoEF,1998)*

| Taxa                                        | No. of species  |                  | %            |
|---------------------------------------------|-----------------|------------------|--------------|
|                                             | India           | World            |              |
| Protista                                    | 2577            | 31290            | 8.24         |
| Arthropods                                  | 60383           | 10,65,000        | 5.67         |
| Other invertebrates including Hemichordates | 8329            | 87121            | 9.56         |
| Protochordates                              | 116             | 2173             | 5.34         |
| Pisces                                      | 2546            | 21723            | 11.72        |
| Amphibia                                    | 206             | 5145             | 4.00         |
| Reptilia                                    | 485             | 5860             | 8.54         |
| Aves                                        | 1228            | 9672             | 12.69        |
| Mammalia                                    | 372             | 4629             | 8.03         |
| <b>Total</b>                                | <b>76242</b>    | <b>232,623</b>   | <b>32.77</b> |
| <b>Grand total including plants</b>         | <b>1,26,656</b> | <b>17,19,183</b> | <b>7.36</b>  |

#### *Phylum protozoa*

- Acellular and microscopic
- Exhibits a great variety of shapes
- Found in land, fresh water, salt water
- Nutrition is holophytic, holozoic or parasitic.
- Classification

» Sarcodina      ex : - Amoeba

» Mastigophora   ex : - Euglena

» ciliata          ex : - Paramecium caudatum

» sporozoa        ex : - Plasmodium

### **Phylum: Porifera**

- Multicellular animals with a cellular grade of organization. Tissues, organs and systems are absent.
- Aquatic, sedentary & incapable of movement.
- Digestion is intracellular possess a great power of regeneration.
- Classification
  - » Calcaria Ex : - Scapha
  - » Hexactinellida Ex : - Hyalonema
  - » Demospongia Ex : - Urnshaped bath sponge

### **Phylum Coelenterata**

- Multicellular animals with a tissue grade of organisation.
- Aquatic, & exhibit phenomenon of polymorphism.
- Digestion is both extracellular and intracellular.
- Classification

#### ***Hydra***

- » Hydrozoa Ex :- Hydra
- » Scyphozoa Ex :- Aurelia (jelly fish)
- » Anthozoa Ex :- Corals



### **CORALS**

Corals are tiny sea anemone like organisms belonging to Phylum Coelenterata.



It secretes calcareous exo-skeleton

Corals consist of many small polyps living together in a colony.

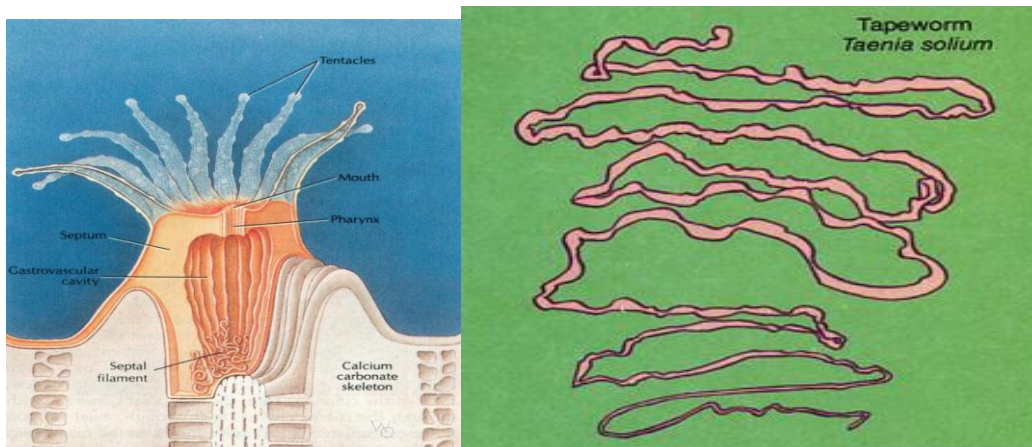
A single polyp has a cube shaped body with a mouth surrounded by tentacles. Polyps feed during night.

### HABITAT REQUIREMENTS

- ❖ Shallow, tropical salt waters
- ❖ Warm water: 20 – 28°C (65-86°F)
- ❖ Strong sunlight (for symbiotic algae)
- ❖ Lack of turbidity
- ❖ Hard substrate for attachment.

### Coral symbionts: Zooxanthellae

- ❖ ***Zooxanthellae* - Algae live in gastrodermal cells of coral**
- ❖ **Several millions of *zooxanthellae* live one sq. inch of coral**
- ❖ **Algae give coral its green or brownish blue Colour**
- ❖ **Algae provide polyps with Oxygen and Carbohydrates - enable - produce  $\text{CaCO}_3$  for skeleton**
- ❖ **When stressed, *zooxanthallae* got expelled – coral die (Barnes and Hughes, 1999)**



Cross sectional view of a coral

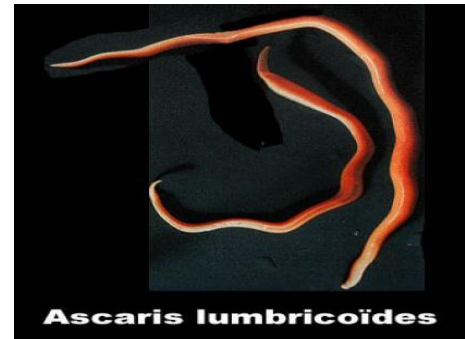
Tapeworm

***Phylum: Platy helminthes***

- Body is bilaterally symmetrical and dorsoventrally flattened.
- Digestive system is incomplete
- Usually hermaphrodites, reproductive system is well developed and highly evolved.
- Classification
  - » Turbellaria Ex :- Planaria
  - » Trematoda Ex :- Liver fluke
  - » Cestoda Ex :- Taenia solium

***Phylum- Aschelminthes or Nematoda***

- Body is unsegmented, cylindrical & pointed at both ends
- Digestive system is well developed
- Unisexual males are always smaller than females.
- Fertilization is internal.
- Classification: Nematode Ex :- *Ascaris lumbricoides*



**Phylum - Annelida**

- Body is triploblastic, bilaterally symmetrical and elongated.
- Digestive system generally consists of straight tube with mouth at the anterior end and anus at the posterior end.



**Earth worm (Annelida)**

- Classification

- » Chaetapoda Ex :- *Neanthes*
- » Archiannelida Ex :- *Polygordius*
- » Hirudinea Ex :- *Acanthobdella*

**Phylum Arthropoda**

- Bilaterally symmetrical, triploblastic, metacentrically segmented and eucoelomate.
- Digestive system well developed incomplete and circulation system open with a dorsal heart and arteries.
- Classification

- » Onychophora Ex :- *Peripatus*
- » Crustacea Ex :- Crab
- » Insecta Ex :- Fruit fly
- » Arachnida Ex :- Spider
- » Myriapoda.Ex : Centipede.Millipede



Crab( Crustacea)



Spider ( Arachnida)



Centipede ( Myripod)

***Class: Insecta***

- 29 orders: Coleoptera ( Beetles)
- Hemiptera ( Bugs)
- Lepidoptera ( Butterflies & Moths)



Diptera ( Flies)

Hymenoptera ( Honey bees, ants)

Isoptera (Termites)

Dictyoptera ( Cockroaches)

Odonata ( Dragon Flies)

### ***Phylum Mollusca***

- Body consists of head, foot, visceral mass and mantle.
- Body is covered by calcareous shell of one or more pieces.
- Digestive system is simple and circulatory system is open except in cephalopods

Major Classes:

» Amphineura Ex :- *Chiton*

» Scaphopoda Ex :- *Dentalium, Tusk shells*

» Gastropoda Ex :- Gastropods, slug, snails

» Bivalvia Ex :- Mussels

» Cephalopoda Ex :- Octopus, Squids

### **Phylum Chordata**

- **General characters.**
- Marked regional differentiation of the body into the head trunk and tail
- Organ systems are well developed

A living endoskeleton, a post-anal tail and a ventral heart are the unique characters.

| <b>Chordata</b>                            | <b>Non- chordate</b>            |
|--------------------------------------------|---------------------------------|
| Notochord or a vertebral column is present | Absent                          |
| Nerve chord is dorsal or tubular           | Nerve cord is ventral and solid |
| Endoskeleton is present                    | Absent                          |
| Heart is ventral                           | Heart is dorsal                 |
| Eyes are derived from the brain            | Eyes are derived from the skin  |

**Classification** -Hemichordata

- Urochordata
- Cepalochordata
- Vertebrata

**Amphibia**

- These are lowest and earliest tetrapoda or land vertebrates
- Poikilotherms living in both fresh water and land.
- Scales are absent.
- Limbs are pentadactyle
- Heart is three chamber with two auricles and one ventricles.

Case of Gastric Brooding Frog (Australia) – Rear young ones in the stomach with the help of hormone Prostaglandin which counters the action of Hydrochloric acid in the stomach and has potential use in the treatment Gastric Ulcer. But it is extinct in 1981.

### **Indian bull frog**

- The largest of Indian amphibian that grows about 7” plus another 7” legs and seen in through out India and common in Western Ghats. It has voracious appetite and can even feed on young chicks or duckling or even young snakes!



### **Malabar flying frog**

- Endemic to Southern Western Ghats
- Found in evergreen and moist deciduous forests, they can glide slantingly from tree cover over distance of 10mt.

### **Caecialiidae**

Presence of similar Caecilians in Latin America and India provides additional proof that Latin America and India were together near Antarctica prior to the continental drift

- Kandala caecilian –Maharashtra
- Blind caecilian- Kerala



Caecilian

### **Reptilia**

- These are Poikilotherms animals adopted for terrestrial mode of life.
- Skin is dry and covered by horny epidermal scales to prevent loss of water from the body.
- Skin glands are absent.

- Fertilization is internal through an organ called hemipennis.
- Three major orders:
- Crocodilia (crocodiles)
- Squamata (Lizards and snakes)
- Testudines (Turtles and Tortoises)
- Mesozoic era : Age of reptiles
- Herpetology: science dealing with reptiles

### **Marine Turtles**

Olive Ridley Turtle

Leather back

Green

Logger head and

Hawksbill

These mostly nests along the sand bars of Sunderbans or Bitharkanika. They live around 300 years and are mostly scavengers or vegetarians. These get killed in fishermen's nets by drowning ('Passive fishing')

### **Aves**

- These are adapted to aerial or volant mode of life
- Homeothermic animals body is covered by feathers which form an insulation.
- Fore limbs are modified into wings.
- Skull is monocondylar
- Hearts four chambered two auricles and two ventricles.
- Fertilization is internal.

## **27 Avian Orders**

- Anseriformes Waterfowl (ducks, geese, swans)
- Apodiformes Swifts, hummingbirds
- Caprimulgiformes nightjars
- Charadriiformes jacanas, terns, skimmers, oystercatcher
- Ciconiiformes Herons, storks, ibis, spoonbills, bitterns
- Columbiformes Pigeons, doves, sand grouse
- Coraciiformes Kingfishers, bee-eaters, rollers, hoopoes, hornbills
- Cuculiformes Cuckoos
- Falconiformes Vultures, hawks, eagles, falcons, osprey
- Galliformes Grouse, pheasants, quails, mega pods
- Gruiformes Cranes, rails, bustards, coots, buttonquails
- Passeriformes Perching birds (over 70 families), including crows, thrushes, sparrows, swallows, wrens, warblers, flycatchers, larks, nuthatches, vireos, shrikes, blackbirds
- Pelecaniformes Pelicans, boobies, cormorants, darters
- Phoenicopteriformes Flamingos
- Piciformes Woodpeckers, honey guides, barbets
- Podicipediformes Grebes
- Procellariiformes Albatrosses, petrels
- Psittaciformes Parrots
- Sphenisciformes Penguins
- Strigiformes Owls
- Struthioniformes Ostriches, rheas, kiwis, cassowaries, emus
- Trogoniformes Trogons

## **Mammalia**

- These are highest group in the animal kingdom.
- Homoeothermic body is covered with hairs.
- External ears are present.
- Skull is bicondylar.
- Heart is four chambered it maintains complete double circulation
- Fertilization is internal
- Egg laying mammals, all others are viviparous

About 5000 species of mammals world over and classified under 26 orders within three sub classes: Eutheria True mammals

- Metatheria Eg: Marsupials
- Protheria Eg: Platypus

## **Important Mammalian Groups**

- Order Artiodactyla (even-toed ungulates: antelope, deer, camels, pigs, cows, sheep etc.)
- Order Perissodactyla (odd-toed ungulates: horses, rhinos)
- Order Proboscidea (elephants, mammoths etc.)
- Order Carnivora (carnivores: cats, dogs, bears, weasels etc.)
- Order Primates (apes, monkeys, lemurs, human beings)
- Order Chiroptera (bats)
- Order Insectivora (insect-eaters: hedgehogs, moles, shrews)
- Order Pholidota (the pangolin)
- Order Rodentia (rodents: rats, mice, squirrels, gerbils etc.)
- Order Lagomorpha (rabbits, hares, pikas)
- Order Cetacea (whales, dolphins) & Order Sirenia (sea cows)

## **CHAPTER: 5**

### **APPROACHES IN BIODIVERSITY CONSERVATION**

- **In situ Conservation** – Protected Area Network along the Bio geographical zones
- **Ex situ Conservation**- Zoological gardens, Botanical gardens, Seed banks
- **Targeted protection to Apex species** (conservation of Flagship sp. or umbrella sp.)
- **Legal Provisions** such as Wildlife Laws and legislation; International conventions such as CBD, CITES, CMS etc
- **Community Participation** and participatory approach such as JFM, Eco-development.
- **Landscape approach** and Biosphere Reserves
- Efforts on **reduction of pollution** levels including the impending Climatic change

#### **In situ Conservation**

- Protecting species can only be done through protecting habitat
- Setting apart large natural wilderness or areas of conservation importance (such wetlands)
- About 4500 major Reserves in the world covering over 500 million ha
- India has 611 P.A s ( N.P : 96 + WLS: 510+ Conservn. Reserves: 3 + Community Res.: 2 )  
encompassing an area of 15.7 million ha which is 4.77% Of our Geographic area

#### **Ex situ Conservation**

- Through Zoos, Botanic gardens, Aquaria, Seed Banks, Cryo-preservation etc.
- Zoological/ Botanical Gardens accomplish:
  - Species and habitat conservation
  - Education
  - Scientific Research

- Cumulative area of zoo's in India ~ 9,000 ha
- Total animal collection ~ 50,000 animals
- Total number of species ~ 600
- No. of Recognized zoos - 164
- De-recognized zoos - 91
- Modernized Zoos - 14

### **Managing the Protected Areas landscape**

- Protected areas themselves have to be effectively managed to succeed in realizing their conservation objectives.
- Hence these P.A s have to be part of a larger regional schemes to ensure biological and social sustainability and to deliver appropriate benefits to the community.
- It is here that the economic incentives and disincentives play their role in ensuring that the benefits are delivered to the community.
- Hence the concept of Eco-development, concept of Biosphere Reserves and enactment of Wildlife Legislations etc.

### **How benefits accrue to Community**

- Eco development: implementation of community and individual beneficiary development schemes among the fringe villagers so as to wean them from dependency on the forest resources.
- Avail the positive benefits from Bio-prospecting and curtail the negatives of Bio-piracy.
- Direct Community participation in the protection of Biodiversity: Village level Biodiversity Management Committees ( BMC) and People's Biodiversity Register (PBR)

## **BIOPROSPECTING**

- Exploration of biodiversity for commercially valuable genetic and biochemical resources.
- The systematic search for genes, natural compounds, designs and whole organisms in wild life with a potential for product development by biological observation, and biophysical, biochemical and genetic methods without disruption to nature (Nicolas Mateo et al., 2001)

### **Major Components**

#### **Chemical prospecting**

- Drug and pharmaceuticals
- Pesticides
- Cosmetics
- Food additives
- Other industrially valuable chemical products

#### **Gene prospecting**

- Genetic Engineering
- Crop development
- Fermentation
- Cell culture

#### **Bionic prospecting**

- Designs
- Sensor technologies
- Architecture
- Bioengineering
- Bio-modeling

## **Provisions in CBD**

### **Access to genetic resources**

- Providing country is the authority to determine access to genetic resources
- Facilitate access for environmentally sound uses by other Parties
- Mutually agreed terms
- Prior informed consent
- Scientific research with full participation of providing country
- User countries shall take measures with the aim of sharing benefits with providers

### **Access to and transfer of technology**

- Providing countries to be given access to and transfer of technologies
- Cooperate to ensure that IPRs, Traditional Resource Rights of Indigenous Communities, Bioethics and Bio safety are supportive of the CBD objectives
- Effective participation in biotech research for provider countries
- Priority access for provider countries to results and benefits arising from biotechnology

## **Benefit Sharing**

### **Monetary Benefits**

- Access fees.
- Up – front payments.
- Milestone payments.
- Sharing of Royalties.
- License fees in case of commercialization.
- Special fees to be paid to trust funds supporting conservation and sustainable use of biodiversity.

- Salaries and preferential terms on mutually agreed terms.
- Research funding.
- Joint ventures.
- Joint ownership of relevant intellectual property rights

#### **Non-monetary Benefits**

- Sharing R&D results
- Collaboration in S&T and development programmes (Biotechnology)
- Participation in Product Development
- Collaboration in Education and Training
- Admittance to *ex situ* facilities and databanks
- Institutional Capacity Building
- Human Resource Development
- Information Exchange
- Contribution to Local Economy
- Contribution to other domestic benefits
- Food and Livelihood security benefits
- Social Recognition
- Joint IPRs

## **Safeguarding IPRs of indigenous/ local communities**

**Survey, inventory & documentation of the indigenous knowledge system and preparation of community registers**



**Preparation of Electronic Database**

**(Access to Patent Office)**



**Access to Database with prior informed consent**



**Negotiation and signing of agreement(s)**



**Development of marketable product/s (with S&T intervention)**

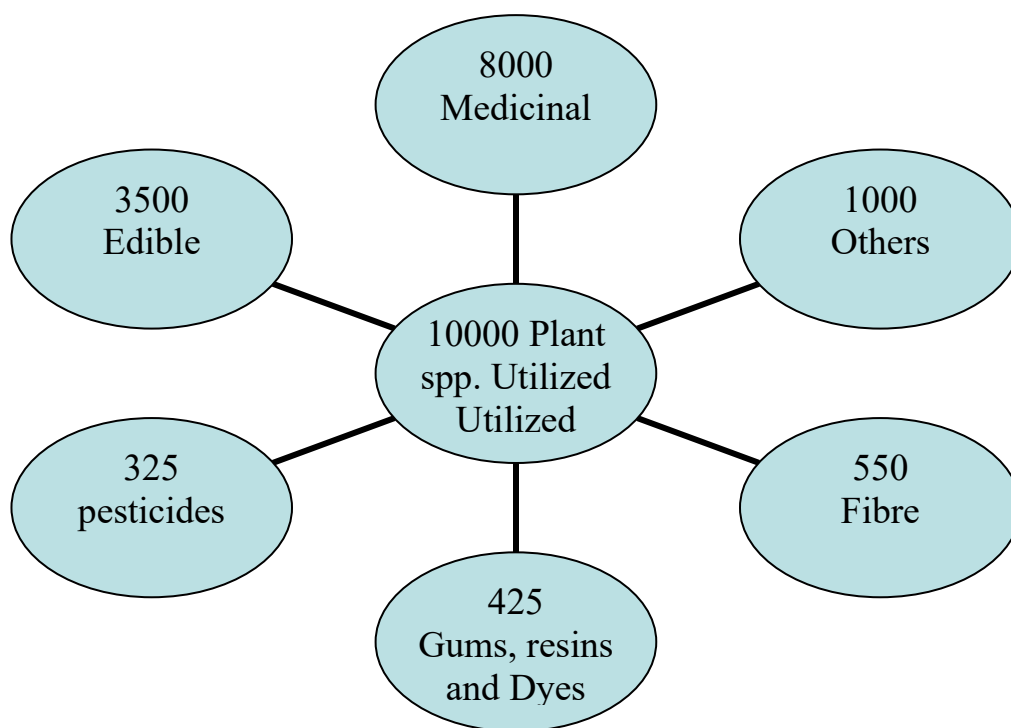


**Commercialization of the products**



**Benefit sharing with the indigenous/ local communities**

India has over 70 million tribes belonging to over 550 communities. They occupy about 18.74% of the total area of the country, and has rich heritage of Traditional Knowledge (TK) about the use of bio-resources.



### **Proportionate Utilization of Indian Flora**

#### **The KANI Experiment**

Pushpangadan and co-workers (1987) conducted the study on the forest dwelling Kani Tribe of South Western Ghats Mountains. Discovered that fruits of Arogya Patcha (*Trichopus zeylanicus*) when consumed would reduce fatigue and provide energy. Within a period of seven years a scientifically validated, standardized herbal formulation 'Jeevani' was formulated. Evaluations related to toxicity, efficacy, shelf life and clinical properties were carried out by TBGRI, and the drug was ready by the end of 1994. The drug was released for

commercial production. TBGRI transferred the money to the Kani tribe (Rs. 6,50,000).

They are now regularly getting 50% of royalty.

## **BIOPIRACY**

- Theft or usurpation of genetic materials especially plants and other biological materials and traditional knowledge by the patent process.

- Bio piracy- **Bio** means biological

**Piracy** means robbery

- Creates a false claim to novelty and invention
- Scarce bio resource to monopoly control of corporate
- It creates market monopolies and excludes the original innovators (farmers) from their rightful share to local, national and global markets
- deplete or destroy species

## **Why bio piracy?**

- Increasing demand in industrialized countries for herbal products.
- Potential use of bio resources
- unequal geographical distribution of bio resources.

## **FORMS OF BIOPIRACY**

- Traditional Knowledge Biopiracy
- Genetic Resource Biopiracy
- Marine resource Biopiracy
- Microorganism biopiracy

### **Traditional Knowledge Biopiracy**

- ❖ The unauthorized use of common TK
- ❖ The unauthorized use of TK acquired by deception or failure to fully disclosure the commercial motive behind the acquisition
- ❖ The unauthorized use of TK acquired on the basis of a transaction deemed to be exploitative
- ❖ The commercial use of TK on the basis of a literature search

| <b>Bio prospecting</b>                                                 | <b>Biopiracy</b>                                                               |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Positive term used for commercialization of traditional medicines.     | Negative term for the appropriation of legal rights over indigenous knowledge. |
| Follow the new rules of international treaties and national laws       | Don't follow                                                                   |
| Supports conservation of bio-resources                                 | Considered as detrimental to biodiversity conservation                         |
| Indigenous groups who originally developed knowledge gets compensation | No compensation to the indigenous groups                                       |
| Pre informed consent of source county is obtained                      | Bio-resources collected with out pre consent                                   |

### **Genetic Resource Biopiracy**

- The unauthorized extraction and use of widespread resources.
- The unauthorized extraction and export of resources in breach of ABS regulations of the relevant country.
- The unauthorized extraction and export of resources in countries lacking ABS regulations.
- The authorized extraction of resources on the basis of a transaction deemed to be exploitative.

### **International Agreements**

ITPGRFA (International Treaty on **P**lant **G**enetic **R**esources for **F**ood and **A**griculture)

CBD (Convention on **B**iological **D**iversity)

WIPO (**W**orld **I**ntellectual **P**roperty **O**rganization)

UPOV (International Union for the **P**rotection of **N**ew **V**arieties of **P**lants)

TRIPS (**T**rade **R**elated **A**spects of **I**ntellectual **P**roperty rights)

### **Case of Basmati Rice**

- Queen of fragrance
- 1997, an American company Rice Tec Inc
- Patent by the US patent office
- Brands like 'Kasmati' and 'Texmati'
- High level inter-ministerial group consisting representatives of CSIR, ICAR, APEDA,

**India won the trial**

### **Monsanto's Wheat Biopiracy**

- claim by Monsanto company "invented" the unique low-elasticity, low gluten properties of an indigenous Indian wheat; patent was granted by European patent office, Munich in May ,2003.

- The wheat exhibiting a special baking quality, derived from native Indian wheat
- All flours, biscuits and edible products made from such wheat.
- New strain named as Nap Hal .
- Challenged Monsanto wheat
  - Bio piracy both in the Indian Supreme Court and in the European Patent Office in Munich with Greenpeace.

### **Turmeric Biopiracy**

- In May, 1995 – patented by University of Mississippi Medical Center for "Use of Turmeric in Wound Healing by the US Patent Office.
- Patent also granted exclusive right to sell and distribute turmeric.
- A complaint was filed by India's Council of Scientific and Industrial Research, which challenged the novelty of the University's "discovery, -Dr. R A Mashelkar
- The U.S. patent office investigated the validity of patent.
- In India, where turmeric has been used medicinally for thousands of years
- concerns grew about the economically and socially damaging impact of this legal "biopiracy."
- In 1997, the patent was revoked.

### **Neem Biopiracy**

- In 1996, - US Department of Agriculture and a pharmaceutical research firm -W.R.Grace & Co
- European Patent office, Munich for 'fungicidal uses of neem oil'
- Challenged by Vandana Shiva and Ajay Phadke
- No 'novelty' factor in neem's magical properties
- Patent was overturned in 2005.

### **Wild life Biopiracy**

- Czech entomologist Petr Švácha and Czech Forester Emil Kučera
- 200 endangered insects from Singalila national park, Darjeeling.

### **Case of Bt Cotton Gene**

- *Bacillus thuringiensis* (Bt.) first extracted from Black cotton soils in Andhra Pradesh
- Mahanandi B.M.C., Kurnool sent a demand notice to Monsanto to pay accession fees as per Biodiversity Act 2002
- Long litigation and out of Court settlement
- Fees of Rs. 73.00 lakhs in 2006-07 and Rs 1.37 lakhs in 2007-08.

### **Case of Tarantula Spider : Araku Valley in AP**

- ◆ Dr Marc clark Baumgarten of Germany and his local associate Mr Venkat Reddy landed in Araku valley of Visakhapatnam in Nov 2007.
- ◆ The accused is a doctor and Neurologist working on neurotoxins of biological origin defines “Tarantula” as a “mobile pharmacy unit”.
- ◆ On New moon day, they track blue color tarantula with diamond shaped back Tarantula on tamarind trees and Bamboo grooves.
- ◆ ARAKU Biodiversity Management committee with chairman as V.S.S. President has lodged a complaint with Chief judicial magistrate of Araku of Visakhapatnam.
- ◆ Non bailable warrant under section 58.
- ◆ Punishable under section 55(i) which has punishment of Imprisonment up to 5 years or fine upto Rs 10.00 lakhs. And in case the biological resource is damaged, the cost of the rehabilitation is to be paid

### **WTO-TRIPS: a review**

- Commercial Treaty which largely benefit private firms.
- Enables persons or institution to patent the biological resources in country outside the country of origin resources or knowledge
- No provision that patent applicant or other IPR over biological resources have to obtain prior informed consent of the country where resources or knowledge of its use is located.
- Provides exclusive rights on patent holder to sale ,import, use patented product or products from patented process
- Non obligatory on patent applicant to disclose geographic origin of material or knowledge used in invention.
- Amend TRIPS to exclude biological materials and process

### **Community participation and Biological Diversity Act**

- 30% of the biodiversity in India is outside traditional forests
- Biodiversity Management Committee proposed by the B D Act for better management of the resources, empower the local community as well as for documentation
- First attempt on Community participation by WWF Project: Community Biodiversity Conservation Movement( CBCM) during 1989.
- They emphasized on small, intense and focused projects in different geographical locations largely managed by local based Institutions and worked till 1994-95
- Initiated study on Sacred groves of Kerala, underutilized plants of India Set up seed bank at Pune etc.

### **People's Biodiversity Register**

- Had its origins in the Western Ghats Biodiversity Network initiated by CES/ IIS, Bangalore and FRLHT (Foundation for the Revitalization of Local Health Traditions) during 1995.
- Evolved when it was felt that the large Institutional network entrusted to document Biodiversity at macro level often failed to reach the diverse and vast rural landscape.
- PBR is expected to serve as a tool to document , monitor and provide information for sustain. mgt of local biodiv. Resources including traditional practices
- Tool to promote biodiv. – friendly development in the emerging decentralized mgt of natural resources.
- Tool to establish claim on individual and local communities over knowledge of uses of biodiv. Resources and to bring them an equitable share of benefits flowing from uses of such resources and knowledge.

### **PBR**

- A total of 60 PBRs have been prepared in six states viz. Assam, Orissa, Jharkhand, Rajasthan, Karnataka and Himachal Pradesh during 1996-98 and copies were deposited with local organizations.
- As on today none is complete with respect to these 10 modules.
- During 2000-01, Karnataka Biodiversity Board prepared school level Biodiv. Register in 100 schools in their school areas in Tumkur dist, incorporating data on agri. crop, wetland, med. plants, fishes, traditional conservation practices
- CES developed a computer based identification key for school children in biodiv. Documentation.
- In the Western Ghat Biodiv. Network( WGBN), the CES involved Bot. and Zool. teachers of 15 colleges working with a team of 5 – 15 students to map local landscape and investigate

occurrence of plants and animals and is successful in bringing in 27 Institutions in the survey and is supplemented by various Research scholars.

- PBR is expected to cover all the six lakhs villages in India and document the resources and traditional practices as a check against illegal patent by multinational companies.
- PBR also provide insight into the various sacred groves and scared ponds and the use pattern of biodiversity among the various cultural groups in India rites

#### **PBR: a review**

- FRLHT initiative was more pragmatic, structured and well conceived, the work was more assigned to scientific workers rather than community
- Hence, CES/IIS prepared a 10-moduled modification on PBR
- Unfortunately, it turned out to be more academic and complicated and was filled with jargons and hence partially lost its luster.

#### **Protecting Biodiversity: Indian efforts**

- Environmental Impact Assessment
- Wetland Conservation
- National Lake Conservation Plan
- Biosphere reserves
- National river conservation Plan
- Protected Areas (declaration)
- Eco development and JFM and NAEB
- Ganga Action Plan
- Area oriented Fuel and Fodder project
- Medicinal Conservation Areas
- National and State Biodiversity Board

## CHAPTER: 6

### SPECIATION, EXTINCTION AND ENDEMISM

#### Concept of Species:

Species may be considered as the basic unit in biology because it refers to the distinct biological entities and represents an important level of integration in nature (Mayr, 1957). Species is essentially a continuum with its allied species and it is often difficult to pinpoint the partition at which one species separated from other. On an Evolutionary point of view, Family – Genus – Species etc., form a continuum.

There are various categories of species concept of which the Biological concept is most accepted as it is based on genetic kinship. It refers to “**a community of cross fertilizing individuals linked together by bonds of mating and isolated reproductively from other species**” (Grant, 1957).

Below the species level, there are sub species and varieties. There are **Cryptic Species** in which the phenotype remains similar but is reproductively isolated; conversely, in **Polymorphic Species**, the case is exactly opposite.

There are cases of species in which lack of reproductive isolation do exists. Typical example is provided by the grass *Bothriochloa intermedia* which absorb genes not only from other species of *Bothriochloa* but from *Dicanthium* and *Capillipedium*. However, the introgression id only in the direction of *B. intermedia* without which all other species remain reproductively isolated.

**Doyen and Slobodchikoff (1974) provided an operational definition of Species as , “groups of phenetically similar, interbreeding populations that share similar ecological niche”** which covers evolutionary, ecological and biological aspects.

### **SPECIATION:**

New species are formed through two processes:

1. Splitting of species
2. Species Transformation

Speciation is by true definition (though loosely covers the whole aspect of species formation) refers to the splitting of species into two or more species where as Transformation of the old species to a new one may occur over a period of time

If same species gets distributed over a large area so that after a few generations, these populations at two ends of the territory may be too far to have direct gene flow among their members, leading to the evolution of two species

**Transformation** of a species to a new one takes place by the accumulation of changes in time such that members get reproductively isolated.

### **Various mechanisms by which these processes works through:**

1. Reproductive Isolation
2. Random Genetic Drift
3. Hybridization
4. Mutations
5. Natural selection

Essentially, Reproductive Isolation leads to speciation and is caused by:

1. Geographic/ Physical isolation

Eg: Islands or continents drift or presence of mountains or other physical barriers or through differential migration

2. Ecological Isolation that is caused through :

- a. Pre mating Mechanism

1. Temporal ( Seasonal and Diurnal) : Flowers open up close at different times
    2. Ethological (mechanical): closing of flowers before the pollination or pollinating agents unable to effect pollination due to certain behavioural factors

- b. Post mating mechanism

1. Pre-zygotic ( Autogamy and Incompatibility - Pollen-pistil)
    2. Post-zygotic

- a. Incompatibility: Endosperm-embryo

- b. Hybrid in viability or sterility

Random Genetic Drift occurs in small populations where in some genes will be lost for ever as they may not get chance to transmit to next generation as only in large population more or less all genes are transmitted. Similar drift occurs also when there is non random mating even fairly large population. RGD causes fixation of new mutations as well as reduction in genetic variability.

Through Hybridization various characters gets assembled which otherwise would have taken years. Most often, hybrids may not propagate as offspring tend to be sterile

Mutation is the appearance of sudden heritable variations due to some changes in the DNA structure. Incidentally most of these mutations are lethal but a few may survive with some new characters.

Natural selection provides 'direction' when works among these processes leading to a new species or destroy these if it does not fit in the prevailing environment.

## EXTINCTION OF SPECIES

### **Natural Extinction of species**

- Extinction has been fact of life since the first life emerged on this planet and it was a natural process.
- It is estimated that on an average 9 lakhs vertebrate spp. become extinct every one million years during the last 200 million years ie. About 90 spp. for every century.

### **Man Induced Extinction**

- Rate of extinction was highly accelerated over the last 200 years due to human induced extinction.
- About 75% of the mammals and birds extinct in recent history, were the island dwelling species
- About 10% of the world's birds population are confined to islands.
- BSU considers more than 600 flowering plants as threatened or endangered
- ZSI mentions 77 sp of mammals, 44 birds 19 sp reptiles as highly threatened
- Some examples of extinct plants in India
  - Sterculia khasiana : Meghalaya
  - Hedychium maginatum : Nagaland
  - Carex rapanda : Meghalaya.

- *Ergrostis rangachari* : T.N
- *Calanthe whiteana* : Silkkim
- *Ophiorriza caudata* : Kerala

### **Endemism**

A taxon is said to be ENDEMIC if it is confined to a certain geographic location.

Two subcategories: - **Paleo endemic**

- **Neo endemic**

**Paleo endemism** refers to a species that was formerly widespread but is now restricted to a smaller area.

**Neo endemism** refers to a species that has recently arisen such as a species that has diverged and become reproductively isolated, or one that has formed following hybridization and is now classified as a separate species. This is a common process in plants especially those which exhibit polyploidy.

The opposite notion is the cosmopolitan distribution.

Endemic types or species are likely to develop on islands due to the reproductive isolation effected by geographical limitations.

Eg: the Hawaii, the Galápagos Islands

Endemism can also occur in biologically isolated areas seen in areas like Nilgiri shola forests, highlands of Ethiopia, or in large lakes such as Lake Baikal.

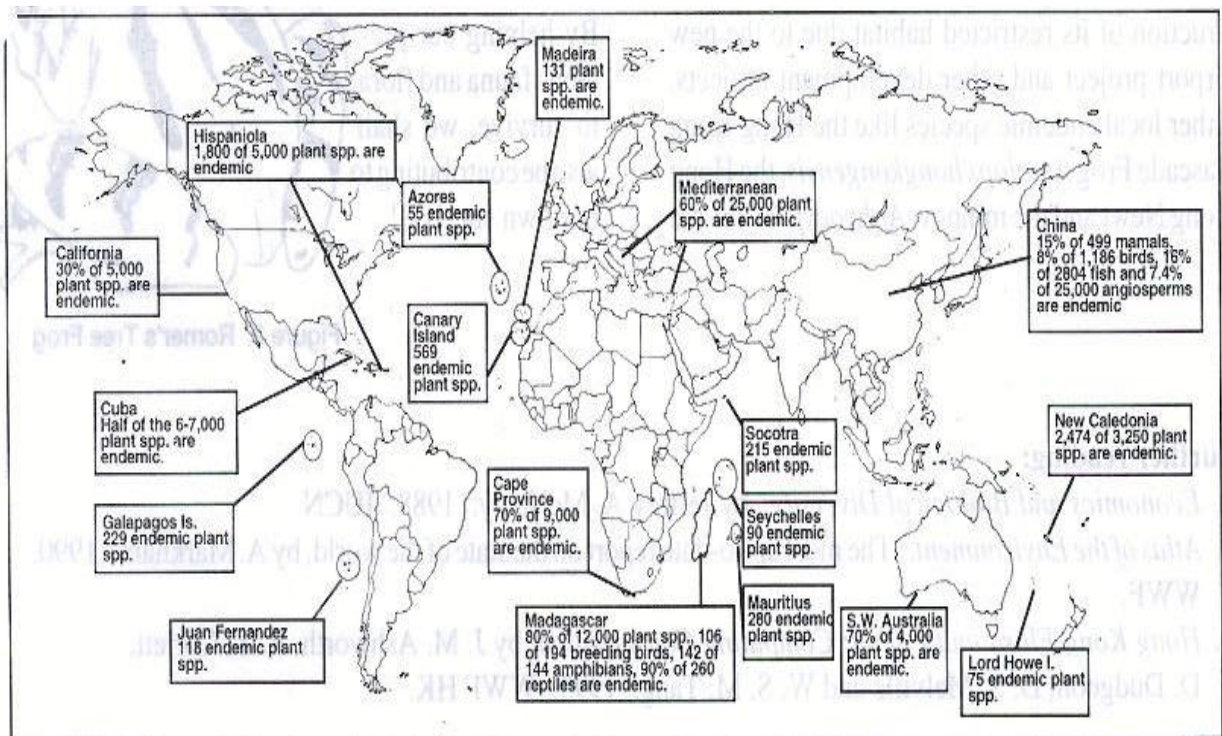
### **Causes of Endemism**

Endemism may arise by several mechanisms but underlying principle is the reproductive **ISOLATION effected by** geographical limits.

- Continental Drift: Between 200 and 80 million years ago the single 'super continent' Pangea, broke up to form modern continents and animal and plant life evolved in different ways. Eg: Madagascar ;

- In Australia, 80 % of its wildlife endemic.
- **Genetic Drift:** A small population with limited genetic diversity is isolated. After many generations, genetic drift leads to the formation of a distinct species or subspecies.
- **Islands on the land** - Any ecosystem or habitat surrounded by a different one is like an island for the species.
- Eg: Shola forests in Nilgiris

Eg: The rift valley lakes in Africa with widely varying fish fauna; Lake Baikal in Russia



### Endemism and species wealth in the world

- Colonization on volcanic islands: A population arriving on an island (volcanic) adapts to fill different ecological niches. Many generations of natural selection result in the formation of several distinct species.
- Almost 900 species of birds - 10% of the world's total - have a range of only one island.

- With birds comes the plants through digestive guts / superficially sticking to body / floating on sea.
- Hawaii and the Galapagos have low species diversity but are mostly endemic.
- Refugia: A species that was originally widespread in its distribution suffers extinction over most of its range. The island becomes a “refugia”. It is a case of Paleo endemism

### **Endemism in India**

- 5150 spp of flora ( 11.35% of the total)
- 2103 spp of fauna ( 2.6% of the total) But among mammals , 11.82% is endemic.  
Reptiles(37.5%) amphibians( 60%), Birds (4.8%), Fishes (3.06%)
- Pteridophytes : 200 spp endemic
- Angiosperms: 4950 spp
- Fishes: Fresh water : 64, Marine: 14
- Amphibian: 123
- Reptiles: 182
- Birds: 60
- Mammals : 44
- Molluscs: 967
- Butterflies: 9

### **Threats to endemic spp**

- By some estimates, one species gets extinct every 30 minutes and a million species may have died out by the end of the last century.
- **Wildlife Trade : next only to Narcotics and arms trade.**

- **Introduced species** - Species that have been introduced either accidentally or deliberately, may wipe out the local species because they have evolved in other environments. The local species may have few defenses against such predators.
- **Destruction of habitats** - Human activities, like urban development and pollution, are especially threatening to endemic species whose habitats are so restricted.
- Faulty Forestry practices: Logging, Monoculture, conversion to uniform system in miscellaneous and tropical forests, conversion of grasslands to Eucalyptus or Acacias as in the case of Nilgiris.

### **Endemism in SHOLA FORESTS**

- Shola forests are rich storehouse of biodiversity.
- The flora show special characteristics, as they have to adapt to extreme climates and winds. As the high altitude sholas are like islands, disconnected from other regions, endemism is high. Even branches of shola trees are colonised by a variety of species, many of them getting their water supply from the condensing mist.
- Predominant trees : *Microtropis spp*, *Rhododendron arboreum*, *Syzigium spp*. *Rhodomyrtus sp*.
- Shrubs: *Gaultheria*, *Anaphylis*, *Heydiotis*
- The grasslands: *Chrysopogon zeylanicus* and *Eulalia phaeothrix* being two of the predominant species. Also seen *Dicanthium*, *Bothriochloa* etc. More than 60 of the grasses here are endemic to Western Ghats.
- About 50 spp of *Strobilanthes* ( *Kurinji*) are reported from the shola grasslands such as *Strobilanthes asperrium*, *S. calycina*, *S. cuspidatus* of which all except two are endemic to Western Ghats.

## **CHAPTER: 7**

### **BIODIVERSITY HOTSPOTS OF THE WORLD AND INDIA'S MEGA DIVERSITY**

Biodiversity is not evenly distributed on the planet. Some areas harbour far greater concentrations of living creatures than others. **Conservation International (CI)** has identified those biologically rich areas under the greatest threat of destruction as biodiversity hotspots, and concentrates conservation in these areas to have the most impact.

A biodiversity hotspot is a bio geographic region with a significant reservoir of biodiversity that is threatened with destruction.

- The concept of biodiversity hotspots was originated by Dr. Norman Myers (1988, 1999).
- To qualify as a biodiversity hotspot, the region must meet two strict criteria:
  - it must contain at least 0.5% or 1,500 species of vascular plants as endemics, and
  - it has to have lost or likely to lose at least 70% of its primary vegetation.

CI has initially identified 25 priority hotspots based on three criteria:

The number of species present, the number of those species found exclusively in an ecosystem and the degree of threat they face

- Around the world, currently 32 identified
- These sites support nearly 60% of the world's plant, bird, mammal, reptile, and amphibian species, with a very high share of endemic species.
- In India, EASTERN HIMALAYAS AND WESTERN GHATS are denoted as the Biodiversity Hotspots

## **BIODIVERSITY HOTSPOTS OF THE WORLD**

**1. TROPICAL ANDES** Sometimes called the “global epicenter of biodiversity,” the Andes is the richest and most diverse of all hotspots. It is home to 20,000 endemic plants and at least 1,500 endemic nonfish vertebrates, including a spectacular array of birds and amphibians. Ecuador and Peru.

### **2. SUNDALAND**

Featuring some of the largest islands in the world, Southeast Asia’s Sundaland hotspot is home to a number of unique species, including the endangered orangutans of Sumatra and Borneo. The second-richest hotspot in endemic plants, Sundaland is also well known for its mammal diversity. Borneo.

### **3. MEDITERRANEAN BASIN**

Best known for its 13,000 endemic plants, the basin is also home to a number of interesting vertebrates such as the Spanish ibex, an unusual ungulate.

### **4. MADAGASCAR & INDIAN OCEAN ISLANDS**

Often considered a mini-continent, Madagascar is famous for reptiles such as chameleons and more than 50 different kinds of lemurs—unique primates found only on these islands. Madagascar is thought by many to be the world’s top conservation priority due to its remarkable biodiversity and extensive deforestation. Madagascar

### **5. INDO–BURMA**

Stretching from the eastern slopes of the Himalayas through Burma and Thailand to Indochina, this hotspot features the world’s highest freshwater turtle diversity—43 species—and an amazing array of mammals. Several new ungulate species, such as the saola and giant muntjac, were recently discovered here. Thailand

## **6. CARIBBEAN**

The Caribbean hotspot has one of the highest concentrations of species per unit area on Earth. Reptiles are particularly diverse 497 species are found here, 80 percent of which are found nowhere else. Nonfish vertebrates in this hotspot number 1,518. Jamaica

## **7. ATLANTIC FOREST REGION**

Once covering an area nearly three times the size of California, the Atlantic Forest has been reduced to about 7 percent of its original extent. It is most famous for 25 different kinds of primates, 20 of which are found only in this hotspot. Among its best-known flagship species are the critically endangered muriquis and lion tamarins.

## **8. PHILIPPINES**

The most devastated of the hotspots, the Philippines' forest cover has been reduced to 3 percent of its original extent. The Philippines is especially rich in endemic mammals and birds, such as the Philippine eagle.

## **9. CAPE FLORISTIC PROVINCE**

This Mediterranean-type hotspot in southern Africa harbors an incredible 8,200 plant species, more than 5,500 of which are endemic, in an area roughly the size of Ireland—approximately 20 percent of its original extent.

## **10. MESOAMERICA**

Forming a land bridge between two continents, the Mesoamerica hotspot features species representative of North and South America as well as its own unique biota. The spider and howler monkeys, Baird's tapir and unusual horned guan are flagship species. Costa Rica and Belize.

## **11. BRAZILIAN CERRADO**

A vast area of savanna and dry forest, the Cerrado is Brazil's new agricultural frontier and has been heavily impacted in the past few decades. It is home to 4,400 endemic plants and several well-known mammal species, including the giant anteater, Brazilian tapir and maned wolf.

## **12. SOUTHWEST AUSTRALIA**

A Mediterranean-type system, this hotspot is rich in endemic plants, reptiles and marsupials including the numbat, the honey possum and quokka, an unusual, nocturnal kangaroo. It also harbors some of the world's tallest trees, among them the giant eucalyptus.

## **13. MOUNTAINS OF SOUTH-CENTRAL CHINA**

An area of extreme topography, these mountains are home to several of the world's best-known mammals, including the giant panda, the red panda and the golden monkey. Largely unexplored, this hotspot is sure to hold many undiscovered species.

## **14. POLYNESIA/MICRONESIA**

Comprised of thousands of tiny islands scattered over the vast Pacific—from Fiji and Hawaii to Easter Island—this hotspot is noteworthy for land snails, birds and reptiles. Hawaii has suffered some of the most severe extinctions in modern history, due in part to the introduction of non-native plant and animal species.

## **15. NEW CALEDONIA**

New Caledonia is one of the smallest hotspots—about the size of New Jersey—yet its concentration of unique plants is unmatched. Five plant families are found nowhere else on Earth. This hotspot also features many endemic birds, such as the kagu, a long-legged, flightless forest dweller representing an entire bird family.

## **16. CHOCÓ–DARIÉN WESTERN ECUADOR**

This hotspot features some of the world's wettest rain forests, where amphibians, plants and birds are particularly abundant. Of the 350 amphibian species found here, an incredible 210 are endemic—one of the highest levels of endemism of any hotspot.Ecuador

## **17. GUINEAN FORESTS OF WEST AFRICA**

With the highest mammal diversity of any hotspot, these forests are home to the rare pygmy hippopotamus and many other striking species, including the western chimpanzee, Diana monkey and several forest duikers. Large-scale logging and hunting have heavily impacted these endemic mammals.

## **18. WESTERN GHATS & SRI LANKA**

The Western Ghats mountain chain and adjacent island of Sri Lanka harbor high concentrations of endemic reptiles; of 259 reptile species, 161 are found nowhere else on Earth. This hotspot is also home to a number of distinctive flagship species, including the lion-tailed macaque.

## **19. CALIFORNIA FLORISTIC PROVINCE**

Extending along the coast of California and into Oregon and northwestern Baja California, Mexico, this is one of five hotspots featuring a Mediterranean-type climate of hot, dry summers and cool, wet winters. It is especially rich in plants, with more than 4,000 plant species, almost half of which are endemic.

## **20. SUCCULENT KAROO**

The only arid hotspot, the Succulent Karoo of southern Africa is renowned for unique succulent plants, as well as lizards and tortoises. The seasonal burst of bloom in Namaqualand, in the southern part of this hotspot, draws thousands of visitors each September.

## **21. NEW ZEALAND**

This hotspot claims a number of world-famous bird species, including the kiwi, a nocturnal, flightless bird that is so secretive, few New Zealanders have seen it—despite the fact that it is their national emblem. The critically endangered kakapo, a large, flightless parrot, is another of the island's most unusual endemic species. New Zealand

## **22. CENTRAL CHILE**

Bearing more resemblance to California than to other areas in the Southern Hemisphere, this hotspot features an arid region as well as a more typical Mediterranean-type zone. It is best known for its incredible variety of plant species but also features unusual fauna, including one of the largest birds in the Americas, the Andean condor.

## **23. CAUCASUS**

Situated between the Black Sea and the Caspian Sea, Caucasus habitats range from temperate forests to grasslands. Especially noteworthy is the diversity of plants some 6,300 species have been recorded here, more than 1,600 of which are endemic.

## **24. WALLACEA**

Named for the 19th century naturalist Alfred Russel Wallace, this hotspot comprises the large Indonesian island of Sulawesi, the Moluccas and many smaller islands. The area is particularly rich in endemic mammals and birds.

## **25. EASTERN ARC MOUNTAINS & COASTAL FORESTS OF TANZANIA & KENYA**

A chain of upland and coastal forests, this hotspot claims one of the densest concentrations of unique plant and primate species in the world. It is home to the well-known African violets and 4,000 other plant species, as well as the 1,500 remaining Kirk's red colobus monkeys. Trips to this area: Tanzania.

## **WESTERN GHATS**

- These hills cover 60,000 km<sup>2</sup> and form the catchments for a complex of river systems that drain almost 40% of India. The average elevation is around 1,200 meters. The area is one of the world's ten "Hottest biodiversity hotspots" and has over 4000 species of flowering plants, 139 mammal species, 508 bird species and 179 amphibian species. At least 325 globally threatened species occur in the Western Ghats.
- The Western Ghats are not true mountains, but are the faulted edge of the Deccan Plateau.
- Though this area covers barely 5 % of India's land, 23% of all species of higher plants in India (4,000 of 17,000 species) are found here. Almost 1,800 of these are endemic to the region. The range is home to at least 84 amphibian species, 16 bird species, seven mammals, and 1,600 flowering plants which are not found elsewhere in the world.

### **Western Ghats comprised of 7 SUB-CLUSTERS:**

- **Agasthyamalai Sub-Cluster** : The Agasthyamalai Biosphere Reserve 900 km<sup>2</sup>, includes Kalakkad Mundanthurai Tiger Reserve 806 km<sup>2</sup> in Tamilnadu and Neyyar, Peppara and Shendurney Wildlife Sanctuaries and their adjoining Reserve Forests
- **Periyar Sub-Cluster** : Periyar National Park, 777 km<sup>2</sup>, in Kerala, On the eastern side, lying largely in a rain-shadow area with mostly drier forests,
- **Anamalai Sub-Cluster** : Chinnar Wildlife Sanctuary, Eravikulam National Park ,90 km<sup>2</sup>, Indira Gandhi National Park and the Wildlife Sanctuary, 958 km<sup>2</sup>, and Palani Hills National Park 736.87 km<sup>2</sup> in Tamilnadu and Parambikulam Wildlife Sanctuary 285 km<sup>2</sup> in Kerala.

- **Nilgiri Sub-Cluster**: The Nilgiri Biosphere Reserve with Karimpuzha National Park 230 km<sup>2</sup>, Silent Valley National Park, 89.52 km<sup>2</sup> and Wayanad Wildlife Sanctuary 344 km<sup>2</sup> in Kerala, Bandipur National Park 874 km<sup>2</sup> in Karnataka, Mukurthi National Park 78.46 km<sup>2</sup>, Mudumalai National Park 321 km<sup>2</sup> in T.N. This has a largely secure forest complex of over 6,000 km<sup>2</sup>
- **Talacauvery Sub-Cluster** : Nagarhole National Park 321 km<sup>2</sup>, Pushpagiri Wildlife Sanctuary 92.65 km<sup>2</sup>, in Karnataka and Aralam Reserve in Kerala.
- **Kudremukh Sub-Cluster** : Kudremukh National Park 600.32 km<sup>2</sup>, and surrounding Reserved Forests of Someshwara, Agumbe and in Karnataka.
- **Sahyadri Sub-Cluster**: Anshi National Park 340 km<sup>2</sup>, Chandoli National Park 317.67 km<sup>2</sup>, Koyna Wildlife Sanctuary and Radhanagri Wildlife Sanctuary in Maharashtra.

## **FLORA**

- The Western Ghats have four tropical and subtropical moist broadleaf forest types...
  - North W. G. moist deciduous forests,
  - North W. G. montane rain forests,
  - South W.G evergreen forests
  - South W. G. moist deciduous forests, and
  - South W. G. montane temperate forests.
- The northern portion of the range is generally drier than the southern portion, and at lower elevations makes up the North Western Ghats moist deciduous forests with predominantly of teak. Above 1,000 meters elevation are the cooler and wetter North Western Ghats montane rain forests, whose evergreen forests are characterized by trees of family Lauraceae.

- The evergreen Wayanad forests of Kerala mark the transition zone between the northern and southern eco regions. The southern regions are wetter and species-rich. At lower elevations are the South Western Ghats moist deciduous forests, with *Cullenia* the characteristic tree genus, accompanied by teak, Dipterocarps, and other trees. The moist forests transition to the drier South Deccan Plateau dry deciduous forests, which lie in its rain shadow to the east.

- Above 1,000 meters are the South Western Ghats montane rain forests, also cooler and wetter than the surrounding lowland forests, and dominated by evergreen trees, although some montane grasslands and stunted forests can be found at the highest elevations. The South Western Ghats montane rain forests are the most species-rich ecoregion in peninsular India; eighty percent of the flowering plant species of the entire Western Ghats range are found in this eco region.

## FAUNA

- The Western Ghats has at least 325 globally threatened species. Many are endemic species, especially in the amphibian and reptilian classes.
- Mammals- There are at least 139 mammal species.
- **Critically Endangered Mammals**: Malabar Large-spotted Civet. Lion-tailed Macaque Only 2500 of this species are remaining. The largest population in Silent Valley NP and in Kudremukh NP , Nilgiri Langur ,Asian Elephants (over six thousand elephants) and 10% Tiger population. Mouse deer in Agasthyamalai.
- Wroughton's free tailed bat in Bhimgad in Belgaum. Theobald's tomb bat in in Krishnapur caves. Lesser False Vampire bats in the Talevadi caves

- **Vulnerable Mammals:** the Bandipur NP and Nagarahole hold over 5000 Gaur. Indian Muntjac. Sloth Bears, Wild dog etc. the Dandeli and Anshi NP has the Black Panther and Great Indian Hornbill
- Host of other wildlife like Leopards, Sambar, Chital, Wild Boars
- These hill ranges serve as important wildlife corridors, allowing seasonal migration of elephants
- **Reptiles-** The snake family **Uropeltidae** is endemic to WG
- **Amphibians-** More than 80% of the 179 amphibian species is endemic and are mostly in the rainforests. The endangered Purple frog discovered in 2003 said to be a living fossil. This is closely related to species found in the Seychelles.
- **Fish-** 102 species of fish reported; home to several brilliantly coloured ornamental fishes like Red line torpedo barb, Red tailed barb, Günther's catfish and freshwater puffer fish and Malabar Mahseers
- **Birds-** There are at least 508 bird species. Bhadra Wildlife Sanctuary has species from both the Sahyadri as well as the Malabar
- **Insects-** roughly 6,000 insect spp. from Kerala alone. Of 334 butterfly spp. recorded from the WG, 316 species have been reported from the Nilgiri Biosphere Reserve alone.
- **Molluscs-** Seasonal rainfall patterns of the Western Ghats necessitate a period of dormancy for its land snails, resulting in their high abundance and diversity including at least 258 species of gastropods from 57 genera and 24 families.

## **EASTERN HIMALAYAS**

- Eastern Himalaya is situated between Central Nepal in the west to Myanmar in the east, occupying Sikkim, North Bengal, Bhutan and North-East India.
- Eastern Himalaya can be divided into four distinguished regions;
- Darjeeling Himalaya including eastern Nepal
- Sikkim Himalaya
- Bhutan Himalaya
- Arunachal Himalaya

## **FAUNA**

- It is home to 163 globally threatened species, including Asia's three largest herbivores—the Asian elephant (*Elephas maximus*), the greater one-horned rhinoceros (*Rhinoceros unicornis*), and the wild water buffalo (*Bubalus bubalis*)
- largest carnivore is the tiger (*Panthera tigris*), and some unique species like clouded leopard, Malayan sun bear, Binturang
- Endemic and unique goat antelopes such as Takin, Serow
- Endemic **Ape** like Hoolock Gibbon
- High altitude spp. like. Ibex, Blue sheep, Yak, Red Panda
- Several large birds such as vultures, adjutant storks, and hornbills.

## **FLORA**

Major Forest Types:

- Tropical Evergreen and semievergreen
- *Dipterocarpus spp.*, *Shorea robusta*, *Tetrameles nudiflora*
- Sub-Tropical forests
- Eg: *Schima wallichii*, *Castanopsis indica*,
- Tropical Moist deciduous
- Montane wet Temperate Forests
- Himalayan Moist Temperate Forests

*Acer campbelli*, *Corylopsis himalyana*, *Ilex sp.*, etc.

- Mixed conifer forests
- Hemlock *Larix griffithiana* (only deciduous conifer in India), *Picea morinda*
- Sub alpine forests and meadows

## **THREATS**

- Chronic collection of non-timber forest products;
- harvest of trees for fuel, fodder, and lumber;
- conversion of forests for agriculture contribute to ecosystem degradation and habitat loss esp. Shifting cultivation.
- Unsustainable and illegal wildlife trade fueled by consistent demand for wildlife products, especially parts of the large species such as tigers, rhinoceros, and elephants
- Unscientific management of the forest resources

## India's Amazing Biodiversity from its varied Landscape

- a) **Two 'Realms** – the Himalayan region represented by Palearctic Realm and the rest of the sub-continent represented by Malayan Realm
- b) **Five Biomes** –
  - (i) Tropical Humid Forests (ii) Tropical Dry or Deciduous Forests
  - (iii) Warm deserts and semi-deserts
  - (iv) Coniferous forests and (v) Alpine meadows.
- c) **Ten Bio-geographic Zones** - 1. Trans Himalayan, 2. Himalayan, 3. Indian Desert, 4. Semi-Arid, 5. Western Ghats, 6. Deccan Peninsula, 7. Gangetic Plain, 8. North-East India, 9. Islands, 10. Coasts

### Mountain Systems

- Extent: About 100million ha.
- The Himalayas in the far north include some of the highest peaks in the world. The highest mountain in the Indian Himalayas is Khangchenjunga (8586 m) which is located in Sikkim on the border with Nepal. To the south of the main Himalaya lie the Lesser Himalaya, rising to 3,600- 4,600 m, and represented by the Pir Panjal in Kashmir and Dhauladhar in Himachal Pradesh. Further south, flanking the Indo-Gangetic Plain, are the Siwaliks which rise to 900- 1,500 m.
- Vindhya and Satpura Mountain Ranges
- Aravallis Range
- Eastern Rajmahal Hills
- Western and Eastern Ghats – Faulted slopes of the Deccan Plateau
- North Eastern Hills – branch of Arrakkan Range- Mishmi Hills, Karbi Anglong Hills, Khasi-Garo- Jaintia Hills, Cachar Hills, Naga Hills

### **Desert and Semi Arid areas**

- Arid and semi-arid zones spreading over 30 million hectare
- Thar desert; semi arid zones of Punjab and Rajasthan and the salt Marshes of Rann of Kutchh
- Vibrant desert ecosystem with animals having wide adaptations Eg: Camel, kangaroo rat
- Fauna: Desert Fox, Bengal Fox, Desert Cat, Wolf, Black Buck and Chinkara., Spiny-tailed lizard, monitor lizard, saw scaled-viper, Russel viper, krait.
- Avian-Fauna: Sandgrouse, partridges, larks and shrikes are endemic; demoiselle, crane , Bustards . Raptors include tawny and steppe eagles, long legged and honeybuzzards, falcons and kestrels.
- Lakes in these regions frequented by migratory water fowls
- Flamingo city in the Kutchh, Asiatic wild Ass.

### **Wetlands**

The total area of wetlands (excluding rivers) in India is 58.28 million ha, or 18.4% of the country, 70% of which comprises areas under paddy cultivation.

The country's wetlands are generally differentiated by region into EIGHT categories (Scott, 1989):

- Lakes of the Deccan Plateau in the south, together with the lagoons and the other wetlands of the southern west coast;
- The vast saline expanses of Rajasthan, Gujarat and the gulf of Kachchh;
- Freshwater lakes and reservoirs from Gujarat eastwards through Rajasthan (Kaeoladeo Ghana National park) and Madhya Pradesh;
- The delta wetlands and lagoons of India's east coast (Chilka Lake);

- The freshwater marshes of the Gangetic Plain;
- The floodplain of the Brahmaputra including the marshes and swamps in the hills of north-east India and the Himalayan foothills;
- the lakes and rivers of the montane region of Kashmir and Ladakh; and
- The mangroves and other wetlands of the island arcs of the A & N

**Ramsar Wetland Sites:- Indian Examles**

- Tso Moriri Lake (J&K)
- Wular Lake (J&K)
- Pong Dam Reservoir (H.P)
- Harike Lake (Punjab)
- Ropar Lake (Punjab)
- Kanjli Lake (Punjab)
- Sambhar Lake (Rajasthan)
- Keoladev Wetlands (Rajasthan)
- Bhoj Wetlands (M.P)
- Loktak Lake( Manipur)
- Deepar bheel (Assam)
- East Calcutta Wetlands (West Bengal)
- Chilka lake (Odisha)
- Bhitar Kanika Wetlands (Odisha)
- Koleru Lake (Andhra Pradesh)
- Point Calimere Wetlands (TamilNadu)
- Vembanadu Lake (Kerala)
- Ashtamudi Lake (Kerala)
- Sasthamkotta Lake (Kerala)

## **Grass lands**

### **Five distinct types:**

- Sehima - Dicanthium type: in the Peninsular India. Other spp. Heteropogan sp, Themeda sp.
- Dicanthium- Cenchrus- Lasiurus type: Semi arid Northern and N-W India.
- Phragmites-Saccharum-Imperata type: Alluvial plains of Ganga, Brahmaputra, West Bengal.
- Themeda-Arundinella Type: Foot hills and humid mountains of NE India, Himalayan belt.
- Temperate –alpine type: High altitude areas. Other Spp: Dactylus glomerta, Bromus inermis , Festuca pratensis.

## **Marine System**

- A coastline of 7,516 km
- The total commercial marine catch for India is between 1.4 and 1.6 million tonnes, with fishes from the clupeoid group (e.g. sardines *Sardinella* sp., Indian shad *Hilsa* sp. and whitebait *Stolephorus* sp.) accounting for approximately 30% of all landings.
- Five species of marine turtle occur in Indian waters: Green turtle, Loggerhead, Olive Ridley, Hawksbill, and Leatherback

| <u>Locality</u>      | <u>Genera</u> | <u>Species</u> |
|----------------------|---------------|----------------|
| ■ Andaman Islands    | 31            | 82             |
| ■ Nicobar Islands    | 43            | 103            |
| ■ Lakshdweep Islands | 37            | 103            |
| ■ Gulf of Kutch      | 24            | 37             |
| ■ Gulf of Mannar     | 36            | 117            |

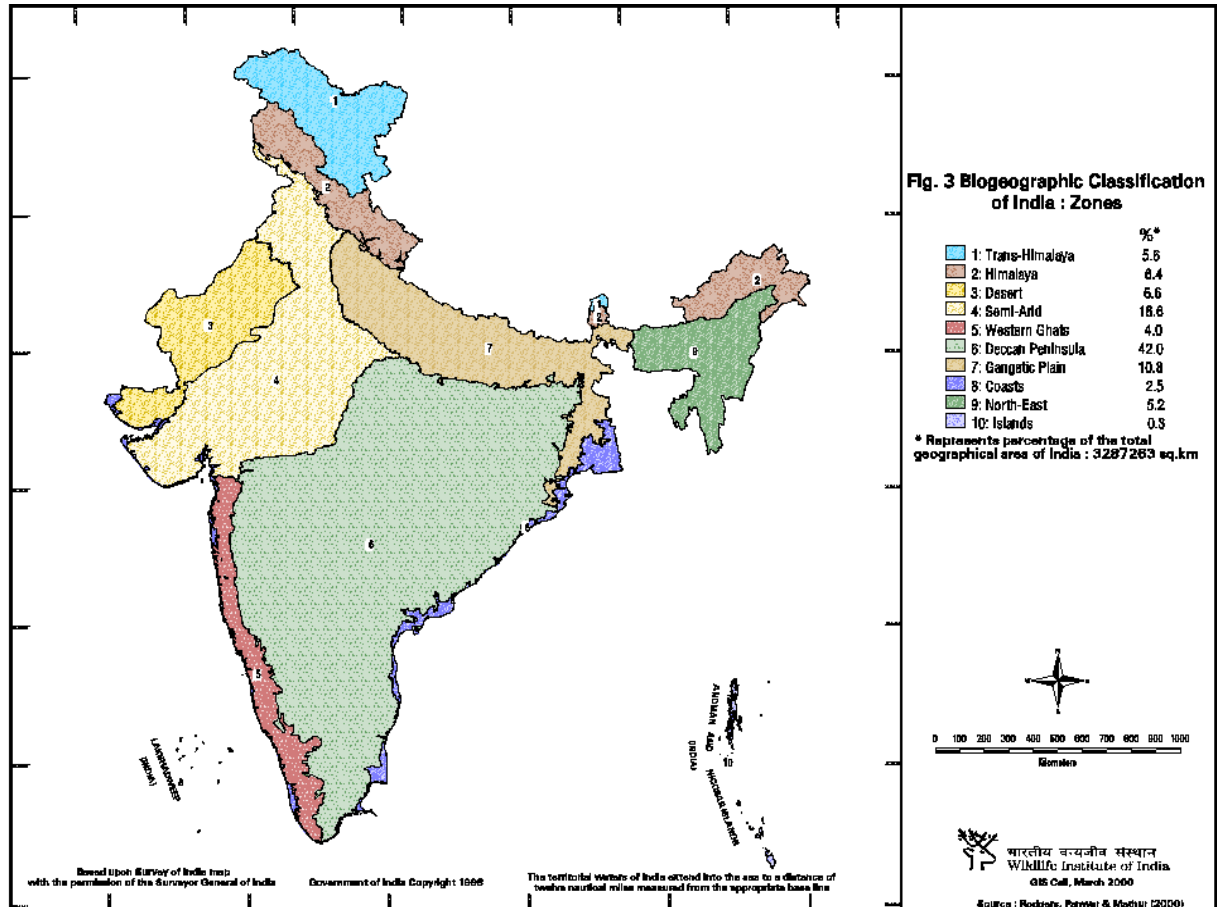
### **Comparison Between the Number of Species in India and the World.**

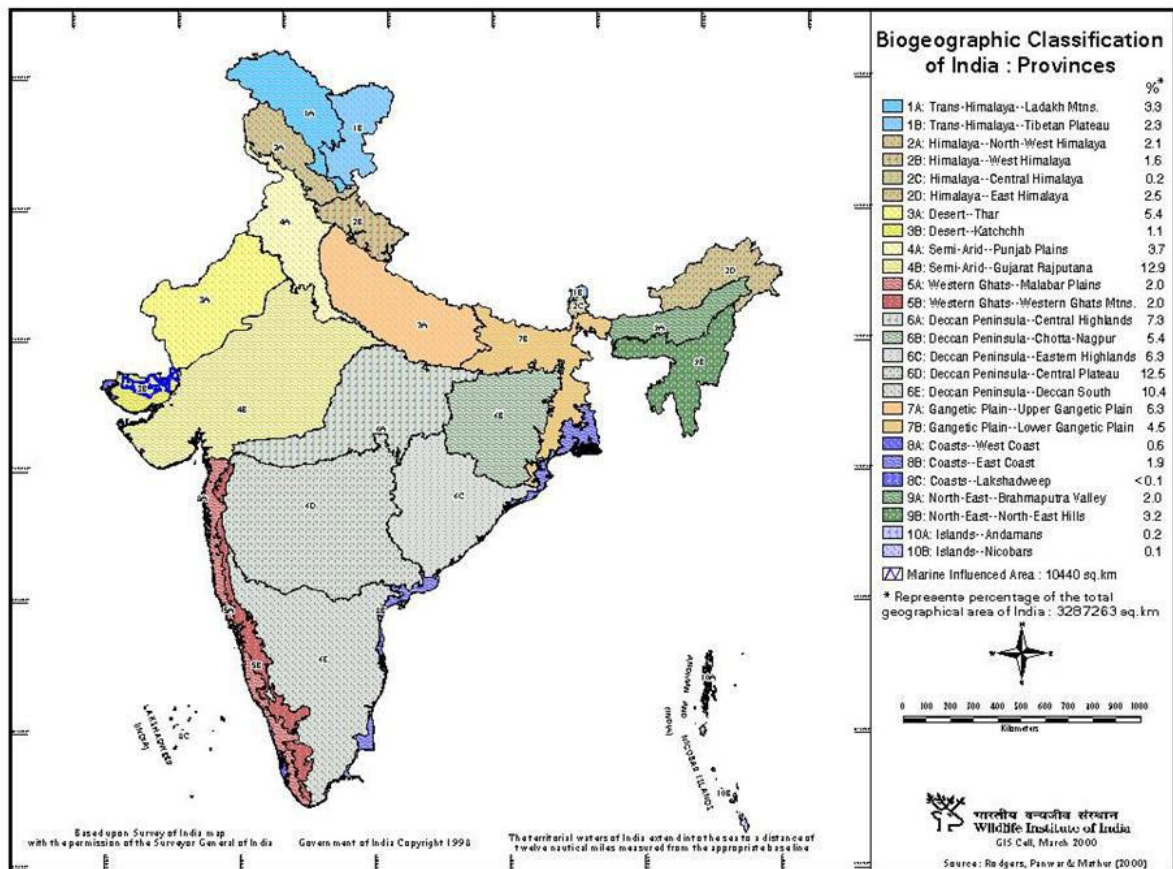
| Group            | No of spp. in India | No of spp.in the world | (%)  |
|------------------|---------------------|------------------------|------|
| Mammals          | 350                 | 4,629                  | 7.6  |
| Birds            | 1224                | 9,702                  | 12.6 |
| Reptiles         | 408                 | 6,550                  | 6.2  |
| Amphibians       | 197                 | 4,522                  | 4.4  |
| Fishes           | 2546                | 21,730                 | 11.7 |
| Flowering Plants | 15,000              | 250,000                | 6.0  |

## CHAPTER: 8

### BIOGEOGRAPHIC ZONES OF INDIA

In 1988, the Wildlife Institute of India (WII) prepared a Bio geographic Classification of India to facilitate national conservation planning at the national and intra-state levels. Within India, this classification recognizes 10 Bio geographic Zones, which are further divided into 26 Biotic Provinces.





## **BIOGEOGRAPHIC CLASSIFICATION**

### **BIOGEOGRAPHIC ZONE**

Large distinctive units of similar ecology, biome representation, community and species e.g. Himalayas & desert

### **BIOTIC PROVINCE**

Secondary units within zone emphasizing on particular communities separated by dispersal barriers or gradual change in environ, factors e.g. Western & Eastern Himalayas

### **THE LAND REGION**

Tertiary units within a Province indicating different land forms

e.g. Kumaon and Garhwal in West Himalayas;

## **BIOMES**

This is an ecological unit; BIOMES can be equated with Champion & Seth's broad Forest vegetation Types. A biome such as Temperate Broad leaved forest could be found in several Bio geogr. zones or Provinces.

### **TRANS HIMALAYAN ZONE (5.62%)**

1A : Ladakh mountains

- Hemis NP (J.K)
- Pin Valley NP (HP)

1B: Tibetan Plateau

- Kibber WLS (HP)
- Changthang WLS (J.K)
- Shingba Rhododendron WLS (Sikkim)

Fauna: Wild Sheep ( Nayan, Urial) and Goats ( Ibex, Him.Tahr), Snow leopard, Tibetan Antelope.

### **HIMALAYAN ZONE (6.4%)**

2A: North West Himalaya

- Dachigam NP(J.K) –
- Kashmir Hangul (Red deer)

2B: West Himalaya

- Kedarnath NP (Uttaranchal) – Musk deer

2C: Central Himalaya

- Kyongsla Alpine WLS (Sikkim) – Black bear
- Sighalila NP(WB) – Red Panda

## 2D: East Himalaya

- Namdapha NP (Arunachal Pradesh)- Tiger

## **DESERT ZONE (6.56%)**

### 3A: Thar

- Desert NP (Jaisalmer, Rajasthan)
- Desert Fox, Chinkara,
- Black Buck, Bustard

### 3B: Katchch

- Wild Ass Sanctuary (Little Rann)
- Asiatic Wild Ass, Flamingoes

## **SEMI ARID ZONE (16%)**

### 4A: Punjab Plains

- Harike Lake WLS- Migratory Water fowls

### 4B : Gujarat –Rajputhana

- Gir NP - Lion
- Chambal WLS (UP & MP) Marsh crocodiles, Tortoises
- Ranthambore NP –tigers, sambar

## **WESTERN GHATS ZONE (4.03%)**

### 5A: Malabar plains

- Kudremukh NP (Karnataka) LTM, Gaur
- Thekkadu Bird Sanctuary( Ker.)- Frogmouth

### 5B: Western Ghats Mountains

- Silent valley NP (Ker.)- LTM, Tiger

- Nagarholle NP ( Karn.)
- DECCAN ZONE (42%)

#### 6A: Central Highlands

- Satpura NP (MP) – Tiger

#### 6B: Chotta-Nagpur

- Simlipal NP, Satkoshia WLS (Orissa) – Tiger, elephants

#### 6C: Eastern Highlands

- Indravati NP ( Chattisgarh)- Wild Buffaloes

#### 6D: Central Plateau

- Tadoba NP (Maharashtra) – Tiger
- SriSailam WLS (AP)- Tiger

#### 6E: Deccan South- Guindy NP(TN)- Black Buck

### **GANGETIC PLAINS (10.8%)**

#### 7A: Upper Gangetic Plains

- Corbett NP( Uttaranchal)
- Dudhwa NP (UP)

#### 7B: Lower Gangetic Plains

- Valmiki NP (Bihar)
- Buxa NP, Jaldapara WLS (WB)

### **COASTS (2.5%)**

#### 8A: West Coasts

- Gulf of Katchch Marine NP (Gujarat)- Coral
- Sanjay Gandhi NP, Borivilli( Maha)- leopards

#### 8B: East Coasts

- Sunderban NP- Tiger
- Gulf of Mannar Marine NP (TN)- Coral, dugong

#### 8C: Lakshadweep

- Pitti WLS- Marine birds
- NORTH EAST ZONE (5.2%)

#### 9A: Brahmaputra Valley

- Kaziranga NP, Pabitora WLS (Assam) – Rhino, Wild buffaloes
- Manas NP – Golden Langurs, Hispid Hare

#### 9B: North East Hills

- Keibul Lemjao NP (Manipur)- Sangai deer
- Sepahijala WLS( Tripura) – Phyre's Leaf monkey
- Dampa WLS (Mizoram) - Tiger
- Intaki NP, Rangapahar WLS (Nagaland)
- Balphakram NP (Meghalaya)- Elephant

#### **ISLANDS ZONE (0.25%)**

##### 10A: Andamans (550 Islands but 26 are inhabited)

- Rani Jhansi Marine NP – Coral
- Mount Harriett NP
- Barren Island WLS

##### 10B: Nicobars (22 Isle and 10 inhabited)

- Galathea NP- Crab-eating Macaque
- Campbel Bay NP
- Megapod island WLS - Megapod

## **CHAPTER: 9**

### **WILDLIFE BIOLOGY**

- Habitat: A place where an animal lives ( Odum)
- A range of environment a species occurs (Krebs)
- Niche: Organism' s profession ( Odum)
- The role of an organism within a community (Krebs)
- Habitat is the address and the Niche is its occupation
- Habitat is not synonymous with vegetation and Niche is not about feeding relationship alone
- Two Species can occupy same habitat but cannot occupy same niche which leads to competition and ultimately leads to the exclusion of the other
- Major habitats: Forests (EG to Thorny), Grassland, Mountains, Desert ( Hot & Cold), Aquatic ( Fresh water and Marine) etc.
- Ecotone: transition zone between two habitats eg: estuarine, wetlands etc.
- Habitats → Specific species;
- Biotope → Community ( having many spp.)
- Biosphere → All living beings
- Macro habitat: eg. Forests
- Microhabitat : eg. A snag tree there
- Stenotopic spp: occupying a narrow habitat eg: Barking deer
- Eurytopic spp: occupying a varied habitat eg: sambar deer
- Different wildlife adapts to various levels of plant succession  
( pioneers, colonizers)
- Rhino an early Seral Species.

## **HABITAT**

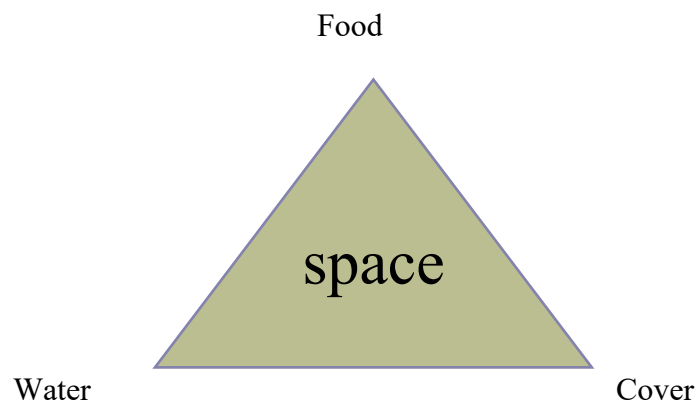
Three components.

- Food, Water and Cover

Some researches add a fourth dimension: space

These determine the carrying capacity of a habitat

Cover is needed for escape, ambush, reproduction, resting, travel etc.



**Welfare factors:** Food, water, cover, space

**Decimating factors:** Competition, fire, starvation, epidemics etc.

## **COVER**

Different types of Cover:

- Refuge Cover
- Ambush Cover
- Loafing Cover
- Breeding Cover
- Roosting Cover

### **Interspersion and Juxtaposition**

**Juxtaposition:** is a measure of the proximity of different habitat units (Giles, 1978). Dissimilar habitat units if properly juxtaposed, adds to the animal richness. If food is present in close proximity to cover, more animals are attracted.

**Interspersion:** It is a measure of system relations (Giles, 1978). It is the intermixing of units pertaining to different habitat types. It indicates the distribution of food resources and proximity to food resources. A desirable juxtaposition is a function of interspersion

**Edge effect:** An edge is the place of contact between plant communities or successional stages. It is also synonymous with Ecotone. When more edges are there, more will be the animal richness. There are Inherent edges and induced edges.

### **Edge effect and Interspersion**

- Snag trees: Standing dead trees that are devoid of leaves.
- Fallen dead trees
- Dead and Downy dead material
- Cliffs, Talus ( rocky outcrops), caves
- Water bodies

### **Habitat Evaluation**

Two types of Habitat Evaluation:

1. Done for specific management objectives where appraisal is done for the needs of a particular species
2. Done to determine the habitat values for several spp. of animals or for entire biological communities and is more generalized in nature

### **Three basic aspects are studied:**

What the habitat consists of (Inventory) food availability, cover, extent of edge, extent of dispersion and juxtaposition etc. How good or bad the habitat or our target species.

Whether changes occurring in the habitat are good or bad.

### **Parameters important for Habitat evaluation**

1. **Physical Parameters:** Climate, light, wind, topography, humidity, soil, Fire, water availability

2. **Biological Parameters:** Food availability, cover availability, Indicator species, Species diversity

The most important biological parameter of a habitat is the vegetation which is the expression of a site on a prevailing climate and wildlife are evolved along with that.

We use a mix of various of methods to get evaluation of the vegetal cover such as tree cover, shrub cover, grass cover, ground flora etc.

We evaluate vegetation through ecological sampling techniques

### **Ecological Sampling Techniques**

- For vegetation Non-random sampling like Systematic sampling is adopted
- Ground flora measurement : 1mx1m plots at definite intervals in a transect
- Shrub cover: 5mx5m plots at definite intervals
- Tree cover : 25m x25m or 50m x50m depending on the diversity

### **Other evaluation Models**

- Community Models with the help of birds
- Pattern recognition Model for wetlands
- Animal health Model
- Geographical Information System models & Diversity Indices.

## **CHAPTER: 10**

### **WILDLIFE BIOLOGY :**

#### **HERBIVORY, COMPETITION, CARRYING CAPACITY, GROWTH EQUATIONS**

##### **GRASSES AND HERBIVORY**

- Energy flow from grassland ecosystem is higher as much of the biomass gets locked up in tall trees in forests.
- Grasses evolved in late tertiary age along with herbivores.
- Grazers have fermenting bacteria in guts vis-à-vis browsers that has simple guts.
- Grasses have their meristem concealed below at the base and hence withstand grazing or fire.
- Smaller the bodyweight of animal, browsers they become; heavier body → mixed feeders; Heaviest → exclusive Grazers.
- Grazers have large bodyweight while carnivores have much less.
- Animals in cooler climes has larger in size (Bergman's Rule)
- Animals in cooler climes have much shorter extremities such as tail, ear lobes, bill, neck etc. vis-à-vis their tropical cousins (Allen's Rule)

##### **Jarmen's Classification:**

Less than 5kg : confirmed browser eg: Mouse deer

5 -20 kg : more browser and less grazer eg: Barking deer

20 -50 kg : mixed eg: Chital

50 -200 kg : mixed but more of grazer

Above 200 kg: Grazer eg: Buffaloes, elephant

## **Competition & Facilitation**

**Gause Theorem:** Two species with same or similar ecological niche cannot coexist; one will be excluded through competition or will evolve away

- **Niche overlap:** Occurs often in nature. Works well when there is abundance of resources and during crunch period they would revert back to their own niche
- It gives better and efficient utilization of resources;
- It gives better competitive edge
- Niche width

## **AVOIDING COMPETITION**

Animals avoid competition through ecological isolation

Different habitat

Different food species

Behavioural difference

- Cases of Tiger, Leopard, Lion, lesser cats
- Case of LTM and Nilgiri Langur: LTM is diurnal; frugivorous; in high canopies; NL exhibit two activity patterns – early morning and evening; leaf eater; mid canopy
- Case of Bee eaters: Blue throated- in Forests, Green- In dry tracts, Blue tailed - near canal, Chestnut headed- in eco tone
- **Facilitation is complementing the other spp.**

Langur- chital

Rhino – Hog deer

### **Habits and Activity patterns**

- Diurnal, Nocturnal and Crepuscular
- Aerial, Arboreal, Terrestrial, Fossorial and Aquatic
- Focal animal sampling
- Feeding: Carnivore, Herbivore, Omnivore
- Movement: Migration, seasonal movement. Range movement, Territorial movement
- Reproduction: Rut and mating; Mating display

### **SOCIAL BEHAVIOUR and COMMUNICATION**

- Family Groups esp. in mammals
- Vocalization- both audible and inaudible (ultra sound in case of cetaceans, elephants, bats)
- Alarm calls, Communicative calls, Mating calls
- Wild male elephants could respond to ‘rumbles’ in earth produced by female in heat( exp. In Namibia)
- Wild dogs: whistle; whimper; yelp
- Hoolock
- Pea cock
- Himalayan Sibia
- Orange headed Thrush

### **BIRD SOUND RECORDING AND ANALYSIS**

Useful to identify birds through calls

Useful to bring into open very shy birds by imitating the calls of its mate

Birds singing vary with seasons, vary during mating time etc.

## Habits and Activity patterns

- Marking territory: Territory and Home Range
- Inter specific and intra specific aggression
- Dominance Hierarchies and pecking order
- Variations within species

Sexual dimorphism

Immature & adult

Seasonal changes

Racial differences

- Pheromones & scent glands
- Seasonality in reproduction

## Animal signs

- Foot Impressions & tracks
- Animal droppings
- Feeding Signs
- Digging of soil
- Mark on the tree trunk by Tiger, bear etc.
- Tiger injures nape and feeds from back rejecting intestine& stomach while Leopards feed on intestine and stomach
- Wild dogs clean away the bones while Hyena even crush and eat it hence their scat is full of calcareous encrustations
- Pugmarks for Cats
- Spoor for Canids
- Foot prints for herbivores
- Scat for carnivore
- Pellets for Deer
- Birds and reptiles have their droppings covered with white powdery Uric acid
- Deer leave sharp cut
- Hairy pull out on stems by cattle
- Porcupines generally girdle trees like Cassia, Bombax
- Soil digging by pigs and sloth bears

## **RESPONSE OF STRESS TO WILDLIFE**

- Caused by competition, fire, drought, food shortage and other climatic & biological factors

### **During drought:**

- Females stop breeding and would not come to heat
- Males are the one to die first
- Competition for mate helps in breeding and survival as fittest would only transfer their genes to next generation
- Examination of the carcass resulted from starvation or disease shows that their bone marrow is watery and blood coloured. Healthy marrow shall be pinkish white and cheesy.
- Observation of kidney fat also an indication of starvation
- When 30% of the weight of animal
- High temperature stress: in camel, a maze of blood vessels around the brain to cool it down.

## **AGE DETERMINATION IN ANIMALS**

- By way of observing the annual rings on the horns
- By observing the dentition and its wear and tear
- By observing the number of tines in the antlers of deer

## **Carrying Capacity**

- Maximum no. of animal that can be supported in a given area.
- More practically, it may be the average number of animals which can be supported in an area over a period of years.

- How to assess it

Female to young ratio

Habitat condition

Health of the animal

- Ecological and Economic CC
- Ecol.CC : Max CC that area can support
- Eco. CC : Habitat not damaged- on a sustained basis it is maintained
- Originated at the cattle ranches of Europe where cattle units were recognized indicating the number of animals permitted to graze in a unit area.
- CC must convey entire spectrum of herbivores and carnivores in an area and not one species alone.
- It is dynamic state
- Requirements of food, water and cover vary among species and these should be included in the concept
- It should specify time
- More poor quality animals can be supported than healthy ones
- Animals may exceed their CC
- Interspersion and juxtaposition enhance the CC
- CC generally to be determined after long years of observation
- CC is related to the limiting factors in a system.

## **CHAPTER: 11**

### **MAJOR MEGA FAUNA OF OUR COUNTRY**

#### **Major Herbivore:**

##### **I. Cervids**

1. True Deer
2. Musk deer
3. Mouse deer

##### **1. Apes**

##### **2. Loris**

##### **3. Langurs**

##### **4. Macaques**

##### **II. Pigs**

##### **1. Wild boar**

##### **2. Pigmy hog**

##### **II. Bovids**

##### **1. Antelopes**

##### **2. Goat Antelopes**

##### **3. Goats & Sheep**

##### **4. Wild Cattle**

##### **III. Rodents & Lagomorphs**

##### **1. Squirrels**

##### **2. Porcupine**

##### **3. Hare**

##### **II. Pachyderms**

##### **1. Indian elephant**

##### **2. Rhinoceros**

##### **IV. Bats**

##### **Cetaceans**

##### **I Whales & Dolphins**

##### **II Dugongs**

##### **III. Equids**

##### **1. Wild Ass**

#### **Major Omnivores**

##### **I. Primates**

## Feral Horses

### **Major carnivores:**

#### I. Cats (Felids)

1. Large cats
2. Lesser cats

#### II. Dogs (Canids)

1. Hyena
2. Wolf, dogs, Jackal

#### III. Bears

1. Bears
2. Red Panda

#### IV. Veverids (Civets)

#### V. Mustelids (Martens, Badgers, Otter)

#### VI. Herpestids (Mongoose)

### **Deer**

#### **Basic Characters**

- Antlers are shed annually
- Ungulate (hoofed)
- Ruminants
- No incisors in the upper jaw
- Canines present
- Facial glands
- No gall bladder except Musk deer

- Moist naked nose

## **Indian Deer Species**

### **Sambar**

Occurs through out the country except deserts and alpine altitudes; highly adaptable; largest of Indian deer; It is essentially a browser; occurs solitary or in small groups

### **Red deer (Hangul & Shou)**

Hangul occurs in Kashmir's Temperate forests ( Eg: Dachigam NP) where as Shou seen in Sikkim Himalayas. Hangul is reddish where as Shou is darker.

### **Manipur Shangai**

Seen only in the Keibul Lemjao NP of Manipur; Also called dancing deer due to its balancing actions when feeding on the floating vegetation (locally referred to as Phumdies which is interwoven mat of grasses and other hydrophilic plants) in the lake; these floating vegetation is the primary habitat of these deer which has antlers in the shape of brow; hence also called Brow-antlered deer.

At present, about 38 species left in the wild

### **Barasingha ( Swamp and Hard ground)**

The name Barasingha arises from the multiple tines on the antlers. Hard ground Barasingha are seen in the central India esp. areas like Kanha NP

( MP); Swamp deer or the soft ground species seen near the wetland areas in Assam( Eg: Kaziranga NP) or in Dudhwa NP (UP); Swamp deer has splayed hooves to distribute its bodyweight effectively. The Hard ground spp. has pointed hooves like other deer species.

### **Barking deer (Red and Black)**

These are small and solitary deer seen in forests and very fastidious and selective in their food requirements. It nibbles the young shoot tip of preferred plants. The antler is more like stubs with a distinct V mark on the forehead running down to nostrils. Its barking alarm call much resembles that of dogs.

### **Chital / Spotted deer**

This is the most common deer in India, but are essentially an Ecotone species and prefer comparatively open ground; these are practically absent in dense forests. It is basically a grazer. Association between Langur and Chital is common (mutualism)

### **Hog deer**

Seen as associate of Rhino and Bison in wet riparian grasslands ( eg: Kaziranga NP; Jaldapara WLS in WB). It is smaller than Chital but larger than Barking deer.

### **Musk deer**

These are not true deer but allied to deer species, seen in high altitudes. It is different from other deer in having gall bladder, having its canines protruding out downwards, males having a unique musk gland near the naval area, having no antlers; These are solitary animals and are highly selective about food. Like barking deer, these deer also nibbles the young shoot tips. Carpinia shrubs seen in the high altitude temperate broadleaved forests are highly relished by musk deer. Musk glands get active during breeding season to attract mates.

### **Mouse deer/ Indian Chevrotain**

Smallest of the Indian deer although not a true deer; having the size of large rabbit and found in moist and evergreen forests from southern Western Ghats ( eg: Agasthya Malai) to Coorg. These are solitary and hence selective feeders. Generally not seen and with any alarm hide in holes or in small caves

**Antelopes** These animals generally found in the semi arid and arid areas on the plain lands, feeding on coarse grasses; they combine the characters of both Cervids and Bovids

- Common with Bovids

Permanent **non-shedding horns** with bony core

4 – Chambered stomach

No incisors and no canines

Outer toes absent or fused

- Common with Cervids

Slender legs and graceful build

Facial glands

Hair tufts on the knees

### **Indian Antelopes**

- **Nilgai**

Largest Antelope in India; Has become a pest of crops like Arhar, vegetables etc. in North India; Prefer semi arid plains

- **Black Buck**

Present only in India; Prefers arid to semi arid plains; Seen in Semi arid Rajasthan, Gujarat, Deccan plateau till TN.

- **4 –horned antelope (Chowsingha)**

Dry deciduous forests near riparian areas ; reported mostly in Deccan area; best seen at Bandipur

- **Indian Gazelle**

Mainly the arid plains of Rajasthan; bicoloured with white and light brown

- **Tibetan Gazelle**

At cold deserts like Ladakh

- **Tibetan Antelope (Chiru)**

Most hunted antelope for its highly valued fur; seen cold deserts like Ladakh; now few hundreds exist.

## **Bovids**

### **Goat Characters**

Flat tail that is naked underneath

Beard

Knee calluses

Anal glands

Pedal glands only on forefeet

Body Odour

Habitat: Precipitous slopes and cliffs

Habit : males always associated with a specific herd

### **Sheep Characters**

Facial glands and groin glands

Pedal glands on all legs

Round and hairy tail

Habitat: high altitude Plains and flat lands

Habits: males not associated with a specific herd

### **Goat Antelopes**

These combine the characters of both the goats and antelopes

They fight by ramming each other with their head on unlike goats/ sheep which ram their horns at each other.

All these animals are occupants of rugged mountains or high altitude rugged plains

### **Goat, Sheep & Goat antelopes**

#### **Goat Antelope**

Takin

Serow

Goral

**Takin** is restricted to Eastern Himalayas, mainly Bhutan (their State animal) and is stocky much like a wild cattle and Arunachal. Serows are medium built and found mostly in Eastern Himalayas but distributed till western Himalayas. Gorals are much smaller and found mostly in Western Himalayas

### **Goat**

#### **Himalayan Tahr**

Western Himalayas & Central and Eastern to some extent

#### **Nilgiri Tahr**

Nilgiri belt till Periyar and KMT Tiger Reserve. Nilgiri Tahr is restricted on the shola grasslands of Kerala and T.N; best seen at the Eravikulam NP near Munnar.

#### **Kashmir Markhor**

Largest Mountain goat in the world; Seen towards areas close to PakOccupied Kashmir

#### **Asiatic Ibex**

Seen in Western, Central and Eastern Himalayas; Horns are long curved with serrations much like Mountain Goat which is seen in Pakistan Himalayas

## **Sheep**

### **Ladakh Urial / Red sheep**

**Argali/ Nayan** Also called Great Tibetan Sheep and is the largest Sheep ; has recurved horns facing out where as the recurved horns facing towards neck in the case of Urial

### **Blue sheep/ Bharal**

Seen in Western, Central and Eastern Himalyas; Horns smaller but growing outwards in opposite directions

## **Wild Cattle**

- Well developed sense of smell
- Massive build
- Pad in upper jaw instead of incisors or canines
- Fused incisors and canines in lower jaw
- 4 –chambered stomach
- Big horns that are not shed
- Indian Spp.
- Gaur

Distributed in Southern India, Central India and NE forests; has characterized “white stockings” on its legs.

## **Wild buffalo**

Has two distinct population: Central Indian (eg: Indravati NP in Chhatisgarh) and Eastern Indian alluvial Plains (eg: Kaziranga); arrangement Horns at an angle with the forehead unlike Gaur; Breeding with domestic buffalo is the real problem

### **Yak**

High altitude cattle seen in Western, Central and Eastern Himalayas

### **Mithun**

Believed to have originated from Gaur and domestic cattle; has great resemblance to Gaur except the pink blotches on the body; much of it has been domesticated and is the state animal of Arunachal

### **Banteng**

It is a South east Asian wild cattle mainly distributed over Thailand, Malaysia and Myanmar; reported from Manipur and Nagaland; Believed to be the precursor to domestic cattle in Asia has resemblance to the present day domestic cattle breeds

### **Equids**

- Odd toed ungulates (Perissodactyls)
- Non- ruminant
- Has long incisors
- Long head, neck with long mane
- Slender limbs
- There are no wild horses in the wild although Feral ones exist

### **Bears**

Good sense of smell, poor eye sight, Non-retractable claws, Protrusible lips that separate from gums, omnivore.

- Sloth Bear : in Tropical forests.
- Black bear : in Himalayan slopes
- Brown Bear : near Alpine meadows
- Malayan Sun Bear : NE forests & Red Panda: High altitude eastern Himalayas

## **FELIDS**

- Tiger : 9 spp existed – Siberian, Caspian, South Chinese, Malayan Indochinese, Jawan, Sumatran, Balenese and Royal Bengal,
- Asiatic Lion : in semi arid forests of Gir
- Leopard/Panther: through out except deserts
- Snow Leopard: high altitude Himalayas
- Clouded Leopard: NE hills; mostly arboreal

## **Lesser cats**

- Leopard Cat: through out but mostly forested
- Marbled Cat: Ladakh
- Rusty Spotted Cat: South Indian forests
- Jungle Cat : through out
- Fishing Cat: neat alluvial plains along with rivers
- Caracal: semi arid plains
- Eurasian Lynx: Ladakh
- Desert Cat: hot and arid areas
- Pallas Cat: Ladakh
- Golden Cat: NE

- All these lesser cats have definite niche and habitat

## **CANIDS**

- Five digits (fingers) in forefeet four in hind
- Non-retractable claws
- Long sharp and upstanding ears
- Long bushy tail
- Long limbs
- Long pointed muzzle
- Pack forming

### **Wolf (Tibetan and Grey)**

**Distribution:** Grey wolves seen in semi arid areas ranging from Deccan to Rajasthan to Gangetic plains where as Tibetan wolves seen at high altitude Himalayan plateau.

**Conservation threat:** hybridization, habitat loss, poaching

### **Wild dog**

These reddish dogs with black tails, best seen in the Western Ghat forests at Karnataka and Kerala ( eg: Bandipur NP) although distributed over the Deccan and Vindhya.

**Conservation threat:** habitat loss, poaching

### **Jackal**

Seen through out with buff colour and hairs not smooth unlike that of Fox

### **Fox**

Three species reported in India:

- **Indian Fox:** Through out India ; near habitations generally drier open country
- **Red Fox:** Seen in cold climate areas of J & K, Himalayas
- **Desert Fox:** Is a variant of Red fox seen in desert and warmer climes and are smaller and grayish

### **Striped Hyena**

This ungainly scavenger has sloppy back with weak hind legs and has the characters of Cats and dogs; can be best observed at Gir NP. Its laughing call that ends in a cackle is typical

### **PRIMATES**

- Has nails
- Eyes in the front
- 5- digits ( fingers) on the limbs
- Apes are tail less and can stand and walk on two legs

Evolved to be arboreal with forward facing eyes: Developed cerebral hemispheres.

High level of social bonding and grooming behaviour; while Lorises are not group forming and insectivorous, multi male groups exist among Macaques; single male group among Langurs; while Gibbons are monogamous

### **Major Primates**

- Rhesus Macaque: in Northern India; red rump and reddish brown hairs near the anus ; shorter tail is typical
- Bonnet Macaque: in Southern India; with long tails
- Assamese Macaque : In NE India; thick set body; short erect tails

- Arunachal Macaque: recently discovered; bigger body
- Lion tailed Macaque: in E.G. Forests of W.G.
- Leaf Monkey: in North east esp. Tripura; also called spectacled monkey and mainly leaf eating
- Crab eating Macaque: endemic to Nicobar
- Common Langurs: Throughout except NE & Deserts; said to have four different variants
- Nilgiri Langur: in WG
- Capped Langur: most common Langur of NE
- Hoolock Gibbon: only Ape found in India and seen in NE; Male is black and females are golden; Its calls are loud and are heard in the early morning sung one group to another.
- Slow Loris: in NE India; Kaziranga
- Slender Loris: in South India. Lorises are nocturnal adapted for hanging upside down; Dindigul forests.

## **OTHER SMALLER MAMMALS**

### **1. Mustelids, Viverrids and Herpestids**

These have non-retractile claws and pointed faces unlike cats while the anal glands and well developed first digit in the forefeet distinguishes it from dogs. They have five toes in hind feet

#### **MUSTELIDS:**

Long cylindrical body; enlarged anal sac; short limbs; absence of upper molar teeth

**Badgers, Otters, Martens and weasels**

Most **badgers** such as Hog badger, Ferret badger etc are seen in NE India except that of Honey badger or Ratel which is more of carnivorous/ scavenging in nature.

Eurasian Otter( Corbett NP) and Smooth coated Otter( Chambal), small clawed Otter( Kaziranga)

**Martens** are tree living and mostly seen in higher altitudes Eg: Beech Marten, Yellow throated M, Nilgiri M

**Weasels** are specialized in hunting mice and voles and most of them are adapted for high altitudes. Eg: Yellow bellied weasel, Himalayan Weasel, Tibetan Polecat.

### **VIVERRIDS: Civets**

May be distinguished from Mustelids with their unique civet gland; nocturnal and omnivorous  
Common palm Civet, Small Indian Civet, Large Indian Civet, Himalayan Palm Civet, Binturong, Spotted Linsang

**Herpestids: Mongooses:** Differ from Viverrids on their large ears, diurnal and carnivorous nature.

Grey mongoose ( most common), Small Indian, Crab eating (endemic to Eastern India), Ruddy ( Peninsular India), Stripe necked ( swamps of WG)

### **INSECTIVORES**

- Hedge Hog
- Pangolin
- Shrew
- Lagomorphs: Hares, Pikas
- Rodents : Porcupine, Squirrel

## **AQUATIC WILDLIFE**

- Whales, Dolphins, Porpoises (CETACEANS)
- Dugongs
- Crocodiles: Marsh, Estuarine and Gharial
- Turtles, Tortoises and Terrapins
- Sea Turtle: Olive Ridley, Leatherhead, Green, Hawks Bill
- Fresh water Turtle: Lisssemys, Trionyx and Chitra
- Fresh water Tortoises( Terrapins) , Pond terrapin( Kachuga), Batagur
- Tortoises: Star Tortoises

### **Turtles and Tortoises**

- 33 species
- 4 – Tortoises
- 5 – Marine Turtles
- 24 – Freshwater Turtles
- ❖ Sea Turtle: Olive Ridley, Leatherhead, Green, Hawks Bill
- ❖ Fresh water Turtle: Lisssemys, Trionyx and Chitra
- ❖ Fresh water Tortoises( Terrapins) , Pond terrapin( Kachuga), Batagur
- ❖ Tortoises: Star Tortoises

### **Fresh water Tortoises or TERRAPINS**

- Kachuga
- Pond terrapin
- Batagur

## **Land Tortoises**

- Starred Tortoise
- East Asian Tortoise
- Travancore Tortoise

## **Snakes**

- Four groups of Poisonous Snakes
- Vipers
  - Pit Viper
  - Saw Scale
  - Russel's Viper
- Kraits : Banded Krait
  - Common Krait
- Cobras : King Cobra
  - Spectacled
  - Monocled
- Sea Snakes
- Major non- poisonous snakes:
  - Pythons
  - Rat snake
  - Keel backs
  - Boas
  - Trinket snake
  - Vine snake

### **Bats, Vampires, Pipestrilles**

- Common Pipestrille : very small and frugivore
- Great False Vampire: carnivorous
- Fruit Bat

### **AVIFAUNA**

#### **Major Bird Groups**

- Ducks
- Waders & Storks
- Pheasants & Gallinules
- Cranes
- Raptors
- Frugivorous
- Insectivorous

#### **Birds of different Biomes**

- Forest birds
- Mountain birds
- Desert birds
- Wetland birds
- Grassland birds
- Coastal & marine birds.

## **TIGER:**

- Tiger is the National animal of India.
- The largest among the four big cats & most charismatic animal of the world.
- Native to much of Asia.
- India has 65% of world population.
- The tiger is an apex predator.

## **CHARACTERISTICS:**

- It has an elongated body, short neck, and compact head.
- The total body length of an adult tiger is between 2.6-3.0 m.
- Tigers have extremely strong jaws and sharp teeth.
- The legs are stout with retractile claws.
- The adult weighs up to 135- 260kg.
- The reddish-brown to rust-brown coat with black stripes and a white underbelly is most recognisable characteristic.
- Variations in coat colouration occur among individuals.
- The form and density of stripes differs between subspecies.
- White tigers are caused by a recessive gene.
- A mutation that produces the white tiger, technically known as chinchilla albinistic.

## TIGER SUBSPECIES

The surviving subspecies are:

(six are classified as endangered,)

1. Royal Bengal Tiger - *Panthera tigris tigris*
2. Siberian Tiger - *Panthera tigris altaica*
3. Sumatran Tiger - *Panthera tigris sumatrae*
4. Indo-Chinese Tiger - *Panthera tigris corbetti*
5. South China Tiger - *Panthera tigris amoyensis*
6. Malayan Tiger- *Panthera tigris jacksoni*

### Extinct Sub-species

1. **Balinese Tiger** (*Panthera tigris balica*) was limited to the island of Bali.  
- extinct since early 1980's
2. **Javan Tiger** (*Panthera tigris sondaica*) was limited to the Indonesian island of Java. - extinct since the 1940's
3. **Caspian Tiger** or Persian tiger (*Panthera tigris virgata*)  
-Appears to have become extinct in wild in the late 1950's

## HABITAT

- Highly adaptable animal.
- Deciduous, scrubs, thorny, evergreen, and grassland.
- Often requiring large contiguous areas of habitat that support their prey demands.
- A good swimmer, some time uses waterbodies in mangrove swamps also.

## **BEHAVIOURAL CHARACTERISTICS**

- Tigers are usually solitary animals.
- Except for females with cubs.
- They are territorial.
- Males have discrete territories.
- Female territories are more resource oriented.
- Tigers use scratch and scrape marks on the ground to show their presence to others.

## **PREY SPECIES**

The major prey species are ,

- Sambar,
- Spotted deer,
- Barasingha,
- Hog deer,
- Barking deer,
- Nilgai, Gaur,
- Pigs and
- Cattle.

Apart from large prey, birds like peafowl and large rodents like porcupines. They are even known to attack elephants and rhino calves. Tigers in the Sundarbans are known to feed on fish & crabs. A tiger is capable of jumping to almost twice its height

## **ORGANIZATION**

### **Age classes**

Cubs - < 12 months

Juveniles - 12 – 24 months

Transient floaters - > 24 months old, dispersing tigers, do not breed or hold stable home ranges

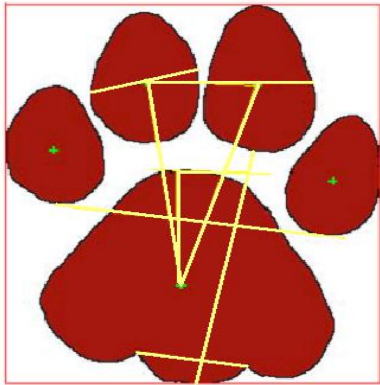
Resident breeders - tigers maintain stable home range and breeder

## **TIGER BIOLOGY**

- Tigress starts breeding at 3-4 years of age
- She continues the breeding vigor for about 5-7 years, before she loses her range to a more rigorous female
- Adult male tigers have larger home ranges, that overlaps the home range of several breeding females
- Peak breeding activity is in winter and early summer.
- Males and females communicate each other with loud and distinct calls.
- A tigress in favorable conditions produces a litter of 3-4 cubs (gestation of 105 days), once every 2-3 years
- Cubs at 18-24 months of age, juveniles are evicted by the mother, and become transients.
- The home range of the tiger in a productive forest in S Asia, vary between 10-20 km<sup>2</sup>, while it could be as large as 200-400 km<sup>2</sup> in Russia

## TIGER DENSITY

Tiger density in the best habitat is 10-20 tigers per 100 km<sup>2</sup>. While in areas with low prey densities (>90% of the tiger habitat) the density is 0.5 to 1 tigers per 100 km<sup>2</sup>



## Tiger Census

- In 1900 India's population of Royal Bengal Tigers was estimated to be as high as 40,000.
- Before the launch of Project Tiger (1973), population was decimated down to about 2000
- By the early 1990's the Bengal Tiger population had increased to 4,200. Recent estimates in 2008 it was shown to have plummeted down to 1411.

Reasons? Habit of inflating the census figures, refinement in estimation methods, poaching

Most common method of estimation is by the Pugmark census. Camera trapping & Radio collaring are devised to be the most advanced methods of census.

## Major Threats

- Poaching
  - For skin, bones, claws, teethes etc.
- Destruction & Fragmentation of habitat.
- Decline in prey spp.

## Man animal conflicts

- Occasionally enters Human habitat. Particularly in areas where population growth and farming have put pressure on tiger habitats.
- Lifting of cattles of adjucent villages.

- Man-eating tigers. -When it is old or injured.

## **TIGER FARMING IN CHINA**

- Traditional Chinese Medicines (TCM) make use of everything from tiger including scat
- In the international market its worth is as much as \$20 for claws, and \$20,000 for a skin.
- A single farmed specimen might fetch as much as \$40,000
- The retail value of all the tiger products might be three to five times that amount.
- More than 4,000 tigers in captivity in China. The country can produce 1,00,000 tigers in the next 10 to 15 years.

## **Conservation in India**

- Project Tiger - Was launched in India in 1973.
- With the goal of saving the tiger and its habitat in India.
- An initial list of 9 Tiger Reserves, this Project went on to cover 29.
- Incorporating an area of more than 40,000 sq. km.
- Captive breeding-
- Tiger Task Force
- Five-member Task Force was constituted in April 2005.
- National Tiger Conservation Authority.

### **Hoolock Gibbon (*Bunopithecus hoolock*)**

- It is the only Indian ape
- Listed as endangered under IUCN and schedule I under WP
- Local name- Holou bandor (assamese), Ulluck (hindi/bengali), Hulu (khasi), etc.

#### **Distribution**

- Hoolock gibbons are found only in China, Myanmar, northeastern India, and Bangladesh
- In India Hoolock gibbons are found throughout south of the river Brahmaputra in the states of Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland and Tripura
- In general they are found in India south and east of the Brahmaputra, Lohit, and Dibang Rivers
- the distribution is not continuous and in many cases is quite fragmented

#### **Habitat**

- Found in tropical evergreen rainforest, tropical mixed deciduous, sub-tropical broadleaf hill forest up to 1400 m
- They prefer the close canopy three tier forest (high, middle and low) vegetation—the high tier trees support roosting, resting and sun basking while the middle and low tier forests provide food and locomotion trees.
- In general, hoolock gibbon habitats are tropical with wet, hot summers with monsoon rains and dry cool winters. The annual temperature usually ranges between 7°C and 32°C

- Like other lesser apes, Hoolock gibbons are exclusively arboreal and their suspensory behaviour helps them to use the available habitat

### **Characteristics**

- Tailless primate, makes distinct haunting songs; Very shy animal
- They are diurnal
- Male is fully black with silvery white brows
- Young females are of similar appearance; however, adult female turn a golden brown colour.
- Newborns are greyish-yellow but turns dark in a couple of weeks
- Long arms almost double the length of its legs
- Standing upright measures up to 1m
- Monogamous and pair for life
- Potential predators include eagles, vultures, leopards, and pythons

### **Behaviour**

- Live in a family unit and maintain a definite territory, which is defended by loud territorial songs. Singing announces the occupation of a specific area of the forest by a mated pair and functions as a distance maintaining signal.
- Size of a group ranges from 2 - 6 members
- The territory irrespective of its group size usually varies from 0.15 to 0.35 km<sup>2</sup>
- Frugivorous in nature, its diet contains fruit, leaves, flowers, tender buds and insects, with mostly ripe fruit, young leaves and infected figs

- A single young is usually born. The time between births is usually 2 - 3 years
- Hoolock gibbons the recorded gestation period is 195 – 210 days
- Sexual maturity in both sexes is attained at 7 years of age
- The newly born infant always clings to the mother's belly and feeds on her milk for up to 6 months after which weaning starts
- Grooming is one of the major activities of social behaviour

### **Population status**

**Status:** Endangered

### **Population estimate:**

The total population in northeastern India was estimated to be about 2,600, of which the majority—about 2,000—occurs in the state of Assam

**Population Trend:** Decreasing

### **Threats**

- The main threats are the combined effects of habitat loss, fragmentation, human interference and hunting
- Large scale hunting for food & because some ethnic groups believe the gibbons have medicinal properties
- Affecting all northeastern Indian primate populations are harvesting of bamboo for paper mills, oil mining and exploration, and coal mining, which deplete habitat and cause pollution and disturbance
- Small and restricted groups may not be viable because of genetic and demographic instabilities
- Shifting cultivation is a major threat, causes habitat loss

## **Conservation**

- This species is listed on CITES Appendix I and on schedule I of the Indian Wildlife (Protection) Act of 1972
- Overall, it is found in 30 protected areas in India
- Protection against deforestation in game reserve
- Provision of environment education, awareness of public
- IUCN has suggested that study of ecological requirement of hoolock gibbon should be under taken
- Periodic population and habitat monitoring
- Ex situ Conservation breeding. First captive born eastern Hoolock Gibbon baby at Conservation Breeding Centre, Itanagar, ARUNACHAL PRADESH on 5th July 2008.
- Translocation of small population to larger and viable habitat
- On line with project tiger and project elephant, project gibbon should be declared for its conservation

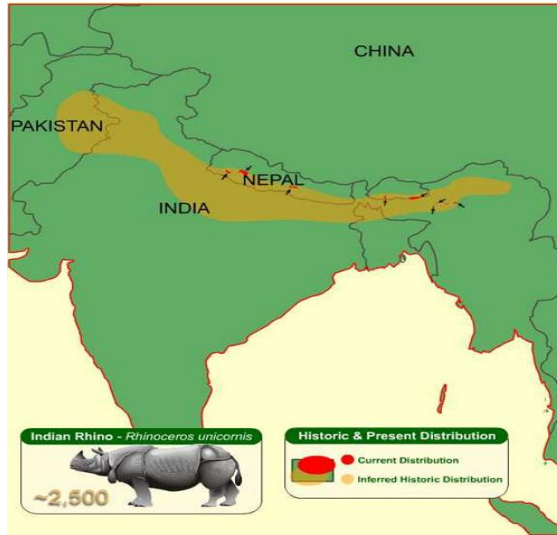
## **Best seen at:**

The Gibbon WLS and the Borajan WLS in Assam

Also found in Nagaland (Intaki), Arunachal Pradesh, Manipur, generally south of Brahmaputra

## **Indian One Horned Rhino:**

### **DISTRIBUTION IN INDIA:**



Assam : Kaziranga, Pabitora, Orang, Laokhawa & Manas.

West Bengal : Jaldapara & Gorumara (northern part of W.B.)

Uttar Pradesh ( Dudhwa NP)

Distribution in the world: India, Bhutan & Nepal

### **KINDS OF RHINOS**

There are five kinds of Rhinos found in the world:

- Indian Rhino (one horn), Asian.
- White Rhino (two horns), African.
- Black Rhino (two horns), African.
- Javan Rhino (one horn), Asian.
- Sumatran Rhino (two horns), Asian.

## CHARACTERISTICS

Size: Head & Body length:

Male: 368-380 cm ; Female: 310-340 cm

Shoulder-Height

Male: 170-186 cm ;Female: 148-73 cm

Tail length: 70-80 cmHorn length: 53 cm (max.)

- Wt: Male: 2,200 kg; Female: 1,600 kg
- This species is the largest of the Asian rhinos.
- It is brownish-grey in colour and hairless.
- The rhino has a single large horn and a semi-prehensile upper lip, which it uses to grasp food
- Can be differentiated from the closely related Javan rhinoceros by the fact that its deeply folded skin is covered in large, raised bumps. This gives the animal the appearance of being covered in plates of armour with rivets. .
- Acute sense of seeing & smelling.
- Near-sighted & can see clearly only up to 30 feet.
- Solitary, both male & female create territories.

## HABITAT AND ECOLOGY

- In general, habitat ranges from Savannas to dense forests in Tropical & Sub-tropical regions.
- Alluvial grasslands.
- Lives in northern India and southern Nepal.
- Mainly inhabits riverine (flood plain) grasslands and occasionally utilizes some adjacent woodland.

- Are grazers
- When not grazing on land, animals like to immerse themselves in water, where they also graze on aquatic grass-like plants.
- Indian Rhinoceroses are vulnerable to sunburn. By wallowing in mud, they protect their skin from the sun.
- These are usually solitary except for females with young. Males maintain loosely-defended territories.

**BREEDING:** The female Indian rhinoceros comes to heat for 24 hours in every 5-8 weeks and attracts the male by spraying urine and by making a gentle whistling sound.

- The solitary female seeks dense cover when she is ready to give birth.
- The calf stays with its mother until the birth of her next offspring, between 18 months and two years later.
- Gestation lasts approximately 15-16 months, and mothers give birth to one calf every 1-3 years.
- Females reach sexual maturity between 5 and 7 years of age; males mature at approximately 10 years of age.
- The first weeks after giving birth, mother rhinos produce 5 - 7 gallons of milk daily.

## **THREATS**

- The main reason for the species' decline is the loss of habitat due to agricultural development.
- This has also made rhinos more accessible to poachers, who illegally hunt them for their horns and other body parts that are used in traditional Chinese medicine.

- While most animals are now protected in sanctuaries, poaching is still a major threat.
- Habitat loss through encroachment and cattle is also a major problem

## CONSERVATION

- The Indian and Nepalese governments are working with international conservation organizations to enforce laws protecting the species.
- The situation is encouraging, with rhino numbers recovering from fewer than 200 at the start of the twentieth century to around 2,400 today.
- However, poaching remains a threat, as does habitat loss and degradation.
- Current conservation initiatives include regular patrols of protected areas by anti-poaching teams, and the translocation of animals from successful populations into protected areas within the former range.
- Maintaining the wild population is critical. Numbers need to be closely monitored and it is important to continue to protect against poaching.
- Translocation of animals from successful populations to areas of suitable habitat should continue, to create as many viable populations as possible.
- Rhino was successfully relocated to Dudhwa NP in UP which was a lost ground for Rhino
- Rhino was reintroduced to Manas in Assam after it was exterminated during the political turmoil
- Education programmes are essential, to teach local communities how to co-exist with the rhinos and use the land sustainably.

- In addition, education in consumer countries should continue along with research to find an alternative to rhino horn in traditional Asian medicine, so that incentives to poach are reduced.

## **CONFLICT WITH MAN**

- Conflict between man and the Indian rhinoceros arises from the damage rhinos do to crops and the damage man does to the rhino's food supply-elephant grass.
- In Nepal, villagers who use elephant grass for the walls and the roofs of their houses, are now allowed to collect grass in national parks at certain times of the year. This arrangement encourages new growth of grass, which in turn benefits the rhinos.
- Encroachment of rhino habitat by man.

## **MUSK DEER**

**Order** : *Artiodactyla*

**Family** : *Moschidae*

**Genus** : *Moschus*

*Moschus chrysogaster* : Himal. Musk Deer

*Moschus moschiferus* : Siberian Musk Deer

*Moschus berezovskii* : Dwarf Musk Deer

*Moschus fuscus* : Black Musk Deer

*Moschus anhuiensis* : Anhui Musk Deer

*Moschus cupreus* : Kashmir Musk Deer

*Moschus leucogaster* : White-bellied Musk Deer

## How different from other Deer

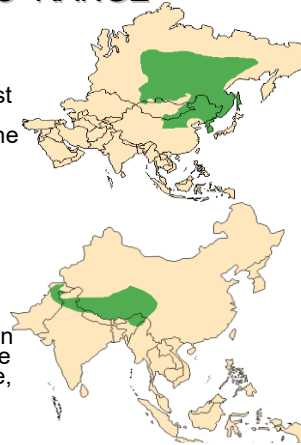
Musk deer are Artiodactyls. They are more primitive than the Cervids, or true deer, in not having antlers or facial glands, Having a single pair of teats, possessing a gall bladder, a caudal gland, a pair of tusk-like teeth and a musk gland.

### GEOGRAPHIC RANGE

- Eastern Asia; Southern China, and Burma, to almost the northern forest boundaries. Also found in the Himalayas.

- **Biogeographic Regions:** Palearctic and Oriental

- In the Himalayas, the animals' range extends in parts up to the tree line at an altitude of 4200 m, but in the northern parts of their range, musk deer may occur at much lower altitudes.



### HABITAT

Mostly, musk deer inhabit the middle altitudes of montane taiga (usually not found above 1600m).

- In the winter, they are attracted to relatively steep slopes covered with coniferous forests.
- Favourite habitats are sections with rock outcrops, which provide shelter from predators.
- In the summer, most of their time is spent in valleys of forest rivers, around streams, and near fields with good grassy vegetation.

- They avoid marshy forests.
- In Himalayas it is found in the sub-alpine oak and Rhododendron forests

## **PHYSICAL DESCRIPTION**

- Differ sharply from other deer.
- Hind legs: well-muscled;
- Forelimbs: shorter, weaker, thin;
- Chest usually small;
- Back highly arched back, so that the animal is much higher at the sacrum than at the shoulders.
- Males weigh slightly less than females.
- Neither sex has antlers. The male has fine and extremely sharp canines protruding directly downward from the mouth. In older males, canine tips extend considerably below the lower jaw.

Body Length: 86-100 cm  
 Shoulder Height: 52-55 cm  
 Tail Length: 4-6 cm  
 Weight: 11-18 kg

## **BREEDING**

- Estrus occurs in December usually lasts for three to four weeks. Females deliver one fawn or rarely two.
- Fawning occurs in secluded places such as beneath dense shrubs, under low branches of fir, or around fallen trees. Up to 1/3 of adult females remain barren every year. Fawns stay with their mothers for up to two years (two winters).

- The young are usually born in May and June, after which they are hidden - concealed away from their mother for up to 2 months.
- Gestation period 185-195 days
- Birth Mass: 450 g (average)
- Age at sexual or reproductive maturity (female) 15-17 months.
- Life span: 10-14 years

## ECOLOGY AND BEHAVIOR

- Musk deer are primarily active at night, although during this period they alternately feed and rest.
- Himalayan musk deer are sedentary, remaining within a defined home range throughout the year.
- In females these are about 125 acres in size, while male musk deer will control a territory which encompasses the ranges of several females, defending it against intrusion by rival males.
- The Himalayan musk deer does not undertake any seasonal migrations, remaining in the same area year-round despite harsh weather conditions.
- A shy animal, the musk deer depends on its sense of hearing to locate sources of danger. When frightened, they make broad leaps, each measuring up to 6 meters in length. Drastic changes in direction are made during flight, and every few jumps the animal will stop and listen.
- **Family:** small groups (no more than 3 individuals) of a females with her young.
- **Diet:** Lichens e.g.Usnea sp, grasses, shoots and branches, leaves, coniferous needles and bark.

- Main Predators: Lynx, yellow-throated marten, tiger, and bear.
- Communication between individuals is by olfaction; thought to be based primarily on their sense of smell, due to the high development of the glands of musk deer.
- Primarily silent, musk deer will emit a loud double hiss if alarmed, and may scream plaintively if wounded. Population densities are about 3-4 animals per square kilometer.

## **POPULATION OF MUSK DEER**

- Himalayan Musk Deer populations in Afghanistan and of Black Musk Deer in Bhutan are estimated to be small.
- Musk Deer in China 600 000 individuals
- In India, Himalayan Musk Deer inhabit parts of Kashmir, Himachal Pradesh, the northern part of Uttar Pradesh, Sikkim and Arunachal Pradesh. The species is more common in the Eastern Himalayas because the habitat of the animals has been less disturbed there. Black Musk Deer occur in the provinces of Assam and Sikkim.
- Siberian Musk Deer populations considered to be near extinction.
- In Nepal, Himalayan Musk Deer numbers within protected areas are increasing, while outside the protected areas they are continuing to decline.
- In Pakistan, Himalayan Musk Deer are found in only a small part of the mountainous regions of the Western Himalayas.
- Populations of Forest Musk Deer occur in the north-east area of Vietnam. The population levels are declining here in all areas because of illegal hunting

## **THREATS**

- Illegal, unsustainable hunting for musk is the principal threat to this species. Each male produces only around 25 g of musk (Dulamtsere et al., 1989; Tsendjav, 2002).
- An estimated 25,000 adult males were killed through harvesting and illegal hunting between 1990 and 2001
- Habitat fragmentation may also threaten the species

## **ASIAN ELEPHANT**

### **Classification**

|          |              |
|----------|--------------|
| Kingdom: | Animalia     |
| Phylum:  | Chordata     |
| Class:   | Mammalia     |
| Order:   | Proboscidea  |
| Family:  | Elephantidae |
| Genus:   | Elephas      |
| Species: | E. maximus   |

- (E. m. indicus)
- (E. m. maximus)
- (E. m. sumatrensis)
- (E. m. borneensis)

## DISTRIBUTION



**Previous Distribution** --The Asian elephant, whose ancestors originated in Africa some 55 million years ago.

- Ranged from modern Iraq and Syria to the Yellow River in China.
- More than 100,000 Asian elephants may have existed at the start of the twentieth century.

### Current Population and Distribution

- Found only from India to Vietnam, with a tiny besieged population in the extreme southwest of China's Yunnan Province.  
25,600 to 32,750 Asian elephants were thought to remain.
- About a 16,000 elephants are held in captivity throughout Southeast Asia while there are thought to be approximately 6,000 domesticated elephants in Myanmar only.

**Habitat**

Major habitat type

Tropical and Subtropical Moist Broadleaf Forests, Tropical and Subtropical Dry Broadleaf Forests

**Biogeographic-realm**

Indo-Malayan

Range States

India, Nepal, Bhutan, Bangladesh, Sri Lanka, Myanmar, Thailand, Laos, Cambodia, Vietnam, China, Malaysia (Peninsular and Borneo), Indonesia (Borneo and Sumatra)

**Ecological Region**

- South Western Ghats Moist Forests,
- Eastern Deccan Plateau Moist Forests,
- Naga-Manupuri-Chin Hills Moist Forests,
- Cardamom Mountains Moist Forests,
- Chhota-Nagpur Dry Forests,
- Eastern Himalayan Broadleaf and Conifer Forests,
- Terai-Duar Savannas and Grasslands,
- Western Ghats Rivers and Streams,
- Sri Lankan Moist Forests,
- Northern Indochina Subtropical Moist Forests,
- Annamite Range Moist Forests,

- Sumatran Islands Lowland and Montane Forests,
- Kayah-Karen/ Tenasserim Moist Forests,
- Peninsular Malaysian Lowland and Montane Forests,
- Borneo Lowland and Montane Forests,
- Indochina Dry Forests,

## **PHYSICAL DESCRIPTION**

- Weight – 3 -6 tons.
- Height -7-12 feet. Tallest point top of the head.

Skin-Smoother, Lightly wrinkled with sparse hair over the entire body ,  
dark grey to brown, with patches of pink on the forehead, the ears, the base  
of the trunk and chest.

Ears-Smaller, Do not reach over the neck.

- Shape of back- Convex or straight.
- Shape of the belly-Either almost straight or sagging in the middle.
- Shape of the head- Crumpled from the front to the back,with humped structures on the top of the head,forehead dented.
- Tusks-males in many cases having tusks. Females having only rudimentary or no tusks.
- Truck- Tip of truck has one finger like projection.
- Feet- Usually have 5 toenails on each foreleg & hind leg 4 or rarely 5.

- Elephants act as seed dispersers by their fecal matter. It is often carried below ground by dung beetles and termites causing the soil to become more aerated and further distributing the nutrients
- Their paths act as firebreaks and rain water conduits the depressions created by their footprints and their bodies trap rainfall
- An Elephants journey through the high grass provides food for birds by disturbing small reptiles, amphibians or insects.
- The crop damage by elephants is a root cause of human-elephant conflict across the elephant range countries.
- For example, an elephant eats around 200 kg of food per day; a single elephant can destroy a hectare of crops in a very short time; a small herd can decimate a farmer's livelihood,overnight.

Such attacks can also lead to human injury and/or death. about 150 - 200 people on average were killed by elephants each year.

### **Elephants killed in India**

The numbers of elephants killed annually in India as a result of human activities is approximately 200 elephants per year because of human-related activities. These include:

- 120 poaching for ivory or meat
- 25 poisoned
- 20 cattle born disease
- 16 electrocution
- 10 hit by trains
- 10 miscellaneous

## **STRATEGY TO MITIGATE HUMAN –ELEPHANT CONFLICT**

1. Changing cropping pattern to prevent crop raiding proclivity of elephant in the eco-fragile buffer. Nearby elephant habitat – Tobacco , Cotton, Tea and Mulberry etc.
2. Physical barriers to prevent elephant from raiding crops and human settlements.
  - Digging elephant proof trench (EPT).
  - Solar electric fencing.
  - Rubble wall.
3. Red chilli powder/paste – sprinkling red chilli powder along the boundaries of agricultural fields. Pungent smell driving away the elephants.
4. providing a network of artificial salt licks and water holes along the park boundaries to supplement mineral requirement and to quench thirst.
5. Rain water harvesting to recharge forest floor.
6. Compensation towards damages to crops and property.
7. Strong case against elephant poaching.
8. Regulate livestock grazing.
9. Prevention of wild fires.
10. Eco-development programme in eco-fragile buffers.
11. Translocation through elephant drives.
12. Chemical.
13. Patrolling.

## **CONSERVATION AND MANAGEMENT**

1. Minimum viable population size

To maintain an effective population size of at least 50 breeding individuals to counter inbreeding depression in the short term.

## 2. Minimum viable area and Habitat integrity

Large home range and need for seasonal movement from the habitat type to another.

Corridors for the free movement should be provided.

Density is 0.1 elephant per square kilometers as in tropical rain forest habitat.

India is a signatory to CITES (Conservation on International Trade in Endangered Species) which include trafficking against elephant or elephant trophy.

Strategy to reconnect elephants' natural migratory routes links protected areas together by creating habitat corridors.

Allowing elephant populations to mix potentially decrease human/elephant conflict.

Ecotourism especially when the local community benefits from the tourist revenues. Seeing elephants in their natural environment may create inspirational experiences that foster positive attitudes towards elephants.

### **GAUR**

**Distribution:** Tropical woodlands of India, Indochina, and the Malay Peninsula.

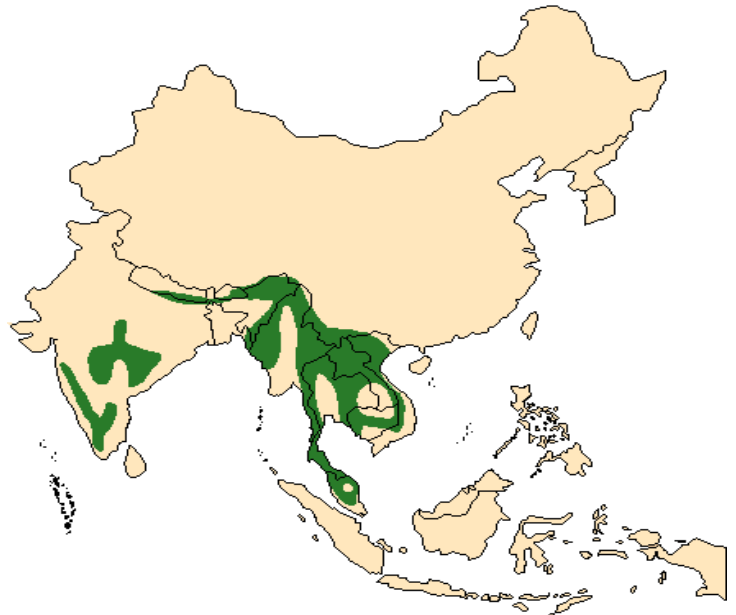
Countries: Bangladesh, Bhutan, Viet

Nam Cambodia, China, Malaysia,

Thailand, Myanmar, Nepal, India, --

(IUCN, 2002).

Largest populations are found today in  
India



## **Habitats**

- North-east  
Tropical Wet, Semi-Wet Evergreen & bamboo forests
- Western Ghats  
Tropical Moist Deciduous
- Central India  
Tropical Dry Deciduous forests
- Eastern slopes in the Western Ghats  
Shola forests, Tropical Thorn forests

In these areas gaur are known to occur, in relatively undisturbed habitats, up to elevations of 2500 m.

## **General Characteristics**

- Body Length: 250-360 cm
- Shoulder Height: 170-220 cm.
- Males stand about 1.8 - 1.9 m at the shoulder,
- Tail Length: 70-100 cm.
- Weight: Males often 1000 - 1500 kg,
- Females 700 - 1000 kg.
- South-east Asian gaur is the largest, average 1500 kg
- The male Indian gaurs average 1300 kg, and
- Malayan gaur, or seladang, is the smallest 1000 - 1300 kg.

## **Ontogeny and Reproduction**

Gestation Period: 275 days.

Young per Birth: 1, rarely 2

Weaning: 7-9 months.

Sexual Maturity: In the 2nd and 3rd year.

Life span: About 30 years.

Breeding takes place throughout the year, though there is a peak between December and June.

Habits: Basically grazing animal

**Diet:** Grasses, shoots and fruit

- Gaur is basically diurnal, but human interference made nocturnal.
- In dry season herds congregate and remain small area
- Not much water loving
- Defensive circle against predators & also lets out a high whistle to warn against danger

## **Ecology & behavior**

- Gaur is a gregarious animal
- Herds are matriarch
- Small mixed herds of 2-40 individuals.
- Adult males may be solitary.
- No serious fighting, size determine dominance.
- Males make a mating call of clear & resonant tone
- Not aggressive to human being generally

## **Current status**

- IUCN has classified gaur as 'Vulnerable
- The overall trend in gaur population is stable

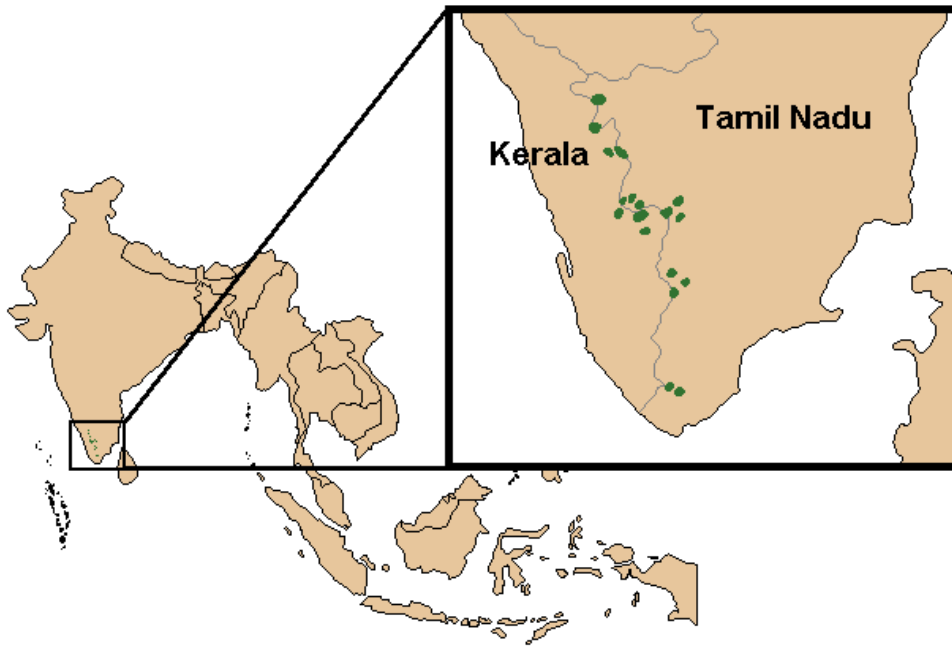
- In Peninsula India and North-East declining
- The Western Ghats & their outflanking hills in the south India are strongholds of gaur
- Wynaad – Nagarhole – Mudumalai – Bandipur complex. Billiranganswamy Temple Wildlife Sanctuary (Karnataka), Tadoba – Andhari Tiger Reserve and Melghat Tiger Reserve in Maharashtra.

### **Threats**

- Poaching
- Cattle grazing
- Degradation of habitat
- Human interference
- Disease
  - foot & mouth Disease
  - Anthrax
  - Rinderpest

### **NILGIRI TAHR**

- An endangered mountain ungulate.
- Endemic to the Nilgiri Hills and the southern portion of the Western Ghats in the states of Tamil Nadu and Kerala.
- It is the southern counterpart of the Himalayan tahr and the Arabian tahr.
- Nilgiri = Blue Mountains, the name is derived from a rare species of bush, Neelakurinji (*Strobilanthes Kunthiana*) which blooms in clustered blue flowers every 12 years.



### **Conservation Status**

Considered as endangered by the IUCN Caprinae Specialist Group.

Schedule I Animal of the WLPA, 1972.

### **Present Population Distribution**

- The Nilgiri Tahr population in the 6 Tahr landscapes.  
( Latest review, Daniels et al 2006)
- Nilgiris Hills Landscape
- Annamalai Hills Landscape
- The High Ranges Landscape
- The Palani-High Wavy Mountain Landscape
- The Seivilliputtur Periyar Hills Landscape
- Tirunalveli Travancore Hills Landscape

## **Population Trend**

- 1000 (Schaller,1970)
- 2200 (Davidar,1978)
- 2234 (Rice,1984)
- 2500 (Shackleton.1997)
- 1950 (Daniels et al., 2006).
- The latest study by Daniels et.al., indicate a decline in population level.
- Conservative estimate : 1800 - 2000

## **General Characteristics**

- The Nilgiri Tahrs are stocky goats with short, coarse fur and a bristly mane.
- General body colour – grey to brown have a darker color when mature.
- Females & young ones are yellowish grey.
- Males are larger than the females.
- Both sexes have curved horns.
- larger & heavier in the males, reaching up to 40 cm
- 30 cm in females.
- Adult males weigh 80 – 100 kg and stand about 100 cm tall at the shoulder.
- Adult males develop a light grey area or "saddle" on their backs - "saddlebacks".

## **Habitat**

- Inhabit the open montane grassland habitat of the South Western Ghats montane rain forests ecoregion.
- Usually found in altitudes above 2000 m.
- Grasslands adequately sheltered by steep rocky cliffs.

- Occasionally visit the shrublands along the base of the cliffs.
- Avoid sholas but sometimes forage along their periphery.
- Easily climbs the inaccessible heights of these hills.
- Occurs - 400km stretch of S-Western Ghats.
- Eravikulam National Park, Nilgiri Hills,
- Anamalai Hills, Periyar Tiger Reserve, Palni Hills and other pockets in the Western Ghats south of Eravikulam.

### **Behavior**

- Herbivores. Feed on the grasses and leaves of the hill ranges.
- Also feed on forbs and shrubs.
- Usually seen in herds.
- They are seen grazing during the day and rest during the night.
- Male Tahrs are known to fight during the mating season.

### **Reproduction**

- Usually seen in herds: 5 - 50 individuals often with young ones.
- Main breeding season (rut) - June to Aug
- Conception - 6 months
- Peak in births occur in Jan & Feb.
- By 2 months of age - kid follows its mother.
- Not weaned until 4-6 months.
- Sexual maturity - 16 months.
- Avg. life span - only 3 or 3.5 years (potential life span is 9 yrs)
- The female usually give rise to two young ones at birth.

## Nilgiri Tahr Census in Eravikulam National Park

The annual Nilgiri Tahr census will be held from April to May .

The ‘method of bounded counts’ which was first put into practice in the Park by Dr. Rajan Varghese in 1984, was followed.

This method necessitates the simultaneous combing and survey of the 12 blocks (based on identified tahr home ranges)

5 days by teams consisting of volunteers, forest officials and expert Muduvan trackers.

**Table-IV Details of Population of Nilgiri tahr in ENP  
(April 2003)**

| Blocks        | I          | II         | III        | IV         | V          |
|---------------|------------|------------|------------|------------|------------|
| Poovar        | 0          | 2          | 5          | 0          | 3          |
| Kumarikkal    | 26         | 39         | 10         | 31         | 23         |
| Kathumala     | 0          | 13         | 72         | 54         | 39         |
| Perumamala    | 0          | 13         | 72         | 54         | 39         |
| Muduvakudy    | 115        | 118        | 39         | 54         | 93         |
| Poolamala     |            |            |            |            |            |
| Varayattumudi | 0          | 98         | 85         | 89         | 51         |
| Karikombu     | 17         | 14         | 12         | 35         | 7          |
| Samban        | 18         | 0          | 13         | 1          | 9          |
| Kolukkan      |            |            |            |            |            |
| Erumapetti    | 84         | 79         | 32         | 92         | 57         |
| Anaimudi      | 56         | 54         | 102        | 61         | 60         |
| Naikkolli     | 211        | 216        | 202        | 211        | 185        |
| Pettimudi     | 55         | 76         | 57         | 74         | 28         |
| <b>Total</b>  | <b>582</b> | <b>722</b> | <b>666</b> | <b>736</b> | <b>558</b> |

The population size N is calculated by:

$$N = X(m) + [X(m) - X(m-1)]$$

Where  $X(m)$  is the largest count

$X(m-1)$  is the second largest count

obtained.

$$N = 736 + (736 - 722) = 736 + 14 = 750$$

Methodology adopted is total count and the above statistical correction was provided by Prof.

Rajan from the Union Christian College, Alwaye, Cochin

### **Threats**

- Hunting and Poaching.
- Habitat alteration (fragmentation)
- Predation by carnivores.
- Overgrazing by domestic livestock.
- Conversion of grassland habitat of the tahr into agricultural land.
- Inbreeding (a result of such small, isolated populations).

### **CONSERVATION**

- Proposals mooted during the 4th World Conference on Mountain Ungulates
- Delegates to the 4th World Conference on Mountain Ungulates, held in Munnar, Kerala, India from 12th and 15th September 2006 adopted the following resolutions to have a healthy population of Tahr.
- Extend the Eravikulam National Park limits to the ecological boundary of the Nilgiri Tahr population.

- Establish protected and functional corridors between the isolated Tahr populations in the Western Ghats.
- Forestry, tourism and other activities in the Tahr landscape should respect conservation measures to protect the Tahr and its habitats.
- Develop a protocol for monitoring the Tahr populations and habitats, and evaluate the ecological impact of tourism and fire in the National Park.
- Explore possibilities for the re-introduction of Tahr into parts of its historical range, from where it has been extirpated.
- Recommendations for the Future Conservation of the Nilgiri Tahr
- The quality and extent of the fragmented habitats should also be assessed.
- Establishment of suitable corridors (within and across the Tahr landscapes).
- Tamilnadu Forest Department already in the process of phasing out wattle in and around the Mukurti NP.
- Regulation of vehicle movement and keeping close watch on the visitors helps in reduction of disturbance and in keeping the Park clean.

## **CHAPTER:12**

### **PROTECTED AREA NETWORK**

India is one of the 17 mega diverse countries of the world. With only 2.4% of the world's land area, 16.7% of the world's human population and 18% livestock, it contributes about 8% of the known global biodiversity, however, putting enormous demands on our natural resources. India is home to world's largest wild tigers population and has got unique assemblage of globally important species like Asiatic lion, Asian Elephant, One-horned Rhinoceros, Gangetic River Dolphin, Snow Leopard, Kashmir Stag, Dugong, Gharial, Great Indian Bustard, Lion Tailed Macaque etc.

#### **Protected Area Network in India:**

A National Board for Wildlife (NBWL), chaired by the Prime Minister of India provides for policy framework for wildlife conservation in the country. The National Wildlife Action Plan (2002-2016) was adopted in 2002, emphasizing the people's participation and their support for wildlife conservation.

India's conservation planning is based on the philosophy of identifying and protecting representative wild habitats across all the ecosystems. The Indian Constitution entails the subject of forests and wildlife in the Concurrent list. The Federal Ministry acts as a guiding torch dealing with the policies and planning on wildlife conservation, while the provincial Forest Departments are vested with the responsibility of implementation of national policies and plans.

A network of 668 Protected Areas (PAs) has been established, extending over 1,61,221.57 sq. kms. (4.90% of total geographic area), comprising 102 National Parks, 515 Wildlife Sanctuaries, 47 Conservation Reserves and 4 Community Reserves. UNESCO has designated 5 Protected Areas as World Heritage Sites.

As the ecosystems and species do not recognise political borders, the concept of Transboundary Protected Areas has been initiated for coordinated conservation of ecological units and corridors with bilateral and/or multilateral cooperation of the neighbouring nations.

There are 4 categories of the Protected Areas viz,

National Parks, Sanctuaries, Conservation Reserves and Community Reserves.

**Sanctuary** is an area which is of adequate ecological, faunal, floral, Geo-morphological, natural or zoological significance. The Sanctuary is declared for the purpose of protecting, propagating or developing wildlife or its environment. Certain rights of people living inside the Sanctuary could be permitted. Further, during the settlement of claims, before finally notifying the Sanctuary, the Collector may, in consultation with the Chief Wildlife Warden, allow the continuation of any right of any person in or over any land within the limits of the Sanctuary.

**National Park** is an area having adequate ecological, faunal, floral, Geo-morphological, natural or zoological significance. The National Park is declared for the purpose of protecting, propagating or developing wildlife or its environment, like that of a Sanctuary. The difference between a Sanctuary and a National Park mainly lies in the vesting of rights of people living inside. Unlike a Sanctuary, where certain rights can be allowed, in a National Park, no rights

are allowed. No grazing of any livestock shall also be permitted inside a National Park while in a Sanctuary, the Chief Wildlife Warden may regulate, control or prohibit it. In addition, while any removal or exploitation of wildlife or forest produce from a Sanctuary requires the recommendation of the State Board for Wildlife, removal etc., from a National Park requires recommendation of the

National Board for Wildlife (*However, as per orders of Hon'ble Supreme Court dated 9<sup>th</sup> May 2002 in Writ Petition (Civil) No. 337 of 1995, such removal/ exploitation from a Sanctuary also requires recommendation of the Standing Committee of National Board for Wildlife*).

**Conservation Reserves** can be declared by the State Governments in any area owned by the Government, particularly the areas adjacent to National Parks and Sanctuaries and those areas which link one Protected Area with another. Such declaration should be made after having consultations with the local communities. Conservation Reserves are declared for the purpose of protecting landscapes, seascapes, flora and fauna and their habitat. The rights of people living inside a Conservation Reserve are not affected.

**Community Reserves** can be declared by the State Government in any private or community land, not comprised within a National Park, Sanctuary or a Conservation Reserve, where an individual or a community has volunteered to conserve wildlife and its habitat. Community Reserves are declared for the purpose of protecting fauna, flora and traditional or cultural conservation values and practices. As in the case of a Conservation Reserve, the rights of people living inside a Community Reserve are not affected.

**Regulations/ laws relating to Protected Areas (PAs):**

The PAs are constituted and governed under the provisions of the Wild Life (Protection) Act, 1972, which has been amended from time to time, with the changing ground realities concerning wildlife crime control and PAs management. Implementation of this Act is further complemented by other Acts viz. Indian Forest Act, 1927, Forest( Conservation) Act, 1980, Environment (Protection) Act, 1986 and Biological Diversity Act, 2002 and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

The Wildlife Crime Control Bureau of the Central Government supplements the efforts of provincial governments in wildlife crime control through enforcement of CITES and control of wildlife crimes having cross-border, interstate and international ramifications.

In order to strengthen and synergise global wildlife conservation efforts, India is a party to major international conventions viz.

Convention on International Trade in Endangered Species of wild fauna and flora (CITES),  
International Union for Conservation of Nature (IUCN),  
International Convention for the Regulation of Whaling,  
UNESCO-World Heritage Committee and  
Convention on Migratory Species (CMS).

**Main issues concerning the management of Protected Areas:** Wildlife conservation and management in India is currently facing a myriad of complex challenges that are both ecological and social in nature. Issues such as habitat loss/fragmentation, overuse of biomass resources in the context of biotic pressures, increasing human-wildlife conflicts, livelihood dependence on forests and wildlife resources, poaching and illegal trade in wildlife parts and products, need for maintaining a broad base of public support for wildlife conservation

exemplify and characterize the contemporary wildlife conservation scenario in India. The government and the civil society are taking several measures to address these issues. Improved synergies and better coordination amongst the wide array of stakeholders are needed to meet the challenges of conserving India's diverse wilderness resources.

### State-wise details of the Protected Area Network of the country

| S.No. | States/UTs           | No of NPs | No. of WLS | No. of Cons Res | No. of Comm Res | No. of PAs |
|-------|----------------------|-----------|------------|-----------------|-----------------|------------|
| 1     | Andhra Pradesh       | 6         | 21         |                 |                 | 27         |
| 2     | Arunachal Pradesh    | 2         | 11         |                 |                 | 13         |
| 3     | Assam                | 5         | 18         |                 |                 | 23         |
| 4     | Bihar                | 1         | 12         |                 |                 | 13         |
| 5     | Chhattisgarh         | 3         | 11         |                 |                 | 14         |
| 6     | Goa                  | 1         | 6          |                 |                 | 7          |
| 7     | Gujarat              | 4         | 23         | 1               |                 | 28         |
| 8     | Haryana              | 2         | 8          | 3               |                 | 13         |
| 9     | Himachal Pradesh     | 5         | 32         | 3               |                 | 40         |
| 10    | Jammu & Kashmir      | 4         | 15         | 33              |                 | 52         |
| 11    | Jharkhand            | 1         | 11         |                 |                 | 12         |
| 12    | Karnataka            | 5         | 27         | 8               | 1               | 41         |
| 13    | Kerala               | 6         | 17         |                 | 1               | 24         |
| 14    | Madhya Pradesh       | 9         | 25         |                 |                 | 34         |
| 15    | Maharashtra          | 6         | 37         | 2               |                 | 45         |
| 16    | Manipur              | 1         | 3          |                 |                 | 4          |
| 17    | Meghalaya            | 2         | 3          |                 | 22              | 27         |
| 18    | Mizoram              | 2         | 8          |                 |                 | 10         |
| 19    | Nagaland             | 1         | 3          |                 |                 | 4          |
| 20    | Orissa               | 2         | 18         |                 |                 | 20         |
| 21    | Punjab               | 0         | 13         | 1               | 2               | 16         |
| 22    | Rajasthan            | 5         | 25         | 10              |                 | 40         |
| 23    | Sikkim               | 1         | 7          |                 |                 | 8          |
| 24    | Tamil Nadu           | 5         | 29         | 1               |                 | 35         |
| 25    | Tripura              | 2         | 4          |                 |                 | 6          |
| 26    | Uttar Pradesh        | 1         | 23         |                 |                 | 24         |
| 27    | Uttarakhand          | 6         | 7          | 4               |                 | 17         |
| 28    | West Bengal          | 6         | 15         |                 |                 | 21         |
| 29    | Andaman & Nicobar    | 9         | 96         |                 |                 | 105        |
| 30    | Chandigarh           | 0         | 2          |                 |                 | 2          |
| 31    | Dadra & Nagar Haveli | 0         | 1          |                 |                 | 1          |
| 32    | Daman & Diu          | 0         | 1          |                 |                 | 1          |
| 33    | Delhi                | 0         | 1          |                 |                 | 1          |
| 34    | Lakshadweep          | 0         | 1          |                 |                 | 1          |
| 35    | Pondicherry          | 0         | 1          |                 |                 | 1          |
|       | India                | 103       | 535        | 66              | 26              | 730        |

### Protected Areas of India from 2000 to 2013 (as on April, 2015)

| Year | No. of<br>National<br>Parks | Area<br>Under<br>National<br>Parks | No. of Wild<br>Life<br>Sanctuaries | Area<br>Under<br>Wild Life<br>Sanctuaries | No. of<br>Community<br>Reserves | Area Under<br>Community<br>Reserves | No. of<br>Conservation<br>Reserves | Area Under<br>Conservation<br>Reserves | No. of<br>Protected<br>Areas | Total<br>Area<br>under<br>Protected<br>Areas |
|------|-----------------------------|------------------------------------|------------------------------------|-------------------------------------------|---------------------------------|-------------------------------------|------------------------------------|----------------------------------------|------------------------------|----------------------------------------------|
| 2000 | 89                          | 37593.94                           | 489                                | 117881.68                                 | -                               | -                                   | -                                  | -                                      | 578                          | 155475.63                                    |
| 2006 | 96                          | 38183.01                           | 506                                | 120244.39                                 | -                               | -                                   | 4                                  | 42.87                                  | 606                          | 158470.27                                    |
| 2007 | 98                          | 38219.72                           | 510                                | 120543.95                                 | 4                               | 20.69                               | 7                                  | 94.82                                  | 619                          | 158879.19                                    |
| 2008 | 99                          | 39232.58                           | 513                                | 122138.33                                 | 4                               | 20.69                               | 45                                 | 1259.84                                | 661                          | 162651.45                                    |
| 2009 | 99                          | 39232.58                           | 513                                | 122138.33                                 | 4                               | 20.69                               | 45                                 | 1259.84                                | 661                          | 162651.45                                    |
| 2010 | 102                         | 40074.46                           | 516                                | 122585.56                                 | 4                               | 20.69                               | 47                                 | 1382.28                                | 669                          | 164062.99                                    |
| 2011 | 102                         | 40074.46                           | 517                                | 122615.94                                 | 4                               | 20.69                               | 52                                 | 1801.29                                | 675                          | 164512.37                                    |
| 2012 | 102                         | 40074.46                           | 524                                | 123548.33                                 | 4                               | 20.69                               | 56                                 | 1998.15                                | 686                          | 165641.62                                    |
| 2013 | 102                         | 40074.46                           | 526                                | 124234.52                                 | 4                               | 20.69                               | 57                                 | 2017.94                                | 689                          | 166347.6                                     |
| 2014 | 103                         | 40332.89                           | 525                                | 116254.36                                 | 4                               | 20.69                               | 60                                 | 2037.11                                | 692                          | 158645.05                                    |
| 2015 | 103                         | 40333.00                           | 528                                | 117230.76                                 | 4                               | 20.69                               | 65                                 | 2344.51                                | 700                          | 160096.09                                    |

*Source: National Wildlife Database Cell, Wildlife Institute of India*

*Note: All areas are in km<sup>2</sup>*

*- Community Reserves have been established in India from 2007 onwards and Conservation Reserves from 2005 onwards. Hence these values are zero.*

### Protected Areas of India (as on April, 2015)

|                                    | No         | Area (km <sup>2</sup> ) | % of Geographical Area of India (%) |
|------------------------------------|------------|-------------------------|-------------------------------------|
| <b>National Parks (NPs)</b>        | 103        | 40500.13                | 1.23                                |
| <b>Wildlife Sanctuaries (WLSs)</b> | 528        | 117230.76               | 3.57                                |
| <b>Conservation Reserves (CRs)</b> | 65         | 2344.51                 | 0.07                                |
| <b>Community Reserves</b>          | 4          | 20.69                   | 0.00                                |
| <b>Protected Areas (PAs)</b>       | <b>700</b> | <b>160096.09</b>        | <b>4.86</b>                         |

|                                           |                                         |
|-------------------------------------------|-----------------------------------------|
| Geographical Area of India (FSI, 2011)    | = 32,87,263 km <sup>2</sup>             |
| Recorded Forest Area of India (FSI, 2011) | = 692,027 km <sup>2</sup>               |
| Forest Area                               | = 21.05 % of Geographical Area of India |

### EXISTING COMMUNITY RESERVES IN INDIA

| Sl.No.                    | Name            | Year of Estd. | Area (km <sup>2</sup> ) | Distt./State Location |
|---------------------------|-----------------|---------------|-------------------------|-----------------------|
| 1.                        | Keshopur Chhamb | 2007          | 3.40                    | Gurdaspur, Punjab     |
| 2.                        | Lalwan          | 2007          | 12.67                   | Hoshiarpur, Punjab    |
| 3.                        | Kadalundi       | 2007          | 1.50                    | Malappuram, Kerala    |
| 4.                        | Kokkare Bellur  | 2007          | 3.12                    | Mandya, Karnataka     |
| <b>Total Area (sq km)</b> |                 |               | <b>20.69</b>            |                       |

## **HOW MUCH CONSERVATION IS ENOUGH?**

Conservation Biology Principles

Bio geographic Zonation

Ground Realities

- Conservationists suggest over 5% of the Bio geographic region or at least country's land surface should be protected.
- 5% average figure is for robust ecosystems; Fragile ecosystem – need more area, say to about 10%
- Currently about 4.86 % of Geog area
- Expected to go up to 5.69% with new proposal in PA

## **CORRIDORS AND LINKAGES**

- CORRIDORS CAN MAINTAIN A SEASONAL ROUTE  
e.g. Elephant In Rajaji And Corbett, Nagarhole And Bandipur
- CORRIDORS CAN ALLOW A DISPERSAL ROUTE.  
e.g. Immature Tigers Seeking Territories
- CORRIDORS CAN ALLOW GENE FLOW FROM ONE SUB-POPULATION TO ANOTHER. e.g. Tigers In Buxa And Manas

### **Landscape Approach:**

Linking P. A through Corridors; Conservation Biology and human ecology at

work .The P.A. in our country are highly altered, insular (like habited islands spread all over the country) with hostile environment all around.

Highly Fragmented – Large animals have serious problems e.g.. Elephants, Tiger

Insufficient corridors ( areas like forests and other uninhabited lands) for dispersal , migration and gene flow-Chitwan and Dudhwa

–Cultivated. lands & villages

Corbett NP and Rajaji N.P.

Kanha NP &Bandavgarh Sanctuary -(600 Cattle killed every yr)

Nagarhole-Bandipur-Mudumalai- Mukurti- Silent Valley – Bhawani- Satyamangalam.

### **Major Protected Area issues in India**

- People inside the PA s
- People around the fringe areas
- Corridors
- Grazing problem
- Extraction of fallen high value durable timber
- Man –animal conflicts
- Protected spp. distributed outside PA
- Inadequate Research and Monitoring
- Lopsided financial investments in PA s
- Human capacity in Protected Area management
- Threats to effective management of the PA's.

## **CHAPTER: 13**

### **IMPORTANT PROTECTED AREAS OF INDIA**

Specific reference to the following NP's:

-KEIBUL LAMJAO NP,

-GIR NP,

-GULF OF MANNAR MNP,

-BANDIPUR NP

- KANHA NP

### **KEIBUL LAMJAO NATIONAL PARK , MANIPUR**

#### **LOCATION & EXTENT**

**State** – Manipur, 53km from state capital, Imphal.

**District** – Bishnupur.

**Area:** 40sq km

- This wetland has overgrown 1.5m deep floating vegetation locally called Phumdi,
- Large portion of 64.75sq.km Loktak Lake falls within the park,

#### **Evolution of the Park**

- Only natural habitat of Brow Antlered Deer,
- Only Floating National Park in the world,
- Host to a number of rare & migratory birds,
- Its journey starts with declaration of Loktak Lake as protected area in October 1953.
- It was officially notified as a sanctuary in 1966.
- In march 28,1977 the status of National Park was conferred.

## Habitat

- It has the unique Plumdi or floating marshy habitat, 80% of the flora is submerged and vegetation form a 90-120cm thick cover on the water surface,
- Dry upland constitute small area found along the outer boundary,
- Eco-system- consist of combination of aquatic, wetland and terrestrial ecosystem,
- Forest type- moist deciduous to semi-evergreen forest.

## Flora

- |                                |                                 |
|--------------------------------|---------------------------------|
| ▪ <i>Zizania latifolia</i> ,   | ▪ <i>Cynodon dactylon</i> ,     |
| ▪ <i>Saccharum munja</i> ,     | ▪ <i>Alpinia galanga</i> ,      |
| ▪ <i>S. bengalensis</i> ,      | ▪ <i>Eichornia crassipes</i> ,  |
| ▪ <i>Eiranthus procera</i> ,   | ▪ <i>Hedychium coronarium</i> , |
| ▪ <i>Dioscoria bulbifera</i> , | ▪ <i>Nelumbo nucifera</i> etc.  |

## Fauna

- Brow Antlered Deer (*Cervus eldi eldi*), also called Manipuri dancing Deer, Hog Deer, Sambar, Muntjac,
- Slow Loris,
- Stump tailed Macaques,
- Large & small Indian Civet,
- Marbled cat, Temminck's golden cat,
- H/black Bear, Malayan Bear(?)
- Otter
- Tortoise,
- Viper, Krait, Cobra.

## **Avifauna**

- Avifauna consists primarily of the smaller reed-dwelling species,
- Raptors are Black Eagle, Shaheen Falcon,
- Hornbills are Brownbacked Hornbill, Pied Hornbill, Rufousnecked Hornbill, Wreathed Hornbill & Great Pied Hornbill,
- Others are White Stork, Bamboo Partridge, Green Peafowl etc..

## **Major Threats**

- Dwindling open water surface,
- Increasing dominance of tree species cover,
- Frequent forest fire,
- Interference of alien spp,
- Illicit felling,
- Poaching (animal & fish ).

## **Major Conservation Strategies**

- Restoration & maintenance of open water surface,
- Controlled burning,
- Fire line making,
- Eradication of alien spp.,
- Regular engagement of patrolling duty against illegal felling, poaching,
- Organizing awareness camp/meeting etc,
- Cattle immunization camps,
- Fencing.

## Gir National Park



Location: Sasan Gir

- Gir Sanctuary :1965 (1153.42sq km)
- Gir National Park :1975 (258.71sq km)

### **Habitat**

Climate - Tropical monsoon

Annual rainfall 600 -1000 mm.

Temperature : 43-10°C

Seven major perennial rivers

### **Forest types**

Very dry teak forest

Dry deciduous scrub forest

Dry savannah forests (locally known as "vidis")

## Flora

### 5 Major Associations

Tectona grandis and Acacia chundra

Acacia chundra and Terminalia crenulata

Acacia chundra and Acacia nilotica

Anogeissus latifolia and Acacia nilotica

Terminalia crenulata and Butea monosperma

### Flora of Gir

Trees : 132 spp.

Shrub : 48

Herb : 232

Climbers : 64

Grass : 26

Total : 507

- *Tectona grandis*
- *Prosopis cineraria*
- *Acacia nilotica*
- *Acacia chundra*
- *Acacia leucofloe*
- *Anogeissus latifolia*
- *Alstonia scholaris*
- *Hardwickia binata*
- *Terminalia crenulata*
- *Lagerstroemia lanceolata*
- *Balantes aegyptica*
- *Zizyphus jujuba*
- *Sterculiaurens*

## **Fauna**

Mammals : 38 species

Birds : 300 species

Reptiles : 37 species

Insects : 2,000 species

- Lion
- Leopard
- Hyena
- Chital
- Sambar
- Chaushinga
- Civets
- Chinkara
- Wild boar
- Langur
- Porcupine
- Jackal
- Fox
- Mongoose

## **Birds**

- Malabar whistling thrush
- Black naped flycatcher
- Pygmy wood pecker
- Painted storks
- Pelicans
- Brown fish owl
- Indian pitta
- Tawny eagle
- Bonelli's eagle
- Crested serpent eagle
- Crested hawk eagle
- King vulture

## **Threats**

- Rail and road route inside the park
- Siddis and maldharis

- There are 79 villages located within a periphery of 2kms
- 20,000 open wells within an 8 km radius
- Two temples inside the forest area.
- Encroachment

### **Management Issues**

- Grazing is the main threat
- Soil& Moisture conservation
- Protection from fire
- Rescue of wild animals
- Relocation of human population from lions habitat
- Prevention: Expansion of tree species
- Regular patrolling

### **Threat to lion population**

- Narrow genetic base
- Especially vulnerable to diseases and causes 70 to 80% of sperms to be deformed.
- Severe overcrowding and hence migrating from the park

### **Asiatic Lion Reintroduction Project**

- To establish a second independent population of Asiatic lion at the Kuno wildlife sanctuary, MP,.To help develop and maintain genetic diversity
- It could not be implemented due to objections from the Gujarat Government

### **Lion Safari & Ecotourism**

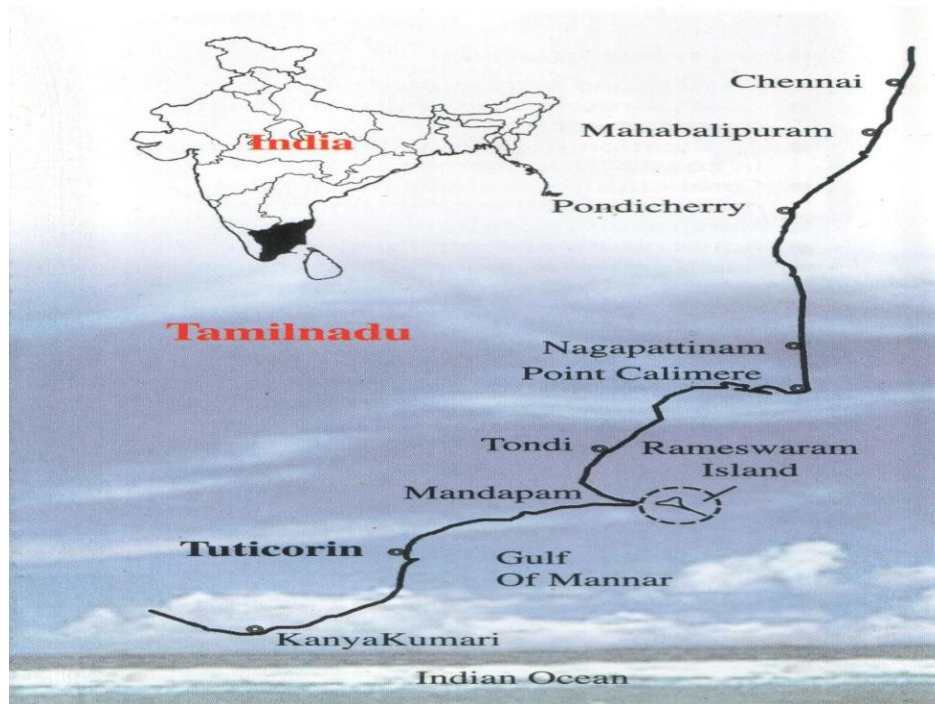
- Area of 416 ha.
- Lions with other herbivores.
- Artificial feeding Water supply.

## **GULF OF MANNAR MARINE NATIONAL PARK**

### **Extent**

- 560 Sq.Km.
- 360 Km coastal length.
- 21 coral islands, coral reefs and surrounding shallow water habitat.
- Islands are divided in to 4 groups.
- 1.Mandapam Group (7 islands)
- 2.Keezhakkarai Group (7 islands)
- 3.Vembar Group (3 islands)
- 4.Thoothukudi Group (4 islands)

The area described as the Pamban-Tuticorin Barrier reef, was declared a National Park in 1986 and later converted into a Biosphere Reserve in 1989.



## **BIODIVERSITY OF GULF OF MANNAR**

About 3600 spp.organisms. Nearly 20% are endemic

|                         |                            |
|-------------------------|----------------------------|
| 13 Species of Mangroves | 100 Species of Echinoderms |
| 117 Species of Corals   | 260 Species of Molluscs    |
| 12 Species of Sea Grass | 5 Species of Sea Turtles   |
| 217 Species of Birds    | 14 Species of Dolphins     |
| 450 Species of Fishes   | 6 Species of Whales        |
| 79 Sp. of Crustaceans   | 1 Species of Sea Cow       |
| 108 Species of Sponges  |                            |

## **HABITATION**

The islands are uninhabited except for Kurusadi, Musal and Nallathanni islands where antipoaching sheds are operating.

Along the coast near the park there are about 125 villages which support about 100,000 people who are mainly Marakars, a local Community principally engaged in fishing

### **Threats**

#### **1. Natural Threat**

- Cyclones, tsunami etc. (1964 cyclone damaged large reef areas in Mandapam; 2004 Indian Ocean tsunami had no significant impact)
- Climate change and coral bleaching (Bleaching reported in 1998 & 2002. From 2004 onwards annual bleaching is observed during summer season)

#### **2. SOCIO ECONOMIC THREAT**

Population - More than 1.6 lakhs fishermen.

Number of villages - More than 125.

|                                                |         |
|------------------------------------------------|---------|
| Approximate no.of mechanized boats in the area | – 1923  |
| Non- mechanized boat                           |         |
| Vallam (Cattamaran with motor)                 | – 4562  |
| Cattamaran                                     | - 21219 |

### **3. OTHER SOURCES**

- Industrial Pollution
- Solid waste
- Sewage waste

#### **It leads to:**

- Habitat destruction and bleaching of corals
- Over harvesting of marine resources
- Potential, localized land based marine pollution

#### **Reasons**

- Insufficient law enforcement machinery
- Lack of integrated management
- Lack of community support
- Insufficient public awareness
- Lack of clear boundary
- Lack of alternative livelihood sources
- Lack of Environmental friendly measures by Industries and other Polluting sources

#### **Tuticorin**

- Residing Population - 3.2 lakhs
- Sewage discharges per day -25,000 cubic metre

- Important place of Polluting sources
- Thermal Power Station (Fly Ash)
- SPIC (Effluents)
- Tuticorin Alkali Chemicals (TAC) – (Poisonous Effluent)
- Harbour activities (Sledges & Dump)
- Dharangadhara Chemicals Works (DCW)- (Chemical, Mercury Waste)
- Tuticorin Salt Marine Chemicals (Effluents)

## **CONSERVATION EFFORTS**

### **Gulf of Mannar Biosphere Reserve Trust (GOMBRT)**

Project launched in 2002. The establishment of the Trust was the precursor to the implementation of GEF-UNDP (Global Environ. Facility Programme of UNDP) funded Project on “Conservation and Sustainable Use of the Gulf of Mannar Biosphere Reserve’s Coastal Bio-diversity”

#### **Objective of the project:**

1. Conserve the Gulf of Mannar Biosphere Reserve’s globally significant assemblage of Coastal Biodiversity
2. To demonstrate in a large biosphere reserve with various multiple uses, how to integrate Biodiversity conservation and sustainable coastal zone management and livelihood development.
3. The focus of the project is on empowering local communities to manage the coastal ecosystem and wild resources in partnership with Government and other stakeholders.
4. Specific Government and village-level institutions are to be strengthened, stakeholders will apply sustainable livelihoods, and an independent, statutory Trust

would ensure effective inter-sectoral co-operation in the sustainable conservation and utilization of the GOMBR's biodiversity resources.

### **Project implementation mechanisms**

- a) Board of Trustees
- b) Empowered Sub Committee
- c) State level co-ordination Committee.
- d) District Level Co-ordination Committee

(Ramanathapuram / Tuticorin)

- 5 Research Advisory Group
- 6 District Nodal officers group
- 7 VMC & EDC's
- 8 SHG's
- 9 Partner NGO's

### **Challenges in Project implementation**

- Establishment of inter-departmental relationships towards holistic implementation of conservation efforts in Gulf of Mannar.
- Availing co-funding support from identified partner agencies and institutions towards the identified tasks in the project.
- Co-ordinating efforts of various agencies, departments and institutions through State Level and District Level Co-ordination Committees.
- Availing field support in execution from various law enforcement departments on continuous basis.

- Gaining people and stakeholder support towards bringing Gulf of Mannar issues on priority in District / State Level issues.
- Gaining people and fishermen union support in accepting with immediate requirement for conservation measures.
- Removing fishing pressure through non-eco-friendly fishing practices, with the existing legal provisions.
- Restricting entry of fishermen in GOMNP.
- Restricting exploitation and destruction of highly endangered scheduled animals as they are in trade for decades.
- Establishment of Long Term Funding Mechanism for project sustenance.
- The village level sub committees were formulated and discussions are on with respect to management of the resources.

### **Bandipur Tiger Reserve and National Park**

#### **Location and Extent**

- 80 km south of Mysore,
- South -Wynad WLS
- West -Mudumalai WLS
- N-W – Nagarhole NP
- The highest peak is Gopalaswamy hill
- Area- 880 sq. km.
- Core- 523 sq. km.
- Buffer zone- 357 sq. km.
- Altitude-780- 1454m

- Topography- Undulating terrain broken by chains of hills, flat topped hillocks and water courses.
- Bandipur is part of the THE NILGIRI BIOSPHERE RESERVE

## **HISTORY**

- 1931:- A Sanctuary of 90 sq. km. area was created in Bandipur Reserve Forest.
- 1941:- Venugopala Wildlife Park was constituted. (Named after the deity, Venugopala)
- 1973:-Bandipur Tiger Reserve was formed.
- 1973- Bandipur National Park.
- Main rivers:- Nugu, Kabini and Moyar.
- The Nugu:- Middle of the Reserve.
- The Moyar:- Southern boundary between this reserve and Madhumalai WLS.
- The Kabini:- Boundary between this Reserve and Nagarhole N.P.
- The Kabini ( at Beechanahalli )reservoir provides water facility and the grazing ground for hundreds of elephants during severe and prolonged pinch period.
- Seasonal streams
- There are a few natural & artificial saltlicks available in the Reserve and are being regularly used by the wild animals.

## **Vegetation**

### **3 Types**

1. Scrub- Eastern most area.
2. Tropical dry deciduous- Central part.
3. Tropical moist mixed deciduous- Western part.

### **Scrub Forest flora**

- Shorea talura
- Santalum album
- Terminalia chebula
- Azadirachta indica
- Acacia leucocephala
- Acacia catechu.
- Zizypus spp.,
- Diospyros spp.,

### **Tropical dry deciduous Forest**

#### **Upper canopy**

- Tectona grandis
- Terminalia tomentosa
- T. paniculata
- Pterocarpus marsupium
- Dalbergia latifolia
- D. paniculata
- Butea monosperma
- Emblica officinalis

#### **Lower canopy**

- Zizypus jujuba
- Sandal
- Cassia fistula and
- Under growth mainly comprises of grasses and Lantana sp

### **Tropical moist mixed deciduous forest**

#### **Upper canopy**

- Bamboo
- Teak
- Terminalia tomentosa
- Dalbergia latifolia
- Pterocarpus marsupium
- Salmalia malabarica
- Adina cardifolia
- Grewia tiliifolia
- Albizzia odoratissima
- Ficus infectivora

### **Lower canopy**

- *Emblica officinalis*
- *Butia monosperma*
- *Zizypus xylocarpus*
- *Bauhunia racemosa*
- *Cassia fistula*

### **Fauna**

- Tiger
- Leopard
- Wild dog
- Jungle cat
- Striped Hyena
- Sloth Bear
- Jackal
- Mugger
- Python
- Elephant
- Mouse deer
- Spotted deer
- Sambar
- Four horned antelope
- Gaur

### **Avifauna**

#### **180 bird spp., Important are...**

- Peafowl
- Grey jungle fowl.
- King vulture
- Gray partridge
- Malabar trogon
- Black wood pecker
- Indian pitta
- Paradise flycatcher
- Malabar pied hornbill

### **Management issues**

- Elephant Corridor problems.
- Road Traffic.
- Human settlements.
- Domesticated animals and grazing.
- Man-Animal conflicts.
- Forest fires.
- Construction activity.
- Poaching and Smuggling.
- Weeds and Diseases.

### **Elephant-Corridor problems**

- The corridor at Bandipur National Park (50 m wide The Mysore Ditch or the Kaniyanpura Corridor) is one of the two in Niligiris and threatened along its northern boundary by land-use projects ranging from agriculture to tourism.
- Resort planners and Companies have legally acquired land, paid for the change of land use, and got the required NOC's. esp in the post- Veerappan "era

### **Traffic Problem**

#### **Highways**

- State highways Mysore-Ooty and Gundlupet-Sultanbathery are passing through the Park.
- Traffic is very heavy and frequent accidents of wild animals take place during night.
- One vehicle passes for every minute.

- At least three large animals (of the size of a deer or bigger) are killed every month
- With no speed limits, vehicles passing through this stretch at an average speed of over 80 km/hr have been posing a threat to wild animals and has led to the death of hundreds of animals, birds and reptiles.
- Wildlife gets attracted to human food like potato wafers, fruits and other waste left by tourists passing through this stretch.
- Dead or crushed animals attract carnivores which in-turn become victims of road accidents.
- There is no settlement inside the Reserve.
- 200 villages situated adjacent to the Reserve (within 5 km.) with a human population of around 1,60,000 (1991 census).
- Illicit collection of fuel wood and smuggling by head loads near Hanagala, Channamallipur and Bargi.
- The commercial use of fuel wood for tobacco and turmeric curing is also going up.

### **Livestock population and grazing**

- Core of the reserve is free from grazing pressure but there are 1,80,000 cattle heads in the five-km radius of the Reserve.
- About one third of the Reserve area is affected by cattle and has become unsuitable for the wild herbivore. The elephants, which were in the habit of foraging in the fringe in the rainy season, now visit cultivated areas outside the

Reserve for foraging, and thus cause severe conflicts between people and the Reserve.

### **Development and construction activity**

Construction of the Kabini reservoir has submerged the valley between Nagarhole and Bandipur

### **Road Expansion**

Tourism Industry and resorts. On an average, 45,584 tourists per year visit the Reserve.

Any large-scale hospitality industry activity, however well managed, leads to issues of pollution, waste disposal and toxicity.

It will lead to increased opportunities for human-animal conflict situations.

### **Forest Fires**

The Reserve suffers from frequent fires due to accumulated leaf litter and deadwood on the floor.

1. Villagers induce early flush of grass, on receipt of showers, for grazing of domestic animals.
2. Tribes clear the dry grass and undergrowth for collection of fallen antlers of deer and N.T.F.P.
3. Smoking and carelessly throwing lighted cigarette and bidi butts.
4. Poachers
5. Vengeance against Dept.

## **MAN-ANIMAL CONFLICTS**

- Farmers may be injured or killed by foraging elephants and can lose an entire year's provisions in a single night's raid.
- Locals often retaliate by killing the "problem" or rogue elephants, or even worse, injuring them badly.
- Injured elephants may become even more resentful of humans.
- About 150 -200 cattle get killed annually by wildlife esp. by elephants
- Since 2004, about 24 Elephants were killed. And 9 got electrocuted.
- About 10 people get killed annually around Bandipur
- Poaching of wildlife
- About 6 -7 elephants are poached or killed on an average and similar number of other wildlife
- Illegal ivory trade
- In the last few decades, severe poaching of male Asian elephants with tusks (tuskers) has drastically skewed the sex ratio of elephant populations in many parts of India.

### **Diseases**

- Foot and mouth disease in Bandipur NP Carcasses of deer and sambhar recovered in the Gundre forest range of the Bandipur National Park indicate that the park is affected by the deadly foot and mouth disease which is transmitted to wild animals by domestic cattle. (24/09/99)

### **Weeds**

- Invasion of habitat by the exotic plants like Lantana and Eupatorium has reduced fodder availability

**Staff** The staff are mostly untrained in wildlife management.

- Of the total sanctioned strength of 231 posts, 74 are lying vacant.
- Threat from Criminals esp. post Veerappan era

### **Management initiatives.**

#### **Widening of the corridor.**

- Government of India gave the Karnataka Government funds and the corridor was widened by nearly 500 m through the acquisition of revenue land adjacent to the national park boundary.
- The corridor was threatened by the development of a tourist resort and after persuasion, the promoter scaled down his project and moved it to an adjoining piece of land.

#### **Man animal conflict.**

- A double-layer protection comprising Elephant Proof Trench (EPT) and solar powered fence around the Bandipur National Park has been mooted to mitigate man-animal conflict in the region.
- In all, 229 km of EPT has to be dug up around Bandipur of which the Forest Department has completed 183.5 km.
- Use GPS transmitters to track the precise movement of collared elephants (usually the notorious crop raiding elephants) in near-real time.

#### **Traffic regulation**

The authorities have made restrictions on the movement of vehicles inside the national park between 6 p.m. and 6 a.m.

## **Barricades**

The Wildlife Trust of India (WTI) has initiated a Rapid Action Project (RAP), supported by the Forest department, to check speed of vehicles plying through this stretch to minimize wildlife casualties by placing barricades in a zig zag patterns

Four barricades and eight signage along this stretch to check vehicle speed.

## **Conservation awareness**

Educate travelers, drivers, police officials and others concerned on wildlife conservation.

Drivers edun. at the Melukamanahalli entry point ”

## **Tourism Regulation**

- Shifting of the present tourism zone which lies on the highway to Ooty that cuts across the park to a new zone so as to reduce tourism pressure on the park and its wildlife habitat.
- The existing buffer region where tourism zone functions will no longer exist as the entire forest has been identified as a core critical tiger habitat by the National Tiger Conservation Authority.
- Tourism-related activities, including the safari rides and the Forest Department offices, will be shifted in phases to a new location while the existing cottages, staff quarters and offices will be disbanded.

## **Fire**

Fire lines created (30-ft) by clearing the vegetation along the periphery of the forest boundary.

Temporary recruitments have been made and more than 350 forest watchers have been appointed to keep a watch on the outbreak of fire.

## **Habitat improvement**

- The new management plan envisages a massive afforestation programme in the restoration zone, which is situated along the fringes of the Protected Area and has been degraded due to various biotic factors and pressure from the villages adjoining the national park.
- It also moots the idea of removing the eucalyptus plantations and other monoculture species, which may be suppressing the indigenous varieties.
- Lantana removal

## **Other approaches**

### **Protection Squads / Patrolling**

14 patrolling camps have been established to check the poaching of wild animals.

### **Eco-development**

To reduce the pressure on the Reserve by the people living adjacent to the park, eco-development works are being carried out in and round the villages situated on the periphery of the Reserve

### **Education and Awareness**

Environmental awareness camps for school children and teachers are being conducted regularly.

### **Population of Animals**

|          |             |
|----------|-------------|
| Tiger    | 60 -70      |
| Panther  | ~ 80        |
| Elephant | 2500 - 3000 |
| Gaur     | ~ 2400      |

|              |            |              |          |
|--------------|------------|--------------|----------|
| Wild Dog     | ~140       |              |          |
| Spotted Deer | 6000 -7000 |              |          |
| Sambar       | ~1000      |              |          |
| Sloth Bear   | 50 - 60    |              |          |
| Chousingha   | 15 -20     | Barking Deer | ~130     |
| Com. Langur  | ~1800,     | Wild Boar    | 180 -200 |

### **KANHA NATIONAL PARK & TIGER RESERVE, MANDLA Dt. M.P**

Estd.in1955 in the Mandla District of MP

Tiger Reserve in 1974

Area: 1,945 sq km

Core : 940 sq. km

Buffer : 1005 sq. km

- The major feature of this region's interesting topography is the horseshoe shape valley and the whole park area is surrounded by the spurs of the Mokal Hills.
- The Surpan River meanders through Kanha's central Maidans, grasslands that cover the extensive plateau.
- Steep rocky escarpments along the edges offer breathtaking views of the valley

### **FLAGSHIP SPECIES**

Tiger: population is about 100

### **Flora**

Over 50% of the park is dry deciduous woodland.

Sal is the dominant species.

**Hilltops and slopes with species such as :** *Acacia torta*, *Anogeissus latifolia*, *Bauhinia retusa*, *Buchanania lanzan*, *Butea monosperma*, *Boswallia serrata*, *Semecarpus anacardium*, *Lagerstroemia parviflora*, *Terminalia arjuna*, *Tichebyla*, *T.bellirica*, *Emblica officinalis* and *Mallotus philippensis*.

### **Major Fauna**

Mammals: 22 species of mammals

- Chital , Sambar , Barasingha ,
- Barking deer , Chousingha , Gaur ,
- Langur , Wild pig , Jackal, Sloth bear,
- Wild dog, Panther, Tiger .

### **Reptiles:**

Python, Indian Cobra, Russell's Viper, Indian Krait, Common Rat Snake, Common Skink, Indian Monitor, Fan Throated Lizard and Indian Garden Lizard etc.

### **Fishes:**

Giant Danio, Common Rasbora, Mud Perches, Brown Snakehead and Green Snakehead etc.

### **Birds:**

The Reserve supports around 300 species of birds.

Black Ibis, Bee-eaters, Cattle Egret, Blossom-Headed Parakeets, Pond Heron, Drongos, Common Teal, Crested Serpent Eagle, Grey Hornbill, Indian roller, Lesser Adjutant Stork, Little Grebes, Lesser Adjutants, Lesser Whistling Teal, Minivets, Pied Hornbill, Woodpecker, Pigeon, Paradise Flycatchers, Mynas,

Peafowl, Red Jungle Fowl, Red Wattled Lapwing, Steppe Eagle, Tickell's Flycatcher, White-eyed Buzzard, White-breasted Kingfisher, White-browed Fantail Flycatcher, Wood shrikes and Warblers among many more

### **Research and Monitoring**

- Under research and monitoring activities, field data collection is carried out in the specially laid out plots, as per guidelines of Project Tiger.
- Daily monitoring of the endangered Barasingha population is also ensured in the prescribe format. Cattle immunization programme in core and buffer zones.

### **Threats**

#### **Human-population**

There are 18 forest villages in the core and 29 forest villages and 149 revenue villages

#### **Livestock population**

- About 30,000 cattle heads in the core zone.
- Around 80,000 cattle heads in the Reserve.

#### **Grazing**

No grazing allowed in the core zone

In the Buffer specific areas have been earmarked .

#### **Fire**

Fire incidence are kept at minimum by preventive and control measures

#### **Conflicts**

#### **Man-Animal**

- crop-raiding

- cattle lifting
- human injury and loss of life

## **ISSUES**

### **Poaching**

Sporadic cases of subsistence poaching and illicit cutting of poles by local people.

### **Criminals and Extremists**

Presence of Criminals and Self styled extremists

**Diseases** - From domestic cattle.

- During 1976, there was an outbreak of Rinderpest. In all 52 Gaur,, Sambar and 35 Chital succumbed to the disease.

### **Mining**

The Hidusthan Copper Ltd. (around 7 km beyond the buffer boundary)

### **Irrigation**

Matiari Project (around 1 km. away from the buffer boundary).

## **MANAGERIAL EFFORTS AND ACTIONS**

1. Publicity work through traditional folk dances, skits, workshops are proving quite effective and need to be continued
2. Motivating school teachers to elicit support of younger generation.
3. Damaging activities of certain NGOs need to be checked.
4. Dedicated NGIs /NGOs are to be involved in mobile seminars designed for the indigenous people.
5. Viable strategy for conserving the available forests to ensure vegetal connectivity with the core.

6. Legislative support is extremely important for avoiding conflict between conservation and economic optimization of use of resource in the buffer area.

## **CHAPTER: 14**

### **MONITORING OF WILDLIFE POPULATION : CENSUS**

#### **Objectives:**

Wildlife census is measuring the abundance of animal populations. It is a method of monitoring WL population.

- to evaluate the success or failure of management interventions
- to know the dispersal trend in the population of a species
- to compare the animal densities in different habitats
- to establish benchmark data - which serve as a basis for future management

#### **Pre requisites:**

- Ideally census should be done for a single species or closely related group of species
- Selection of an appropriate census technique depends on the species, the objectives and the resources available
- Stratification of the habitat based on a reconnaissance survey is essential
- Qualitative indices can also be used such as number of tiger tracks seen per 100km walked or number of Sambar pellets found in a 100m<sup>2</sup> plot
- It can be expressed in Absolute density such as number of tigers/100 km<sup>2</sup> or number of Sambar per 1 km<sup>2</sup>.

#### **Which species to Census:**

- Spp. that require management intervention ( like overgrazing, competition problem)
- Internationally or locally endangered species

- Spp. Of national or local importance
- Spp. Of economic significance ie. Those causing crop damage
- Spp that are tourist attractions
- Important prey spp.

### **Time of Census**

- depend on the species and methodology
- Waterhole census in peak summer
- Season that gives maximum visibility
- Avoid periods of extensive disturbance like timber working
- Avoid monsoon time
- Sightings are more early in the morning or in the evening

### **METHODS**

- Wild animal census can be broadly divided into Direct Method and Indirect Method.
- The Direct method is further divided into Total count and Sampling Count.

### **DIRECT METHOD**

- Total count: assumes a search of entire area of interest and counting all the animals
- However, in practice, neither the entire area nor the all the animals counted
- Total count also requires more man power and resources

## **TOTAL COUNT**

- Block Count
- Road-side Count
- Waterhole Count
- Aerial Count

## **SAMPLING**

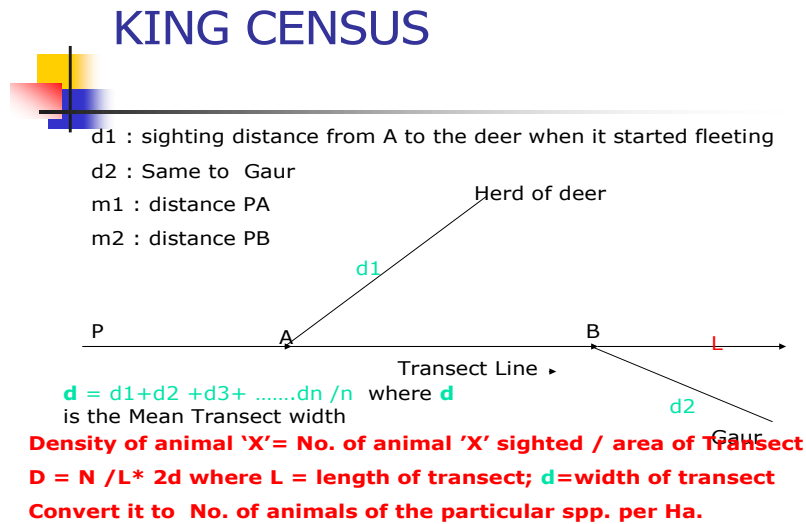
- Sampling is often preferred for population estimation as it helps in statistical treatment and repeatability
- sample count assumes a random distribution of animals
- stratification of the area according to habitat
- pre-census information helps
- Sampling Assumptions
- Sighting of one animal does not influence the sighting of another
- Conditions affecting observer/ object encounter do not change during the operation
- Objects to be samples are distributed at random

## **CENSUS OF LARGE HERBIVORES**

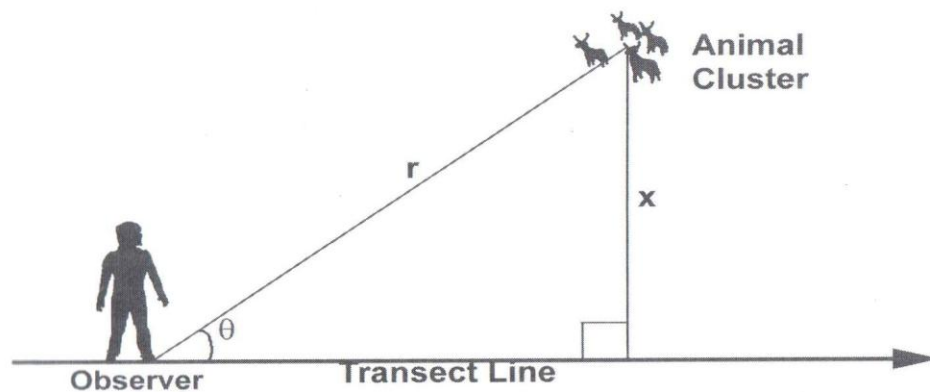
### **LINE TRANSECT METHOD**

- One of the most popular and most widely used
- Marking a transect of known length is the first phase of this method
- The transect is then covered at a uniform pace
- Compass or GPS are can be used

- When an animal is sighted, record the sighting distance, sighting angle and the number of individuals.
- The distance and angle are measured to the geometric centre of the animal.
- Group, Age, sex composition and habitat are also recorded.



### Calculation through certain useful Software



- $x = r \sin \theta$
- $x$  = perpendicular distance
- $r$  = radial distance and

- $\theta$  = angle of sighting

$$D = n f(\theta) / 2 L$$

- $n$  = number of groups of animals sighted
- $L$  = length of transect
- $f(\theta)$  is the probability density function  $f(x)$  which is the probability of finding an animal or group at perpendicular distance “ $x$ ” from the transect.
- The computer programme DISTANCE is used for calculations.

### **Fixed Width Transect**

- Through Kelkar Belt transect Method
- Histogram Plotted with X axis the sighting distance class and the Y axis the frequency of animal sighted
- The sighting distance at which the sightings shows a falling trend is taken as the Fixed width and the observations beyond this width are rejected

### **Water Hole census**

#### **Assumptions**

- There is linear correlation between the number of animal seen drinking per time period and the total number of animals in the area
- The frequency with which certain species drinks is known
- Field staff record an accurate count of animal seen drinking
- presence of field staff does not deter the animals

### **INDIRECT EVIDENCE FOR ELEPHANTS & GAUR**

**the assumptions are,**

- Dung density is related to elephant density
- defecation rate & decay rate of the dung must be known prior to the survey

### **INDIRECT OR DUNG COUNT METHOD FOR ELEPHANTS**

- The dung density is estimated using a line transect
- The transect is covered on foot and the perpendicular distance from the transect to the dung piles observed on both sides is noted
- The 'age' of the dung also should be recorded

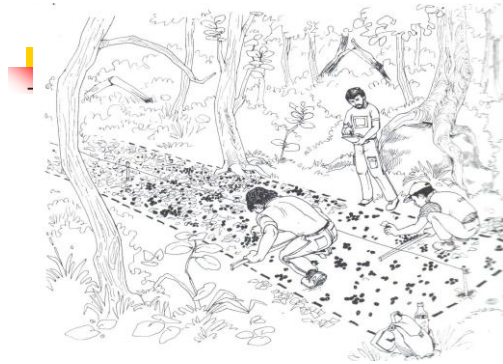
### **ESTIMATION OF ELEPHANT DENSITY**

$$E = Y \times R / D$$

- E = elephant density
- D = defecation rate
- R = the decay rate
- Y = dung density
- The computer programme DISTANCE or ELEPHANT is used for calculations

### **INDIRECT EVIDENCE FOR OTHER ANIMALS**

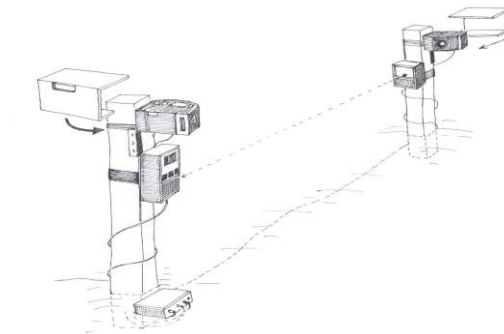
- a transect of fixed width will be used for the purpose
- all evidences such as pellet/scat/hoof/ burrow/scratch, etc. falling within two meters of the 50 m line recorded species wise. This would indicate distribution, habitat utilization and if repeated would indicate seasonal and annual difference in their numbers



## **CAMERA TRAPS**

- Infra red cameras are set on the tiger trails within the forests
- The camera triggers whenever a warm blooded animal crosses the camera line
- Each tiger has distinctive stripe pattern using which the individuals can be identified
- Computer programme MARK is used for the analysis
- Camera traps are good for surveying small carnivores also

## **CAMERA TRAP**



## **SMALL MAMMALS**

- Why capture – for most of the small mammals we can say absolutely nothing without catching them.

- The ideal traps for studying the non-aggressive small mammals are the live traps such as Sherman traps of varying dimensions.
- There are also ‘single capture traps’ as well as ‘multiple capture traps’.
- For catching tree squirrels the homemade wood-wire traps are very effective.
- Snap traps should not be used for the small mammal studies not only because they are not acceptable from the welfare and ecological point of the animal but also from the museum collection point of view.

### **WHERE TO SET THE TRAP**

Traps can be set on the top of the trees (head height), so that the chances of trapping arboreal small mammals are more.

When kept on ground it is better to keep the traps near an object (tree trunk for eg.) than in the middle of an open land, to increase the capture success.

### **HOW MANY TRAPS**

- more the traps the better.
- 100 traps are a reasonable number of trap for density estimation studies.
- For presence / absence studies even 25 to 50 traps are OK.

### **SPACING OF THE TRAPS**

- For the presence / absence studies keeping the traps in a transect is a good way of doing as the same could cover more habitats.
- For the density estimation studies the traps are set in grids. Here again the traps can be set differently.

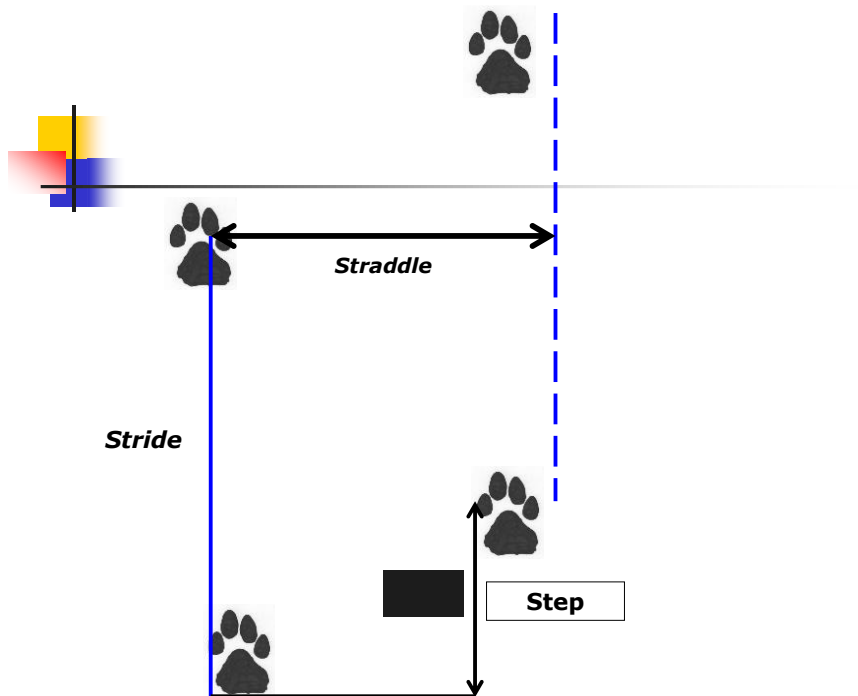
- For example 12 traps can be set in two different ways as shown below.
- Suppose each of the traps is set at a distance of 10m, then in the first case the 12 traps cover an area of  $40\text{m} \times 30\text{m} = 1200\text{m}^2$ , while in the second case the 12 traps are kept in an area of  $30\text{m} \times 20\text{m} = 600\text{m}^2$ .

|   |   |   |   |    |    |
|---|---|---|---|----|----|
| X | X | X | X | XX | XX |
| X | X | X | X | XX | XX |
| X | X | X | x | XX | XX |

### **PUGMARK COUNT FOR LARGE CARNIVORES**

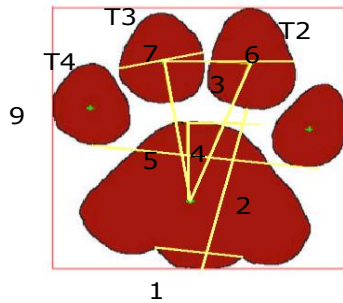
- The method is based on the 'unique' pugmark signature making it possible to distinguish individual tigers
- Tigers mostly walk through forest roads, paths, streams, etc.
- The investigators should search for pugmark in such areas
- The pugmark is then traced to a pugmark tracer, or a photographic image is taken, which is digitized later and various measurements taken using computer software

## STEP, STRIDE AND STRADDLE



- Step is the distance between the successive left and right hind footprints. A step measures half as much as a stride.
- Stride is the distance between two successive prints of either the left or the right hind foot.
- Straddle refers to the width of the tiger's gait. It is measured as the straight-line distance between the outer edges of successive left and right pugmarks.

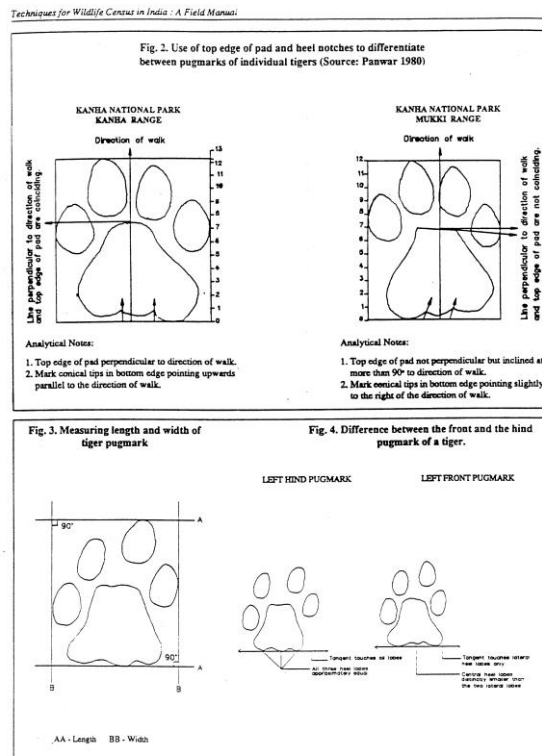
# VARIABLES THAT DISCRIMINATE PUGMARKS OF TIGERS



1. Pug width
2. Heel to lead toe length
3. Distance for T2 to T3 centre
4. Angle between T2 and T3
5. Distance between T1 and T4
6. Length of minor axis of T2 through centre
7. Length of the minor axis of T3
8. Area of T3
9. Distance of pad top to toe baseline
10. Stride
11. Straddle

To obtain correct figure we need to know about:

- SOCIAL ORGANIZATION OF TIGERS, TIGER BIOLOGY & TIGER DENSITY



## MIST NETS FOR BAT STUDIES

- For study of Bats, birds

## **BIRD SURVEY METHODOLOGY**

- Move on the transect at a uniform and slow pace. It is advisable to make a pause for one – two minutes after 10-15 steps. This would enable more detectability of the birds present.
- Record ALL species of the birds sighted
- The same should be repeated in the afternoon also
- One base camp can have two teams each consisting of two (maximum three) persons.
- On the second day the two teams can alternate the transects / routes that they used the previous day
- All the birds opportunistically sighted / heard outside the transect also need be recorded separately. This information is mainly for the preparation of the checklist

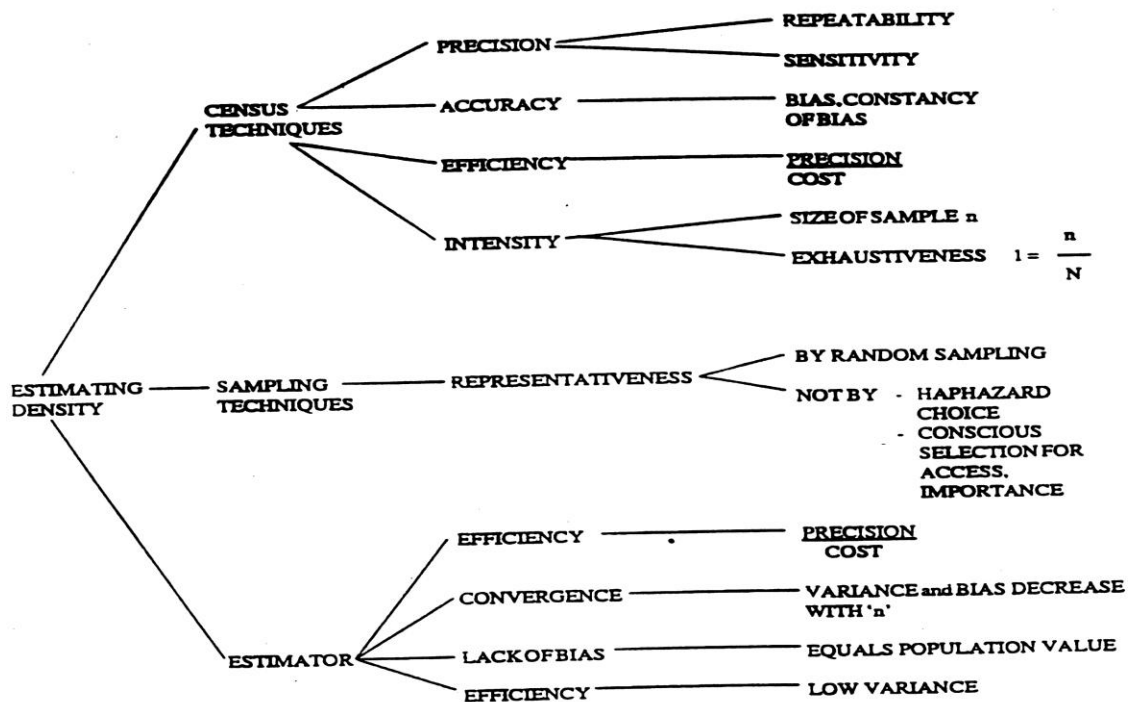
## **Surveying a flock of Birds**

- Quadrant sampling
- Count the sample and extrapolate
- Useful against large flock of migratory water fowls, flying birds etc.
- Tree cover : 25m x25m or 50m x50m depending on the diversity
- The Curve suddenly rises up and then plateaus off after a while
- The point at which the curve tends to plateau off is taken as the sample size

## **Sample Size in WL Populations**

- Set the desired Confidence interval sat, 95% hence  $z=1.96$
- Set the Limits, L ,say  $\pm 10$  animals
- Set the Std deviation, S
- Set ratio pf the Sampling Unit size to Sampling area, r
- No. of Sampling Units needed
- $N = Z^2 \times S^2 / (r \times L)^2$

**Diagram to illustrate relationships between components of an estimate of density.**



## CHAPTER: 15

### **EX SITU CONSERVATION:**

Ex situ (“off site”) conservation refers to the maintenance of wild animals and plants in stable population outside their natural biotope.

**Objective:** To provide support for the survival of species in natural environment. It is not alternative but complimentary to conservation.

#### **Importance of ex-situ conservation**

1. To prevent critically endangered species from extinction.
2. To manage wild population in captivity by controlled co-operative breeding.
3. To aid in public education creating consciousness and to foster research for the survival of species of wild.

#### **Ex situ Conservation Sites**

- Zoological Gardens
- Rescue and Rehabilitation Centres
- Botanic Gardens
- Seed Banks
- Gene Banks

#### **What is Zoo?**

Zoo is an institution that manage and exhibit collection of wild animals. Such animals may be native species, exotic or mixture of both. Zoo generally keep a variety of vertebrate classes of animals like mammals, birds and amphibians. But there may be specialized zoos keeping only one category of animals.

## **Specialized Zoos**

- Bird park: specialized bird collection
- Vivaria: specialized reptiles collection
- Aquaria: specialized fish collection
- Insectaria: specialized insect collection
- Marine zoo/Dolphin aria: specialized marine animal collection
- Primate zoo: specialized collection of non-human primates only.
- Zoo : small area; about 25 acres; main emphasis on animals
- Zoological Garden: medium size; about 50 acres; emphasis on animals plus horticultural aspects
- Zoological Park: Large size; about 100 acre or more; animals in almost natural surroundings; enclosures far apart and more of open zoo models with minimum of caged enclosures
- Rescue Centre and deer parks: Where rescued animals are kept; deer park is an old concept and is being phased out

## **History of Zoo**

- 2500 BC : Archeological excavations reveal that Egyptians kept monkeys, antelopes, mongooses and other animals as pets.
- 1150 BC : Deer Park in China called “Intelligence Park”
- 3 & 4 Century BC : Alexander the great is believed to have established a spectacular zoo in Alexandria. The emperor Ashoka also believed to have established zoos.

- 1826 AD: The formation of Zoological Society of London, the utility of zoos for scientific studied was realized. ZSL established the London zoo in 1828 primarily for research purpose and secondarily for visitors.
- There are about 10000 zoos in the world. At least 600 million people, that is 10% of the entire world population visits zoos annually.

### **In India**

- Emperor Akbar is believed to have kept 1000 Cheetahs in his collection.
- The first collection of wild animal was reportedly setup in 1800 at Barrackpore by the then Governor General Lord Wellesley. This zoo does not exist any more.
- The oldest zoo in India is the one established in 1854 by Raja Rajendra Mullick Bahadur at his residence called the Marble Palace Zoo in Kolkota – bred Macaos and Cockatoos; has some spp. of Deer, Black Buck and Monkeys
- In 1855, Madras Zoo and in 1857 Trivandrum Zoo was established. In 1865, Mysore Zoo and Junagarh Zoo; ,in 1875, the Alipore Zoo in Kolkotta established.
- The National Zoological Park in Delhi and Zoo-cum-Botanical Garden in Guwahati was inaugurated in 1959.

### **Status of Zoos today**

- Over 83 countries maintain zoos and aquaria in the world
- Over 1000 Zoos and Aquaria are of reasonably good standard of which 578 are from developed world which has no richness in diversity.
- Developing countries have few zoos for conservation for want of funds although diversity is greater.
  - 12,32,000 vertebrate exhibited.

- Nearly half of them are fish.
- 2,02,000-Mammals
- 3,51,000-Birds
- 74,000-Reptiles
- 21,000-Amphibians

### **Animal collection in Indian Zoos**

Cumulative area of zoo's - 9,000 ha (App)

Total animal collection            about - 50,000 animals

Total number of species            - 600

No. of Recognized zoos            - 164

De-recognized zoos    - 91

Zoo's modernized                    - 14

### **Modern Zoos in India**

Delhi Zoo in 1955

Nehru Zool. Park in Hyderabad in 1959

Kanpur Zoo in 1974

Chandigarh Zoo in 1977

Nandan Kanan Zoo in 1960

Vandalur Zoo in Chennai in 19

Oldest existing Zoo is Trivandrum Zoo, the Mysore Zoo and the Alipore Zoo in Kolkotta

### **Classes of Zoos**

Various Classes depending on the area, no. of species kept, no. of spp. bred, kind of facilities available. A, B, C and D ( Large, Medium , Small and Mini)

A Class: Larger Zoos. Delhi, Hyderabad, Mysore, Ahmedabad, Kanpur, Chandigarh, Kolkotta, Guwahati, Chennai and Trivandrum.

B Class: Majority of the Zoos. Eg: Lucknow, Jaipur, Junagarh

C and D : Smaller Zoos and Rescue Centres

### **Objectives of Zoo**

Modern day zoos have following four basic objectives:

**Conservation:** To act as repositories for species threatened with extinction.

**Captive Breeding:** To evolve & carry out breeding programmes for the propagation of rare & endangered species.

**Education:** To interpret animals & conservation to the visitors for the better understanding & appreciation of animal life & to create an awareness for the wildlife conservation.

**Research:** To conduct research on behavior, reproduction, nutrition, diseases & co-operate with visitors institute in research endeavors.

### **Zoo Exhibit Themes**

1. The Taxonomic Theme: The traditional approach. The zoo is divided in certain areas & each area is earmarked for a taxonomic group such as primate area, deer area, large cat area etc.
2. The Zoogeographic Theme: In this approach the animals are exhibited on the basis of the continent they are native of viz. African animal area, Asian animal area .
3. The Habitat Theme: Here the animals are grouped on the basis of their habitat viz. tropical forest animal area, desert animal area, aquatic animal area etc.
4. The Behavioral Exhibit Theme: The animals are grouped on the basis of certain behaviors pattern common to the category viz. Carnivore, Grazers, Nocturnal animal etc.
5. No Theme: often zoo add animals to its collection & place them in any enclosure that happen to be vacant. There are no clear-cut themes, master plans for placement of the exhibits.

### **Signage**

In zoo four kind of signage are used:

1. Guide Maps
2. Identification Signage:
3. Interpretative Signage:
4. Directional Signage:

### **Display Requirements**

Comfort of the animal

Aesthetically pleasing

Simulated habitat conditions – ecologically oriented natural environment

Descriptive display board on the animal showing their original distribution, habits, habitat etc.

### **Feeding Requirements**

Monkeys & langurs : fed 3 times a day.

BF : ground Nut & grains ( ~100gm)

Lunch: Bread soaked in Milk ( 10-12 pieces)

Evening: fruits and leaves( for Langurs)

Carnivores : about 8 -12 Kg of fresh meat per day with bones; boiled meat for young ones

Pachyderms: Rhino, elephant, Hippo

Elephant: 100-150 kg green fodder; 50-100 kg Tree fodder; 25 kg dry fodder; Bananas; Concentrates of whet grain, gram, maize, Barley, oil cake etc. Mixed together; 150 gallons of water.

Rhino and Hippo similar with lesser quantity

### **Veterinary & Sanitation**

Vet. Hospital essential requirement. Regular administration of medicines such as De-worming every 3 -6 months; medicines against enteritis; vaccinations. Zoos be kept clean with Proper drainage.

### **Enclosure/ Barrier**

Fence: Such as chain link wire fence, cement walls, wooden rails and stockade, metal bars and even plant hedges.

Moats: Moats are deep, wide ditch dug around an enclosure. If the ditch is filled with water then it is called wet moat and if not it is dry moat.

Flexi-Glass/plastic: Good for reptile, amphibian and insect.

High strung Tensile Steel wires : Becomes almost invisible to visitors; mostly used in the case of birds

Specialized enclosures like Nocturnal Enclosure, Safari Park etc.

### **Moats**

Carnivores: moats 25feet wide and 4 ft depth; G.I fence about 17ft high

Leopards should not have open enclosures

Animals like Hyena, jackal etc. need fencing about 3ft under ground

Dogs family: Moats have 10ft width and fence about 12 ft high

Generally moats kept in front and people observe down; behind the enclosure it is either high wall or G.I fence

### **Hagenback Model ( Open Zoo Model)**

German animal dealer, Carl Hagenback in 1907

Concept of Cages without bars

Used dry /wet moat between animal and visitors.

### **Ex-situ conservation of plants**

#### **Botanical Gardens**

Assembling and cultivation of variety of threatened plant species in a given area is called Botanic garden. Over 1500 botanic gardens all over the world assembling 3 million plants involved in conservation of plants. In many cases the genetic diversity maintained in Botanic garden is inadequate for conservation.

### **Field Gene Banks**

- An area in which various plants collections are assembled.
- More number in one species to maintain genetic diversity plant materials are available for breeding, reintroduction, research and other purposes.
- Many countries have established such banks for threatened wild and domesticated crops.
- They take a great deal of space & these collections are prone to disease and natural disasters.

### **Seed Banks**

- Seed banks are the most efficient and effective method of ex-situ conservation for sexually reproducing plants.
- Seeds – Small easy to store keep their viability under cold storage condition for longer periods.

### **Invitro storage**

- Refers to conservation and storage of germ plasm of plants under laboratory conditions.
- Invitro plants are initiated from meristem tips, buds or stem tip and propagated through division in the test tube.
- The methods adopted – tissue culture, cell culture and cyto-plasmic culture.
- Over 50 countries all over the world undertake this technology for conservation and propagation of plant species.

### **Conservation Breeding of Captive stock of Animal in Zoo**

#### **Two fold Objectives**

- Develop self sustaining captive and stable population – For exhibiting or exchange
- Conserve the species gene pool which is threatened, endangered or extinct in wild

#### **Strategy for self sustaining & stable population**

- Acquire animals
- Breed over a long period
- Acquire male/female of different genetic source
- Zoo genetic lines/inbred strains has:
  - high risk of loss of vigour
  - reduced vitality
  - Vulnerability to disease
  - low fertility & growth rate

#### **Strategy for conserving gene pool**

- Maintain genetic variability as in wilderness
- Estimate genetic variation or heterozygosity scientifically
- Aim to minimize inbreeding and maximizing genetic variability
- Two alternative
- Combine two genetic inbred lines to recreate wild gene pool
- To manipulate mating using males from distinct genetic lines

#### **Stud Book**

- Maintaining the pedigree of individual of each species nationally and internationally for controlled co-operative breeding.

- International Species Inventory System (ISIS)
- Stud books are supplemented by ISIS.
- ISIS maintains a centralized computer data base for census, demographic, genealogical and laboratory data of wild animals.
- As on 1991, data base information is accumulated for 141480 living organisms from 395 zoos in 39 countries.
- Zoos all over plan to expand 140 Nos. of species for breeding to 1000.

### **Cryo preservation**

This means preservation of genetic materials such as sperm, egg and embryo. Under proper storage for longer periods using latest technology.

Data base of each material is stored and exchanged between the zoo for artificial breeding, implanting embryos on the animals between inter specific and intra specific for conservation of animals.

### **Captive breeding – success and short comings**

Many zoos undertake captive breeding of threatened species. Multiply them in large number. Out of 629 threatened species of mammals only 140 species consisting 20628 specimens are held for captive breeding.

This indicates only 10% total population of mammalian threatened species in the world are held in captivity.

### **Conservation breeding programme In India**

- Lion tailed macaque

- Pygmy hog
- Red Panda
- Crocodiles
- Snow Leopard

### **Animal Reintroduction programme**

Over 100 species (threatened) have been bred successfully in Zoos in large number and reintroduced in to the wild.

|                      |             |
|----------------------|-------------|
| Arabian oryx         | - Oman      |
| Hawaiian geese       | - Hawaii    |
| Golden Tamarin       | - Brazil    |
| Pink Pigeon          | - Mauritius |
| Californian Condors- | USA         |
| Marsh Crocodile      | - India     |
| Gharials             | - India     |
| Cervus deer          | - USA       |

### **Rescue & Rehabilitation centre**

- 300 Lions and Tigers
- Vandalur (AAZP), Tamil Nadu
- Bannerghata, Karnataka
- Nahargarh, Rajasthan
- Vishakapattinam, Andhrapradesh
- Tirupathi, Andhrapradesh

### **Conservation status of species of animals held in Indian zoos**

|                            |      |
|----------------------------|------|
| Critically endangered      | - 1% |
| Vulnerable                 | - 4% |
| Endangered                 | - 3% |
| Low risk category          | - 8% |
| Lowest risk leastConcerned | -84% |

### **Acquisition of animals in zoos**

- Capture (Prior to 1972)
- Exchange between zoo
- Orphan animals / Rescued animals
- Gifts
- Purchase (almost stopped)
- Breeding purpose

### **Animal exhibits for education**

Should excite, enthuse and create interest

Should encourage understanding of conservation issues

Provide range of experience for diverse visitors

Revitalize focus on education Maximize educational activities

Develop appropriate resources

Use variety of interpretation techniques

Increase visitors receptivity for programmes

### **ZOO- A Learning Centre**

- Biological Science

- Ethology
- Animal husbandry
- Bio-diversity
- Ecology
- Cultural Enrichment
- Genetics
- Nature conservation
- Captive Breeding
- Wildlife Management

### **Educating Public**

- Graphics
- Keepers talk
- Hands on experience
- Interactive sessions with school/college students
- Prepare exciting, interactive, structured, education programmes
- Cross curricular –incorporate arts with Socio economic features of environment & nature
- Develop links and partnership with NGO's
- Extension programmes- Visit school and colleges

### **Themes for Education**

- Animal classification
- Discussion about species, habitats, behaviour & conservation
- Understanding of importance of eco-system

- Socio –economic value of species and habitats
- Impact of human behaviour on wildlife & conservation

### **Biological Themes**

- Population dynamics
- Adaptation
- Evolution
- Natural selection
- Conservation breeding
- Conservation management techniques

### **Cultural themes**

- Species in cultural and religious believes
- Domestication of species
- Good husbandry
- Appropriate nutrition
- Appropriate habitat

### **Evaluation**

- Aids in planning for effectiveness of Education programme
- Reflects change in peoples attitude
- Use variety of methods to evaluate education programme
  - Casual observation
  - Surveys & Questionnaire

### **Zoo staff training**

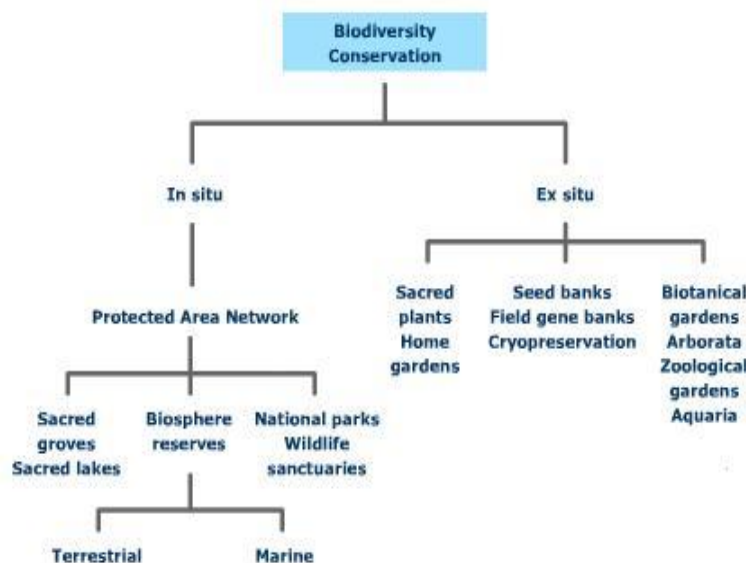
- Zoo education require –

Skill, Creativity, inventiveness

- Use wide variety of education techniques
- Professional approach
- Knowledge of composition and motivation of zoo public
- Formulate Education plan

### Research in Zoos

- Zoos are potential source of basic scientific knowledge
- South Indian zoos to make animal collection available for relevant research endeavours
- Zoos have limited No. staff for research
- Zoos to have MOU with research institutions and Universities
- Zoos and Research institution to mobilize financial resources from organization for research
- South Indian zoos to identify research priorities
- Research report/data to be exchanged.



## **CHAPTER: 16**

### **ECODEVELOPMENT & ECOTOURISM**

#### **ECODEVELOPMENT**

The term is in use in India since 1980's.

- ❖ As a package of programs that will demonstrate the concerns of the PA manager for the socio-economic development of the fringe or buffer zone villages and will result in greater cooperation of the residents of the villages in the conservation and management of wildlife. (MOEF,GOI 1991.)
- ❖ As a strategy for protecting ecologically sensitive and valuable areas from unsustainable or otherwise unacceptable pressures resulting from the needs and activities of people living in or around such areas

Eco development is JFM minus the usufruct sharing. It should have full participation of the target communities during planning, implementation and monitoring; It should be site-specific, holistic and integrated action; It is a process not just one-shot action and requires temporal and spatial linkages, continuous inputs and feedback and is amenable to self-rectification;

#### **ESSENTIALS OF ECODEVELOPMENT**

- Participatory learning and action
- Developing everlasting relations
- Joint effort
- Very slow process
- Need understanding of people and their poverty

- Desire to give rather to take
- Fullest commitment and involvement
- Bottom up approach and not top down
- Process driven and not target driven
- More listening than talking
- Keeping up promises and no false promises
- Requires Govt more as a facilitator than solely as a source of funds;
- Requires innovation and imaginations more than stereotyped solutions.
- Encourages peoples initiative
- Unsustainably large financial inputs not welcome

### **IMPORTANT INITIAL ACTIONS**

- Zone of influence / impacts identifications
- Intensive field survey and exploration
- Identification of problem area
- Categorization of problem areas
- Design strategies
- Evolve modus operandi to involve people, NGOs and other organization
- Motivation, follow up, monitoring and fine tuning

### **PREPARATION OF THE ECODEVELOPMENT PLAN**

- Categorize the villages to low threat, medium and high threat ones

- Prepare a chart or a two way table showing different activities and extent of threat on a 10 point scale
- Select suitable NGOs if available
- Organize Participatory Rural Appraisal to know about the resources available as well as the necessities and aspirations
- Micro plan preparation
- Identify the areas where external inputs required
- Prepare an Eco development plan for the PA

### **Workable Micro plans**

- Ensure reliable and correct data
- Prescribe treatments explicitly
- Follow time and budget lines
- Highlight mutual responsibility and roles
- Review and change
- Be sure on feasibility, cost - benefit and social acceptance of agreed options  
develop monitoring protocols and frequency

### **NGO SELECTION**

- The NGO's are to be selected based on the following criteria:
- Duration of intervention in the village.
- Total number of Self Help Groups organized in the village.

- Tangible and intangible inputs provided for the village/ villagers. (Number of beneficiaries and the financial inputs provided)

## **VARIOUS ACTIVITIES**

- Income earning activities
- Capacity building activities
- Empowerment activities
- Welfare activities
- Gender issues
- Individual based income earning activities
- Animal husbandry, agricultural inputs like improved seeds, fertilizers etc.
- Community based
- Irrigation schemes, poultry, sericulture, piggery
- Welfare schemes
- Drinking water supply, sanitation, community halls
- Training in skills ( capacity building activities)
- Training in various crafts, entrepreneurial training, marketing training
- Empowerment
- Leadership skills, committee management
- Gender Issues
- Specialized activities suited for women folk
- Smokeless chulla, sewing skills, Women SHGs

## **G. O. I INITIATIVE**

- C.S.S:- Ecodevelopment around National Parks and Sanctuaries – India Ecodevelopment Project
- Commenced in 1996-97 in seven sites with \$67m outlay funded by IDA, GEF, GOI and State Govt
- Objective – Conservation of Biodiversity through Ecodevelopment.
- Sites-Buxa, Palamau, Nagarhole, Periyar, Pench, Gir, Ranthambore

## **ECO DEVELOPMENT CASE STUDIES**

- Periyar Tiger Reserve
- Parambikulam Wild life Sanctuary

## **PERIYAR TIGER RESERVE MANAGEMENT ISSUES:**

- Protection problems of core area- 90 Km boarder of TN
- 2.50 lakh people around PA- 35000 directly dependent
- Resource use and livelihoods
- Interagency conflicts-tourism, pilgrimage

## **India Ecodevelopment Project in Periyar (1996-2004)**

### **1. Removing burden of debt & reducing dependency of tribal groups on Park resources.**

#### **ISSUES**

1. Individual land/ pepper crop mortgaged
2. Income/livelihood reduced

3. Heavy dependency on Park resources

#### APPROACH

- Tribals organized into EDCs
- Financial support to pay back debts
- Assistance to raise crops in current season
- EDCs empowered to collect & market pepper

#### IMPACTS

- Freeing tribals from debt burden
- 10-fold increase in tribal income from pepper
- 60% reduction in firewood collection for sale
- Community revolving fund established
- Joint patrolling by tribals & park staff
- Beneficiaries: About 250 families

### **2. Changing Stripes: Converting poachers to park conservators**

#### ISSUES

- 23 poachers of cinnamon bark & sandal
- > 100 park offences filed
- Social stigma
- Constant conflict with park staff

#### APPROACH

- Organize poachers into ecodevelopment committee
- Withdraw cases of park offences for trust building
- Use their knowledge of park for promoting ecotourism

- Link ecodevelopment committee with tour operator

## IMPACTS

- Illegal activities completely stopped
- Park protection strengthened, better relations
- Regular income to the group assured
- Social stigma removed
- National and international recognition

### **3. Controlling unregulated pilgrimage through people**

## ISSUES

- 5 million pilgrims over two months
- 1000 vendors (60% outsiders)
- Unregulated exploitation of fuelwood, small timber
- Excessive solid waste

## APPROACH

- Local ecodevelopment committees to provide pilgrim needs
- Pilgrim facilities confined
- Confederation of the EDCs for financing & monitoring
- Participatory rules & regulations-environmental & social

## IMPACTS

- Impacts confined to restricted area
- No small timber exploitation ( annually 200,000 poles saved)
- 70% reduction in fuelwood collection - alternative LPG
- Assured income to local communities

- National award to confederation for conservation

Beneficiaries: 1200 families

**4. Community based ecotourism programmes ensures park protection and community welfare.**

ISSUES

- Park protection was a challenge
- Visitor satisfaction was low
- Heavy dependence on forests by local people

APPROACH

- Local people involved in ecotourism programmes
- Protection oriented programmes
- Benefits shared by them

IMPACTS

- Park protection strengthened
- Generation of sizable money for community welfare
- Excellent interpretation on park values

Beneficiaries: 1000 families

Some community based programmes:

- Nature walk
- Tiger Trail
- Bullock Cart Trail
- Tribal heritage

- Jungle Inn
- Jungle Patrol
- Bamboo Grove
- Green Mansion & Bamboo rafting

## **5. Vasanth Sena – A story of Women Empowerment**

### ISSUES

- Firewood collection by women and degradation of PA
- Exploitation by the outsiders and money lenders
- Neglect of child education and family health
- APPROACH
- Local women su-moto organized for voluntary patrolling
- Empowerment through social recognition and awareness
- Creation of Self Help Groups

### IMPACTS

- Park protection strengthened
- Public recognition, Social Capital and Livelihood
- support to local women
- Excellent interpretation of park
- Green Women Brigade awarded by MoEF

## **Post-India Ecodevelopment Project Period**

Steps for Institutionalization of the programme

- Periyar Foundation
- Introduction of eco-development surcharge

- Park welfare fund
- Voluntary contributions by public
- Decentralized management & Linking local livelihoods with PA Protection

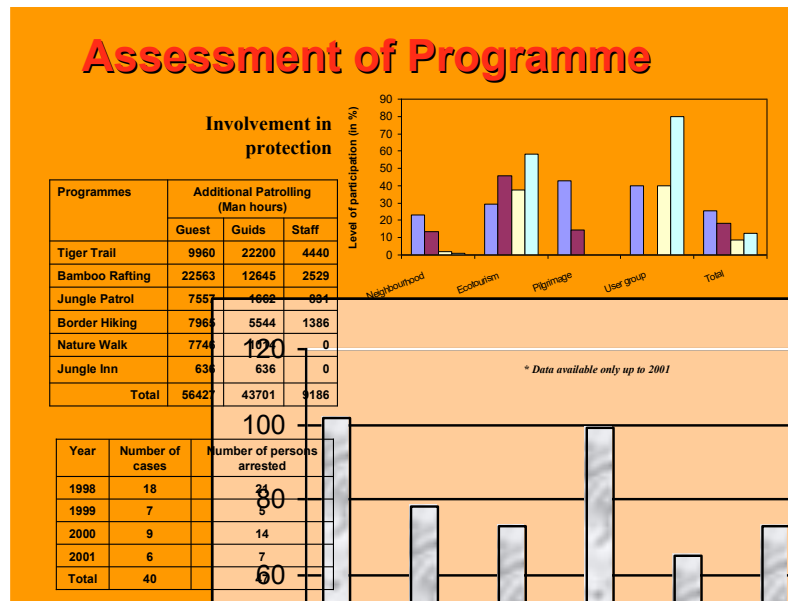
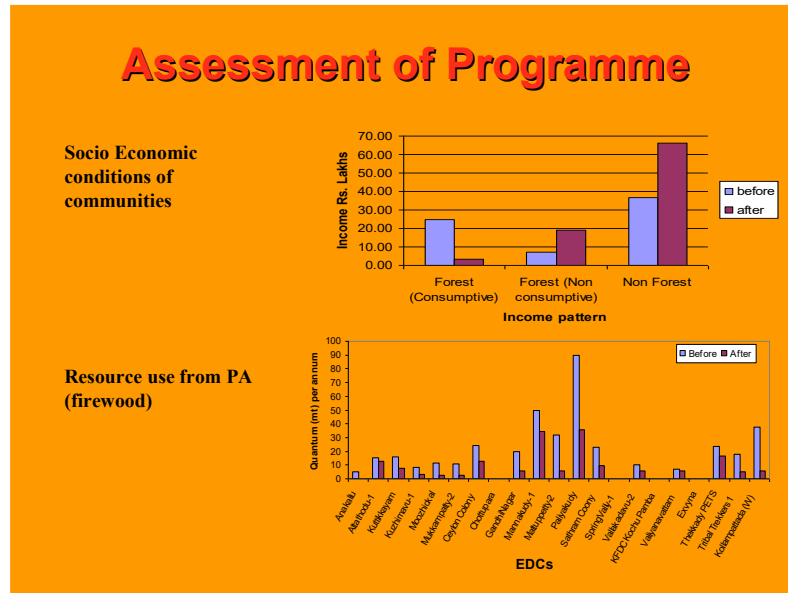
### **Periyar Foundation**

- Government owned public Trust
- Authority of the government and flexibility of a good NGO
- Objective is biodiversity conservation and community welfare in PTR and the Western Ghats – focus on landscape
- Governing Body and Executive committee
- Resource mobilization-local, regional, national and international
- Ecodevelopment Surcharge
- Public representation
- Support of professionals

### **Park Welfare Fund**

- Revenue from Ecotourism and Sabarimala season business
- Rs. 52.00 lakhs generated during 2006-07
- Wages and administrative costs
- Recoupable and permanent advances.

## Assessment of Programme



## What they Achieve in PTR?

### At PA Level

- Improved Protection and community support/ attitudes
  - Offence, resource use, social fencing

- Efficiency
  - Ecosystem health, PA Management and Resource use
- Equity
  - Benefits to local poor and women and livelihood support
- Empowerment
  - Economic, social and political

#### **At National Level**

- Emerging model of PA Management
- Policy implications
  - Concept of PA level Foundations
  - PA Management Effectiveness
  - Ecotourism Policy for PAs

#### **Parambikulam Wildlife Sanctuary**

##### **Management Issues**

- Wild fires
- Grazing
- Unemployment and community
- livelihood
- Unregulated tourism
- Garbage management

##### **Process and Approach**

- Trigger point - ban on felling
- Constitution of EDC's

- Lack of Mutual trust and increased offences
- Revitalization of Programme
- Search for replication – PTR & KMTR

### **Two major areas capitalized**

- Enterprise development
- Ecotourism

### **Enterprise development:**

- Parambikulam Honey: Honey collected by the tribals are marketed under the brand of Parambikulam
- Parambikulam Dhara – bottled ozonized mineral rich drinking water from the natural streams
- Parambikulam Be wax Balm – made from the Bee wax which is a by-product of honey collection and is made by adding natural herbal ingredients such as Eucalyptus oil and other essential oils
- Parambikulam paper bags – Plastic is banned in the WLS and people have to use the Paper bags made by the Tribals.

### **Ecotourism – a tool for Biodiversity conservation**

#### **Issues:**

- Fires, Protection and Grazing
- Unemployment
- Unregulated tourism
- Ownership of communities

#### **Approach:**

- Dialogue with communities
- capacity building
- search of products
- tribal community based ecotourism packages

**Outcome:**

- Tourism regulated and improved protection
- Improved ownership
- Livelihood for locals
- Reduced dependency & Participatory monitoring

**Ecotourism Products of PWS**

- Island nest –stay the islands in the water body
- Tramway Trekking through the old tramway
- Parambi Cruise through bamboo rafts
- TRIBAL SYMPHONY through tribal dances
- KANNIMARA SAFARI
- Full Moon census
- Paid Nature Camp
- Peep through hides
- High range Trekking
- Eco meditation
- Tented Niches

**What they gained.....**

- Community based Protection system

- No grazing
- Sustainable employment opportunities
- Regulated tourism
- Garbage management system
- Improved ownership for the PA

### **Various Eco development activities- TN Experience**

#### **I . Honey and Bee keeping**

##### **Cost- Benefit analysis**

##### **I<sup>ST</sup> year investments.....**

|    |                                                                                              |      |               |
|----|----------------------------------------------------------------------------------------------|------|---------------|
| A. | Cost of bee colonies – 10 Nos with extractor, smoker and supply on the spot @ Rs. 2000/ each | .... | 20,000        |
| B. | Maintenance expenditure                                                                      | .... | 2,000         |
|    |                                                                                              |      | -----         |
|    | <b>Total Rs.</b>                                                                             | .... | <b>22,000</b> |
|    |                                                                                              |      | -----         |

##### **I<sup>ST</sup> year income...**

|    |                                             |      |        |
|----|---------------------------------------------|------|--------|
| A. | Honey collection in 10 boxes @ 20 kgs / box |      |        |
|    | 200 litres @ Rs. 100 / Kg.                  | .... | 20,000 |

|                                                 |      |       |
|-------------------------------------------------|------|-------|
| B. Bee wax collection @ 2 kg / box for 10 boxes |      |       |
| 20 kgs @ Rs. 100 / kg.                          | .... | 2,000 |

|                                                  |      |        |
|--------------------------------------------------|------|--------|
| C. Production of new colonies @ 4 colonies / box |      |        |
| for 40 colonies @ Rs. 500/colony                 | .... | 20,000 |

|                         |             |               |
|-------------------------|-------------|---------------|
|                         |             | -----         |
| <b>Total income Rs.</b> | <b>....</b> | <b>42,000</b> |
|                         |             | -----         |

**Net income in I year .... (income –expenditure) = Rs. 20,000**

## **II year investments.....**

|                                     |             |      |     |
|-------------------------------------|-------------|------|-----|
| Old bee colonies available – 10 Nos | expenditure | .... | NIL |
|-------------------------------------|-------------|------|-----|

A. Cost of 40 new colonies @ Rs. 1000 / each

|                                              |      |        |
|----------------------------------------------|------|--------|
| (Boxes Rs. 500 /each, colonies Rs. 500/each. | .... | 40,000 |
|----------------------------------------------|------|--------|

|                            |      |        |
|----------------------------|------|--------|
| B. Maintenance expenditure | .... | 10,000 |
|----------------------------|------|--------|

|                  |             |               |
|------------------|-------------|---------------|
|                  |             | -----         |
| <b>Total Rs.</b> | <b>....</b> | <b>50,000</b> |

## **II year income...**

|                                                |     |          |
|------------------------------------------------|-----|----------|
| A. Honey collection in 50 boxes @ 20 kgs / box |     |          |
| 1000 Kgs @ Rs. 100 / Kgs.                      | ... | 1,00,000 |

B. Bee wax collection @ 2 kg / box for 50 boxes  
 100 kgs @ Rs. 100 / kgs. .... 10,000

C. Production of new colonies @ 4 colonies / box  
 for 200 colonies @ Rs. 500/colony .... 1,00,000

-----  
**Total income Rs..... 2,10,000**

- -----

**Net income in II-nd year ... (income–expenditure) Rs.1,60,000**

## **2. Mushroom Cultivation..**

About 2500 varieties of mushrooms are used for human consumption, of which about 900 varieties are artificially cultivated.

Oyster Mushrooms are cultivated in all climatic conditions.

This is a short duration crop with less investment and more profit.

There is assured market.

SHGs can profitably cultivate.

Most of the SHGs in 2007 TAP villages in Kallakurichi Division started cultivating Mushrooms.

### **Expenditures..**

A thatched shed of size 3m x 6m  
 life 3 – 5 years Rs. ... 6000/-

|                           |    |       |           |        |         |
|---------------------------|----|-------|-----------|--------|---------|
| Cost                      | of | seed  | materials | 150    | pockets |
| @                         |    | Rs.30 | /         |        | pocket  |
| (used for 300 poly. Bags) |    |       | ...       | 4500/- |         |

|                           |        |            |           |            |
|---------------------------|--------|------------|-----------|------------|
| Cost                      | of     | polythene  | bags,     | chemicals, |
| paddy                     | straw, | treatment, | filling   | poly       |
| sowing                    | seeds  | and        | arranging | in         |
| @ Rs.5/bag - for 300 bags |        | ...        | 1500/-    |            |

**Total cost Rs. ... 6000/-**

(excluding shed cost)

**Income:**

|                            |     |        |     |              |     |       |         |
|----------------------------|-----|--------|-----|--------------|-----|-------|---------|
| In                         | 45  | days,  | 3   | —            | 5   | times | harvest |
| @                          | 1.5 | kg/bag | -   | for          | 300 | bags  | yield   |
| 450 kg, sold at Rs. 45/kg. |     |        | ... | Rs. 20,250/- |     |       |         |

Net income in 45 days .... Rs. 14,250/-

The income may vary based on the quantity produced.

**3. Broom Making**

In most of the forest areas thornless date palm shrubs (Phoenix acantis) are available.

In Kalrayan hills, it is available in Innadu and Palapattu Ranges. Tribal people used to collect the Phoenix leaves and sell to contractors at very low price.

VFC President of 2000 Maniyarpalayam TAP has come out with a proposal to make brooms by themselves involving SHGs.

A training was organised to make brooms and the activity has started.

Now, they get Rs. 10/- per broom instead of Rs. 2/- which they got earlier when sold as raw material.

#### **4. PIGGERY**

White pig farming is a profitable self employment. There is a good demand for pork in India.

Present pork production estimated as 6,12,000 MT and it is likely to rise 7,70,000 MT in 2010 and further increase to 8,40,000 MT in 2020

In rural areas, it can be integrated with other cattle and poultry farming. White pigs, not only gives good revenue but also increases agriculture production by its manure.

#### **Economics**

An exotic white variety, “Large White Yorkshire” is suitable for profitable farming.

It grows to 100 kg in 6 – 7 months.

The male attain maximum weight of 350 – 450kg and female to 250 -300kg.

It attains maturity in 8 – 10 months and a good breeder.

It delivers twice a year (gestation period 4 months (i.e.,) 114 days) and each time delivers 8 – 12 piglets.

It requires a controlled climate condition (Not exceeding 350 c), a clean shed with 150 sq.ft area for a mother and per piglets, regular hygienic maintenance.

|                                |        |     |        |             |     |      |   |      |
|--------------------------------|--------|-----|--------|-------------|-----|------|---|------|
| 3                              | months | old | piglet | cost        | Rs. | 1800 | – | 2000 |
| each for one unit of 5 nos.... |        |     |        | Rs. 10000/- |     |      |   |      |

8 – 10 months old animal, each weighing  
 80 – 100 kg will be sold @ Rs. 4500/each Rs. 22500/-  
 Maintenance charges Rs. 2500/-  
**Net profit for 5 nos in one year Rs. 10000/-**

### **5. Turkey Rearing**

Traditionally rural Indians rear “Chicken” for festival feasts and to entertain guests. The excess is being sold to earn some pocket money.

In the same way, they can rear “Turkeys” to get an additional income 3 – 4 times higher than chicken.

Turkey flesh are soft and tasty and can be sold for higher rates. This bird is popular in North America and Europe and being popularized in India.

It can be reared in all parts of India under any climatic conditions.

High yielding exotic varieties

Broad breasted Bronze

Black Colour. Male can grow to 15 - 18 kg and  
 Female grow to 12 – 16 kg.

Broad breasted large white (or) British white

Male can grow to 12 - 18 kg and Female to 7-9 kg. In 12 weeks it will weigh 8 to 10 kg

Selling rate Rs. 80 to 120 / kg.

Feed on agriculture waste and grains (Sorgham, Bajra, Maize etc.,)

VFC and SHGs in 2007 TAP Villages has shown interest in rearing Turkeys. So preliminary training already given on 13 & 14 September 2007

Rearing Turkeys 100 Nos for one Year with open yard and a shed

**Capital Expenditure**

|                                             |           |
|---------------------------------------------|-----------|
| Shed construction for 100 nos               |           |
| at the rate of 1 sq.m for each bird         | Rs. 24000 |
| Incubator 1 No..                            | Rs. 7500  |
| Pots, vessels for keeping water and grains. | Rs. 1800  |
|                                             | -----     |
| Total                                       | Rs. 33000 |
|                                             | -----     |

**Maintenance Expenditure**

|                               |                  |
|-------------------------------|------------------|
| Cost of chicks 105 nos        | Rs. 4200         |
| @ Rs. 40/each (mortality 5%)  |                  |
| Feeds cost for 1 year         | Rs. 15000        |
| Cost of medicines             | Rs. 400          |
| Lighting                      | Rs. 300          |
|                               | -----            |
| <b>Total maintenance cost</b> | <b>Rs. 19900</b> |
| or                            | Rs. 20000        |
|                               | -----            |

A portioning the capital cost with

|                     |           |
|---------------------|-----------|
| interest for 1 year | Rs. 10000 |
|                     | -----     |

**Total Expenditure Rs. 30000**

**Income...**

Each bird may weigh 5 – 6 kg

and can be sold at Rs. 80 – 90/kg Rs. 46750

Income by sale of turkeys.

Turkeys can lay 80 – 90 eggs / year

Assuming 50% female and selling Rs. 15000

30 eggs per bird @ Rs. 10/each

Income by sale of eggs.

Balance eggs incubated and sale of

chicks @ Rs. 40/each income Rs. 20000

-----

Total income Rs. 75750

-----

**Net income derived out of 100 turkeys Rs. 45750 or minimum**

Rs. 40000

**Other Activities**

- Vermi compost making
- Banana Fibre Making
- Palmyra Palm Leaf products
- Agave fibre making
- Areca Plam products
- Floriculture
- Tailoring

### **ECOTOURISM CONCEPTS: A Livelihood Option Around PAs**

- ❖ Tourism is the world's fastest growing industry and in recent years, has come to play an increasingly dominant role in the economies of developing countries
- ❖ The Tourism industry contributes around 4.9% to India's Gross Domestic Product (GDP) and has emerged as major source of employment.
- ❖ A Ministry of Tourism, Government of India study indicates that tourism supports 46.87 million jobs (directly and indirectly) accounting 8.78% of the total jobs within the country

#### **Environmental Impacts**

- Land, water and noise pollution
- The environment takes a toll bearing the brunt of heavy tourist traffic and use of natural resources often beyond its natural carrying capacity.
- Fall in the water table ( eg: Goa )to far below the reach of the village wells since the deep wells of the hotels keep pumping up water for their pools and lush lawns.

#### **Economic Impacts**

- There are many less favourable economic effects of tourism such as inflation, leakages and dependency.
- Studies estimate that on an average, of every US\$ 100 spent on a vacation tour by a tourist from a developed country, only around US\$ 5 actually stays in a developing country destination's economy.

**Socio-cultural Impacts** Tourism should be linked to people and depends on people. However, the current tourism model is unable to develop into an economically and socially viable option for local communities.

- Tourism has played a significant role in privatization of common resources in tourism destinations, displacement of people and forest dwellers from their homelands to make way for hotels and resorts.
- Tourism-related activities have also made children vulnerable to sexual and non-sexual forms of exploitation.
- There are also problems relating to health, drugs, crime and trafficking of people.

**Cultural shocks:** dilution of one's own culture and customs. The negative impacts of tourism on the Jarawa community in the Andaman and Nicobar islands are noteworthy.

#### **Ecotourism: What is it?**

- The recognition of the ill effects of tourism led to the need to develop an industry that was sensitive to the environment and that which could provide some benefits to the local community. This is how the concept of 'ecotourism' came into being.
- The term 'ecotourism' was coined by a marketing agency that was promoting Costa Rica as a rainforest destination in the early 1970s
- The first formal definition of ecotourism was given by the IUCN (the World Conservation Union), which states that ecotourism is:

*"Is environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features - both past and present) that promotes conservation, has low negative visitor impact, and provides for beneficially active socioeconomic involvement of local populations."*

The International Ecotourism Society defines ecotourism as, “responsible travel to natural areas that conserves the environment and improves the welfare of local people”.

Many buzzwords unfortunately being synonymously being used with ecotourism. These range from

- sustainable tourism
- responsible tourism
- nature-based tourism
- green travel
- cultural tourism

Ecotourism in India has become synonymous with tourism in protected areas and/or areas of significant ecological/wildlife values. Ironically, the kind of tourism that continues to be promoted and practiced is very much mainstream tourism, only the locations have become much more fragile

Ecotourism (as often understood) is not the presence of exclusive resorts in exotic locales managed by enterprising ‘outsiders’; nor is it a State or Centrally managed Government operation that results in the filling of state exchequers

### **Key elements of Ecotourism in India**

Existence of NP/WLS/ natural environment as a prime star attraction.

Should be ecologically, socially, culturally and economically sustainable.

Should have participation of the local stakeholders/ local community.

Should be low profile venture.

Should be capable of dovetailing in the existing tourism of the State.

**Ecotourism destinations in general**

- ❖ Beaches
- ❖ Backwaters
- ❖ Hill stations
- ❖ Valleys
- ❖ Meadows
- ❖ Water falls
- ❖ Water bodies
- ❖ Rivers
- ❖ Wildlife sanctuaries
- ❖ National parks
- ❖ Safaris
- ❖ Nature trails
- ❖ Urban eco parks
- ❖ Cultural heritage sites.
- ❖ Ecotourism Products / activities in Protected Areas
- ❖ Wilderness Safari/ Wildlife viewing in vehicles or an elephant-back or through hide outs and from watchtowers.
- ❖ Trekking and walking through nature trails
- ❖ Cycling or mountain biking
- ❖ Overnight forest stay in designated nature camp sites

- ❖ Birding and study of flora and fauna
- ❖ Boating and other water sports, river rafting, angling
- ❖ Adventure activities like rock climbing, hang gliding, parasailing etc.
- ❖ Any other activity as may be specifically permitted

## **National Ecotourism Policy & Guidelines (1998)**

### **Four cardinal principles:**

- Involve local community and lead to overall development of the area
- Identify and minimize resource use conflicts between tourism and local livelihoods
- The type and scale of tourism development should be compatible with environment and socio-cultural characteristics of local community
- Activities to be planned as part of the overall area development strategy, guided by the integrated land use plan associated with commensurate expansion of public services

### **Guidelines**

While adopting the above principles, following guidelines are laid down for eco regional planning to foster ecotourism

1. Delineation and notification of fringe areas around ecotourism sites (PAs) as Non-plan areas under the City and Country Planning Act to avoid cross-sectoral conflicts
2. Fostering eco tourism through eco development as a land use

3. Prescription of environmental requirements for such areas for incorporation in the relevant rules of the State
4. The first benefit of eco tourism must go to the local people and in the long run, the capacity building in this regard should be built in for foraging partnership with local people
5. Accordingly statutory protection to such areas under the EPA, 1986.
6. Recognizing local Panchayat as the authority having jurisdiction for granting permission for development.
7. Constituting special Committee under chairmanship of District Collector withy respective PA manager as member secretary with adequate representation from Panchayat, EDCs, local NGOs, Hon. WLW for advising Panchayat on issues relating to development
8. Creation of village level micro institutions like FPCs / EDCs and formulation of site-specific ecotourism plans with indigenous participatory planning
9. .Providing soft loans to the identified host communities for promoting ecotourism
10. .Establishing standards for ecotourism in the site specific micro plans in tune with the operational guidelines and the suggested modifications in the State rules and adherence to these standards by the tourist developers / operators through the Panchayat.

**GOI Operational Guidelines-** Definite guidelines for Tour operators and resort owners

- Guidelines on Governmental agencies including the Guidelines on Ecotourism packages
- Guidelines to the visitors

- Guidelines to the host community

### **Environmental requirements for specially notified Non-planning areas**

- The resorts should not be less than 8 Ha
- The resorts/Hotel should comprise of all specified components of a standard Hotel such as offices, dining areas etc ( ~2000sq.m)
- The Bungalow sector should comprise of : 10 hutments each with built up area of 50sq.m
- carrying capacity be assessed
- Environmental compatibility with respect to land use
- No structures with exotic look causing visual pollution
- Eco friendly technology in the design of building, solar power, recycling of waste rain water harvesting etc.
- Development be in sync. With the conservation of fauna
- Involvement of local authority as well as specially constituted district committee.

### **Ecotourism package to Govt agencies**

- Simple adequate boarding and lodging facilities
- Road network within the identified zone
- Self guided Nature trails
- Transportation options
- Interpretative Centres
- Way side exhibits
- Signages
- Observation Towers

- Public Conveniences
- garbage disposal facility
- Living quarters for staff
- No structure causing visual pollution
- Site specific micro planning
- Providing soft loans from specially created trust funds based on Park gate fee, community credit programmes
- Periodic training programmes to the community
- General environmental management

## **STRATEGY**

### **i) Statutory Provisions:-**

Incorporate low level of eco-tourism as a conservation management activity in the Forest Working Plans, Protected Area Management Plans and Tiger Conservation Plans.

### **ii) Carrying Capacity:-**

Massive and casual tourism is counter to the principles of eco tourism. The physical, environmental and social carrying capacities of the tourism will be computed through scientific means.

### **iii. Infrastructure Development:-**

Infrastructure facilities will be in conformity with the statutory provisions. Priority will be given to development of places, close to existing popular tourist destinations, development to be kept at bare minimum.

**iv. Destination Management:-**

Managed by the Forest Department by involving the local management committee so as to ensure employment to the local community under strict MoU. Public – private partnership in professionally managing the camping areas.

**v. Capacity Building :-** Capacity building programmes to enhance skills and competence, to enable the local community to get employment as service providers in guiding, cooking, housekeeping and security. Technical co-operation with reputed national and international agencies in operating recreational facilities.

**vi. Awareness Campaigs:-** Conservation awareness programmes through eco clubs and nature camps

**vii. Micro Plan** Site- specific micro plans will be developed incorporating the above strategies.

**RECENT REGULATION OF TOURIST VISITATION IN TIGER RESERVE**

- Tourist visitation as per carrying capacity
- No of tourism infrastructure in core/critical habit-in buffer area phase out
- Minimum mandatory sighting distance (30 metres)
- Instead of smaller vehicles or Gypsies, Battery operated Vans or Buses
- Between two vehicle minimum distance be 500m
- Route Guide be professionally treained
- No cafeteria/eatery in core/critical habit
- Radio collared tiger or encumbered tigress or injured tiger should not be tracked for viewing

- Tourism infrastructure in non forest private holding should maintain the corridor value.
- Fostering tourism at the cost of habitat undesirable.

### **Estimation of Tourist Carrying Capacity in PAs**

#### **Based on the Criteria of:**

1. Physical Carrying Capacity (PCC)
2. Real Carrying Capacity (RCC)
3. Effective Permissible Carrying Capacity (EPCC)

### **Kanha Tiger Reserve Case Study**

#### **Visitation Data: (Averag of 5 yrs: 45320 people)**

$$PCC = A \times v/a \times Rf$$

Where A = Total allowed road length as people travel by vehicle only and total area is not important; here it is 283km

$v/a$  = no. of vehicle per km (about 500m is allowed between vehicle to avoid dust ; it is 2veh/ km

$Rf$ = Rotation Factor ie. If 3.5 hrs required to complete a visit and the park is open for 9 hrs a day,  $Rf = 9/3.5 = 2.6$

$$PCC = 283 \times 2 \times 2.6 = 1471.6 \text{ or } 1472 \text{ visits/day}$$

$$RCC = PCC \times (100 - C_{fe})/100 \times (100 - C_{fw})/100 \times (100 - C_{ft})/100$$

$C_{fe}$  = road erosion;  $c_{fw}$  = disturbance to WL;  $C_{ft}$  = temporary closing of sites

C<sub>fe</sub> : If medium erosion risk is 50km (weight age factor:2) and high erosion risk is 40 km (w.f = 3), then  $e = 40 \times 2 + 50 \times 3 = 220$  km

$$C_{fe} = 220\text{km}/283\text{km} = 77.8 \text{ or } 78$$

Disturbance to WL; Barasingha (1 month); Chital (2 months) and tiger (2 months); There is 9month tourism allowed due to closure for 3 months

$$\text{Overall corrective factor } C_{fw} = C_{fw1} + C_{fw2} + C_{fw3}$$

$$= 1/9 \times 100 + 2/9 \times 100 + 2/9 \times 100 = 55.5 \text{ or } 56\%$$

$$\text{Temporary closing of sites } C_{ft} = 2 \text{ weeks/yr} / 36 \text{ weeks/yr} \times 100$$

$$= 5.5\%$$

$$RCC = 1472 \times (100-78)/100 \times (100-55)/100 \times (100-5.5)/100$$

$$= 138.4 \text{ or } 138 \text{ visits /day}$$

$$EPCC = RCC \times MC \text{ where } MC = \text{managerial capacity} = 40\%$$

$$EPCC = 138 \times 0.40 = 55.2 \text{ or } 55 \text{ vehicle per day}$$

### **Some Ecotourism Case studies**

#### **Periyar Tiger Reserve, Kerala**

This reserve faced the same problems of conflict with local people as many other protected areas in the country.

In the late 1990s, forest officials here used the GEF-funded Eco development Project to establish a unique ecotourism programme. Different Eco development Committees (EDCs) were formulated depending on the function and interest of the respective group.

Through the community-based ecotourism programme, hotels in the vicinity were contacted and requested to add forest treks into their itinerary for tourists.

Forest treks were conducted by the ex-poachers EDC and other tribal trekkers. EDC members also helped to patrol the forest at night.

Income generated from these activities goes into the respective EDC account. The community based ecotourism programmes are generating around Rs 60,00,000 annually and providing direct employment to more than 500 tribal families

It has been dealt in detail under Eco development

#### **Ecotourism in Parambikulam WLS**

- Better Livelihood for locals
- Reduced dependency
- Participatory monitoring
- Community based Protection system
- No grazing
- Sustainable employment opportunities
- Regulated tourism & Garbage management system

#### **ECO-TOURISM IN KARAMADAI RANGE OF COIMBATORE DIVISION**

- No of Tribal Villages-22
- No of Eco-tourism Programme –10 villages
- Used the traditional knowledge of the local Tribal population such as

- MFP Collection
- Honey Collection
- WL Trackers &Swimming and Use of Coracles.

**INCOME GENERATION-1st APRIL 2007 to JULY 2007 : balance sheet**

Total Collection From Tourists - Rs.4,15,600/-

Funds From State Plan - Rs.3,00,000/-

-----

Rs.7,15600/-

Total Expenditure on the

Infrastructure - Rs.301463 /-

Wages Paid To Tribal For

Services - Rs.78,400/-

Charges For Catering TO

WSHG Rs.1,22,500/-

-----

Rs.2,00,900/-

- -----

**The Keoladeo National Park (KNP), Rajasthan**

Where in an innovative move there has been a conscious effort to involve local community members in tourism related activities by training and employing them as guides and rickshaw pullers.

### **Khangchendzonga National Park, Sikkim**

The Yuksam-Dzongri-Goechcha La is a trekking trail located in the buffer zone of the Khangchendzonga national park. Large numbers of tourists trek on this route every year to enjoy the beauty of the mountains

In 1995 was launched a project called the Sikkim Biodiversity and Ecotourism project, supported by USAID and led by the Mountain Institute and the G.B. Pant Institute of Himalayan Environment and Development.

The project has since become quite a landmark in the field of ecotourism. Over 400 people have participated in training courses to increase their capacity to generate income from ecotourism related enterprises. These included porters, vegetable growers, lodge and teashop operators, and guides.

### **Tso Moriri Lake, Ladakh (Jammu and Kashmir)**

Situated at an altitude of 4511 meters above sea level in the Ladakh region of Jammu and Kashmir, lies the brackish water lake of Tso Moriri. This is one of the world's highest lakes and the largest brackish water body in the India

The Changthang plateau is inhabited by the nomadic Changpa community who moves with its livestock in search of grazing grounds in tune with the changing seasons. However, more and more Changpas are resorted to settled lives.

A permanent settlement of Changpas exists on the shore of this lake. This is the village of Korzok which has at present 23 settled households. The village also has a 300 year old monastery

As a result of the increasing interest of local people in deriving benefits from tourism, they have initiated ten home stays in the village .

## **THREAT OF ECO-TOURISM TO WL RESOURCE**

- Marketing of tourism under the label ECO tourism without regulatory mechanism eco-sell.
- WL tourism done in unsystematic and unscientific manner
- Eco-tourism beyond carrying capacity
- Eco-tourism pit falls – visitor indiscipline-loud music-littering-disturbance--over habituation and hyper aggressiveness of animals .
- Conflict between local communities and WL resort owners and tour operators .

## **NGO's Role in Eco-tourism**

- Promote conservation ethics and generate public awareness.
- Training local villagers to act as nature Education guide & as interpretator.
- Evaluation of impact of tourism by systematic study and research.
- Create awareness about negative impacts of tourism among tourism entrepreneurs, guide,safari drivers e.g tour–travel operators for tigers.

Ecotourism is a double-edged sword. It can do inordinate harm leading to ecological as well as cultural degradation. However, if planned and executed sensitively, it can actually be come a vehicle for conservation as also provide a livelihood option for local communities. The challenge lies in how best this is done.

## **CHAPTER: 17**

### **Wildlife Management Techniques**

Management of wildlife population in its natural areas or at the ex situ site

Management is an intervention to achieve desired results

Is intervention required?

Management Options in Wildlife Areas

Wildlife Population Management

Habitat Management

Human Use Management

Tourist Management

Human-Wildlife Conflicts Management

Zonation

Human Resources Management

Eliciting Public support

Management Plans are to drawn for each Protected Area

Habitat Management

Improving the availability of food

Improving the availability of water

Development of Cover / Shelter

Fire as a management tool

Control of grazing

Disease monitoring

Food availability

Supplementing forage grasses

Weed eradication

Planting grasses in glades

Over wood removal

Weed Eradication

Weed are aggressive colonizers which spread rapidly out-competing other plant species.

These are unpalatable and unwanted plants and are mostly exotics.

Lantana camera ( exotic)

Eupatorium spp.( exotic)

Mikania micrantha ( exotic)

Adhatoda vasica ( indigenous)

Ageratum conyzoides ( indigenous)

Cassia tora ( indigenous)

Proliferation of weeds in a PA is the result of disturbance: heavy grazing by livestock;

heavy forest working, abandonment of cultivation

Weed eradication is successful only if the cause of the infestation is brought under control.

Chemical methods not advisable

Selected species be planted soon after eradication

### **Water Resources Management**

Objectives:

1. To prevent migration of animal so as to avoid human-animal conflict.
2. To reduce over use of the area

### 3. Tourism

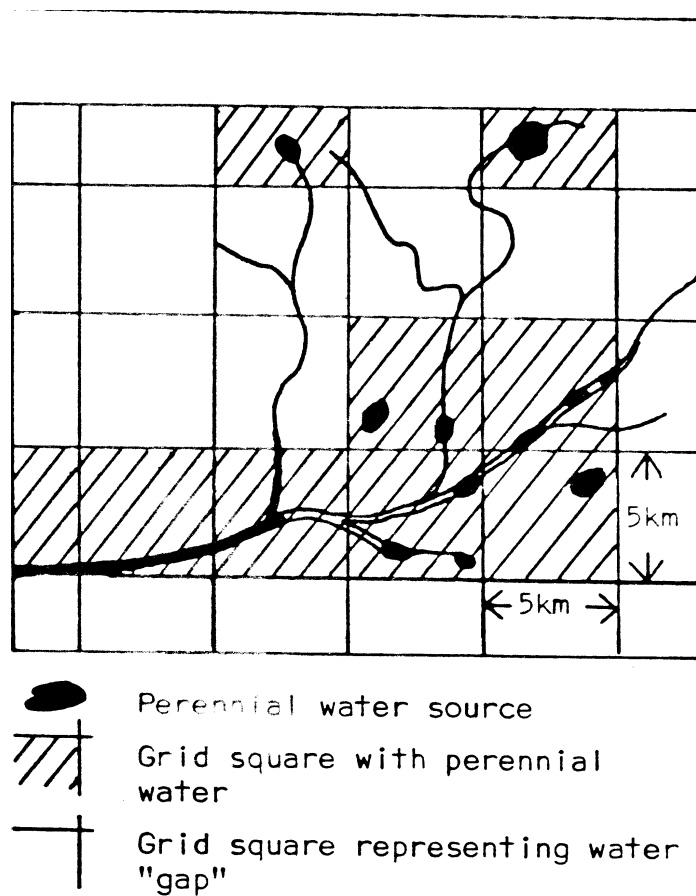
### 4. Education, Research and Census

#### Water availability grid

Locate, map and describe the natural waterholes

Identify the area where there is deficiency

Plan artificial waterholes based on the nature of the wildlife, quality of the area with respect to wildlife.



## Water Hole

It is an open water storage basin either natural (river, pond, stream, spring) or artificial where run off water or rain water get collected on an artificial trench or depression or water is supplied through pipeline

Artificial water hole can be of :

a dug out

Pucca (Cemented) waterhole

Polythene lined waterhole

Generally, of 3 -4 m upper dia

and 2 -3 m in basal dia

and 1 -1.5m depth

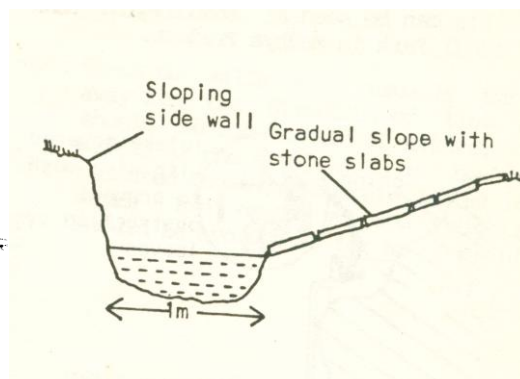
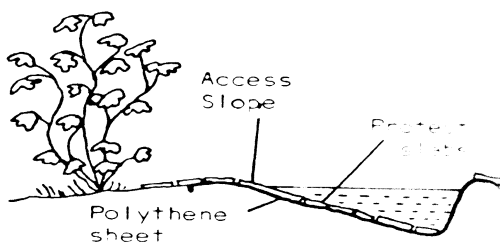
## Artificial Water hole

Tapping shallow ground water or seepages by making depressions as well as slope

Polythene layered water hole where polythene is layered on a boulder layer. Over the polythene layer, spread another layer of gravel and sand so as to cover the polythene as well as to prevent damage

Artificial waterhole can be made through check dams

Impression pad can be set around waterhole to get pug marks



Additional points to note...

Choose site near the Ecotone or edges

Choose site with shade trees and escape cover such as shrubs

Avoid sites that are likely to be disturbed by livestock or people or traffic

In buffer areas, it be at least 500m away from the cattle camp

Excessive water development in arid zones may raise the population levels incompatible with food availability leading to habitat degradation

Water development may adversely affect those areas with endemic or rare species of plants

Development of Cover

Shrub cover management

Lantana thicket – a cover ?

Balance between ground flora and the shrub vegetation

### **Fire as a Management Tool**

Open Glades: such as Rhino glade where only part of the area should be burnt with intermittent stands of tall grasses as cover

Meadows in Moist deciduous Forests:

1. Boundaries of the meadows be burnt once in three years at the end of dry season to prevent woodland invasion

2. A third of the remaining meadow be burnt every year

Early season fire can burn the unpalatable old grass growth and induce new flushes.

Avoid fire where there are vulnerable E.G communities present

Avoid fire at very arid situations

All burning blocks be small, never bigger than a compartment

Burn many small patches rather a single block

Avoid windy days

Burning be done during winter

Ensure adequate fire line precautions

Have fire fighting equipment ready

### **Zonation:**

Concept of **Core, Buffer and Multiple use** areas

Zonation was originally introduced in NP for allowing tourism

All sorts of exploitation or occupation have been eliminated from the **Core zone**

**Buffer zone** is regarded as a multiple use area which could provide forest products to the community

**Tourist zone:** part of the buffer area earmarked for tourist viewing

**Extension buffering:** It is an extension of the nature reserve where spill over breeding populations of plants and animals can establish. It is similar to a corridor

**Socio buffering:** Here the land is used for the benefit of local people to provide various products which were formally gathered from the entire Reserve

### **Protection Activities**

Anti poaching camps

Control of timber smuggling

Control of non-timber forest produce smuggling

Intelligence gathering

Covert operations and Raids, Anti poaching plans & Patrolling plans

## **CHAPTER: 18**

### **INTERNATIONAL CONVENTIONS & WORLD CONSERVATION**

#### **ORGANISATIONS**

- Intergovernmental agreements or treaties on specific issues and their provision places certain obligations on the Governments which agree upon to join it
- Convention on Wetlands (Ramsar Convention)-1971
- Convention on Migratory Species (CMS)-1979
- Convention on International Traffic on Endangered Species of Flora and Fauna (CITES)-1975
- Convention on World Heritage Sites-1972
- Convention on Biodiversity (CBD)-1992
- Whaling Convention -1946
- Convention to combat desertification-2000
- Convention on Climatic Change (UNFCCC)-1994
- Convention on Conservation of Antarctic Marine living Resources-2008.

#### **Convention on Wetlands (Ramsar Convention)-1971**

##### **Wetland: definition**

- The Convention uses a broad definition of the types of wetlands covered in its mission.
- Areas of swamps and marshes, peat land or water whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 metres

- Two criteria:
- The soil remain submerged or water logged whole or part of the year
- Wetland biota depend on it or adapted to water logging during at least part of their life cycle

### **Criteria for Identifying Wetlands of International Importance**

**Group A.** Sites containing representative, rare or unique wetland types

#### **Criterion 1**

A wetland should be considered internationally important, if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate bio geographic region

**Group B:** Sites of international importance for conserving biological diversity

Criteria based on species and ecological communities

#### **Criterion 2**

- ❖ if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

#### **Criterion 3**

- ❖ if it supports populations of plant/or animal species important for biological diversity of a particular bio geographic region.

#### **Criterion 4**

- ❖ if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

**Specific criteria based on water birds**

**Criterion 5**

- ❖ if it regularly supports 20,000 or more water birds.

**Criterion 6**

- ❖ if it regularly supports 1% of the individuals in a population of one species or subspecies of water bird

**Specific criteria based on fish****Criterion 7**

- ❖ if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

**Criterion 8**

- ❖ if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

**List of wetlands of International importance from India under Ramsar**

**Convention**

| S. No. | Name of Wetland          | State            | Date of declaration |
|--------|--------------------------|------------------|---------------------|
| 1.     | Kolleru Lake             | Andhra Pradesh   | 19-08-2002          |
| 2.     | Deepor Beel              | Assam            | 19-08-2002          |
| 3.     | Nalsarovar Wetland       | Gujarat          | 24-09-2012          |
| 4.     | Renuka                   | H.P.             | 08-11-2005          |
| 5.     | Chandratatal             | H.P.             | 08-11-2005          |
| 6.     | Pong Dam Lake            | Himachal Pradesh | 19-08-2002          |
| 7.     | Surinsar- Mansar         | J&K              | 08-11-2005          |
| 8.     | Hokarsar                 | J&K              | 08-11-2005          |
| 9.     | Wular Lake               | Jammu & Kashmir  | 23-03-1990          |
| 10.    | Tsomoriri                | Jammu & Kashmir  | 19-08-2002          |
| 11.    | Sasthamkotta Lake        | Kerala           | 19-08-2002          |
| 12.    | Ashtamudi                | Kerala           | 19-08-2002          |
| 13.    | Vembanad-Kol Wetland     | Kerala           | 19-08-2002          |
| 14.    | Bhoj Wetland             | Madhya Pradesh   | 19-08-2002          |
| 15.    | Loktak Lake              | Manipur          | 23-03-1990          |
| 16.    | Chilika Lake             | Odisha           | 01-10-1981          |
| 17.    | Bhitarkanika Mangroves   | Odisha           | 19-08-2002          |
| 18.    | Harike Lake              | Punjab           | 23-03-1990          |
| 19.    | Ropar                    | Punjab           | 22-01-2002          |
| 20.    | Kanjli                   | Punjab           | 22-01-2002          |
| 21.    | Sambhar Lake             | Rajasthan        | 23-03-1990          |
| 22.    | Keoladeo National Park   | Rajasthan        | 01-10-1981          |
| 23.    | Point Calimere Sanctuary | Tamil Nadu       | 19-08-2002          |
| 24.    | Rudrasagar               | Tripura          | 08-11-2005          |
| 25.    | UpparGanga               | U.P.             | 08-11-2005          |
| 26.    | East Calcutta Wetlands   | West Bengal      | 19-08-2002          |

## **CITES**

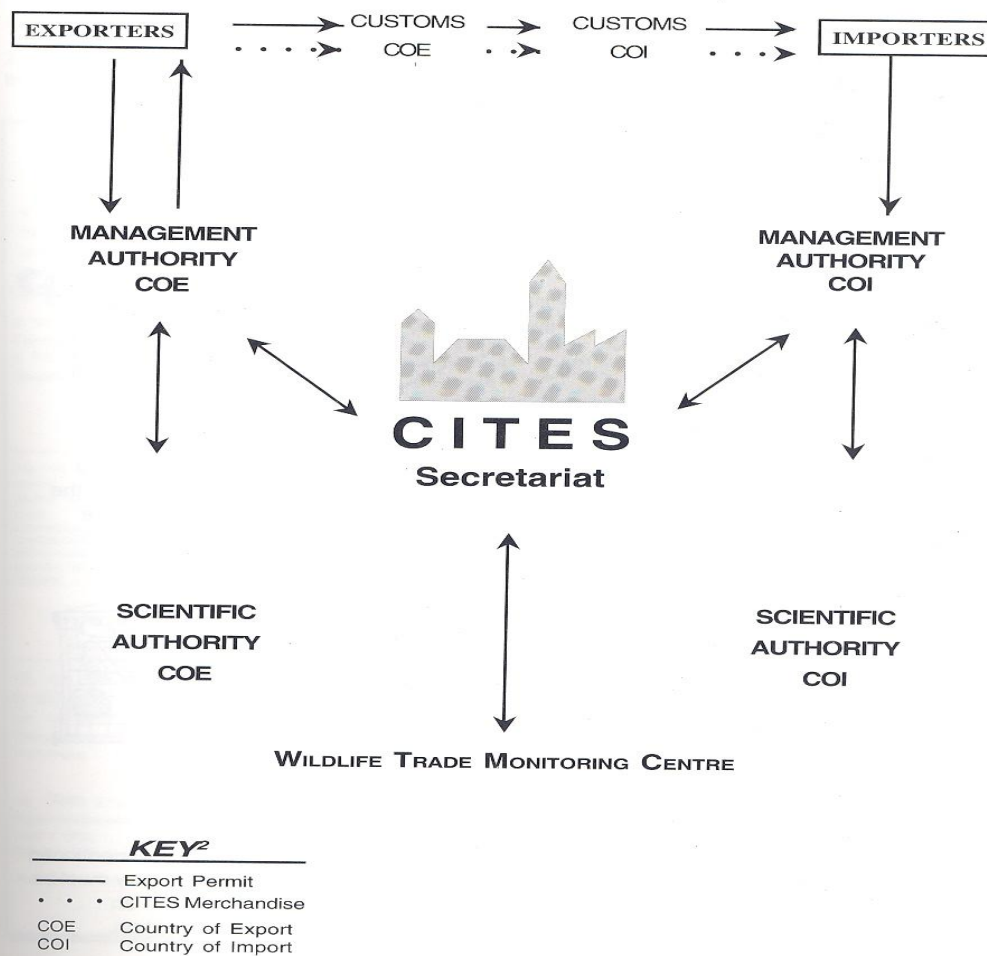
- The Convention on International Trade in Endangered Species of Wild Flora and Fauna
- It is the treaty that monitors and regulates international trade in endangered spp.
- Since 1973
- 175 countries signatory including India
- HQ: Geneva, Swiz

## **How CITES works**

- Convention operates through a system of permits issued by exporting and importing countries mainly by quota system
- Requires designation of Management and Scientific Authorities by each country, designation of ports for import or export of wildlife
- M.A to grant permits and certificates for export or imports
- Like other Conventions, there are CoP, Standing Committees ( animals, plants, Nomenclature & identification Manual) and Secretariat (which coordinates WCMC, WCU and SSC)
- The species covered by CITES are listed in three Appendices, according to the degree of protection they need.

## How does CITES work?

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## CITES in INDIA

- ADG, Wildlife or Director , Wildlife Preservation is designated as the Management Authority supported by four scientific authorities viz. Director, WII; Director, ZSI; Director, BSI and Director, CMFRI
- Four Dy. Directors at Mumbai, Delhi, Kolkotta and Chennai assists to control trade.

- Legislative basis for implementation lies with the Export-Import Control orders and Customs Act, 1962 at the point of export/imports and
- With the state Chief Wildlife Wardens under WL (p) Act, 1972 elsewhere

## **Appendices**

**Appendix I** : includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.

**Appendix II** : includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

**Appendix III** : contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

- **Plants banned for export**

As per notification no. 2 (RE-98) 1997-2002 dated 13th April 1998 by the Ministry of Commerce, the export of following plants/plant portion and their derivatives and extracts obtained from the wild is prohibited  
Cycas beddomei (Beddome's cycad)

- Vanda coerulea (Blue vanda)
- Saussurea costus (Kuth or costus root)
- Paphiopedilium species (Ladies slipper orchid)
- Nepenthes khasiana (Pitcher plant)
- Renanthera imschootiana (Red vanda)

- *Rauwolfia serpentina* (Sarpagandha)
- *Ceropegia* species
- *Frerea indica* (Shindal Mankundi)
- *Podophyllum hexandrum* (Indian Podophyllum)
- *Cyatheaceae* species (Tree Ferns)
- *Cycadaceae* species (Cycads)
- *Dioscorea deltoidea* (Elephant's Foot)
- *Euphorbia* species (Euphorbias)
- *Orchidaceae* species (Orchids)
- *Pterocarpus santalinus* (Redsanders)
- *Taxus wallichiana* (Common Yew or Birni leaves)
- *Aquilaria malaccensis* (Agarwood)
- *Aconitum* species
- *Coptis teeta*
- *Coscinium fenestratum* (Calumba wood)
- *Dactylorhiza hatagirea* (Hathjari)
- *Gentiana kurroo* (Kuru Kutki)
- *Gnetum* species
- *Kamphoria galanga*
- *Nardostachys grandiflora*
- *Panax pseudoginseng*
- *Picrorhiza kurroo*
- *Swertia chirata* (Charayatah)

### **The Convention on Biological Diversity(CBD)**

- Known informally as the Biodiversity Convention, is an international treaty that was adopted in Rio de Janeiro in June **1992**.
  - The Convention has **three main goals**:
    1. Conservation of biological diversity (or biodiversity);
    2. Sustainable use of its components; and
    3. Fair and equitable sharing of benefits arising from genetic resources.
- Its objective is to develop national strategies for the conservation and sustainable use of biological diversity.
  - It is often seen as the key document regarding sustainable development.
  - The Convention was opened for signature at the Earth Summit in Rio de Janeiro on 5<sup>th</sup> June 1992 and entered into force on 29 December 1993.
  - The convention's governing body is the Conference of the Parties (COP), consisting of all governments that have ratified the treaty.
  - The CBD Secretariat is in Montreal, and operates under the United Nations Environment Programme

### **Convention on Migratory Species (CMS)**

- CMS works under the UNEP
- Secretariat at Bonn, Germany
- There are COP, Standing Committee, Scientific Committee
- meets every three years

## **IUCN**

- International Union for Nature and Natural Resources
- Also called World Conservation Union since Dec.1990
- Hq: Gland, Switzerland
- Resulted out of a 1931 Conference on Protection of Nature and founded in 1948
- WWF started as a sister organization in 1987 as funding organization where as IUCN emphasizes on Coordination, consultancy and Research.
- IUCN and WWF are Charity organizations rather than Trust
- Funding is through Framework agreement as well as voluntary donations

## **Objectives**

- To secure the conservation of nature, and especially of biological diversity, as an essential foundation for the future;
- To ensure that where the earth's natural resources are used this is done in a wise, equitable and sustainable way;
- To guide the development of human communities towards ways of life that are both of good quality and in enduring harmony with other components of the biosphere;
- While changing the name, these formal objectives were spelt out in the 18th General Assembly at Perth in 1990

## **Six Commissions**

- **SSC : Species Survival Commission.**
- It sets up Committee of experts from different countries on different spp. Like Big Cats Committee, Rhinoceros Committee etc.

- **Commission on Ecosystem Management (CEM).**
- It provides expert guidance on integrated ecosystem approaches to the management of natural and modified ecosystems
- **World Commission on Protected Areas (WCPA).**
- It promotes the establishment and effective management of a worldwide representative network of terrestrial and marine protected areas.
- **Commission on Environmental Law**
- It advances environmental law by developing new legal concepts and instruments, and by building the capacity of societies to employ environmental law for conservation and sustainable development.
- **Commission on Environmental, Economic and Social Policy (CEESP)**
- CEESP provides expertise and policy advice on economic and social factors for the conservation and sustainable use of biological diversity
- **Commission on Education and Communication (CEC)**
- CEC champions the strategic use of communication and education to empower and educate stakeholders

### **IUCN Council**

- The IUCN Council is the principal governing body of IUCN,
- The Council is responsible for the general control of all the affairs of IUCN, subject to the authority of the World Conservation Congress.

### **IUCN Red List**

Species are classified in nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation.

- ❖ Extinct (EX)
- ❖ Extinct in the Wild (EW)
- ❖ Critically Endangered (CR)
- ❖ Endangered (EN)
- ❖ Vulnerable (VU)
- ❖ Near Threatened (NT)
- ❖ Least Concern (LC)
- ❖ Data Deficient (DD)
- ❖ Not Evaluated (NE)

### **IUCN Management Categories for Protected Areas**

#### **CATEGORY I a: Strict Nature Reserve:**

- Protected Area managed mainly for science
- Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

**CATEGORY I b Wilderness Area:**

- Protected Area managed mainly for wilderness protection
- Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

**CATEGORY II National Park:**

- Protected area managed mainly for ecosystem protection and recreation
- Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

**CATEGORY III Natural Monument:**

- Protected area managed mainly for conservation of specific natural features
- Area containing one, or more, specific natural /cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

**CATEGORY IV Habitat/Species Management Area:**

- Protected area managed mainly for conservation through management intervention

- Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

**CATEGORY V Protected Landscape/Seascape:**

- Protected area managed mainly for landscape/seascape conservation and recreation
- Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area. Eg. Biosphere reserves

**CATEGORY VI Managed Resource Protected Area:**

- Protected area managed mainly for the sustainable use of natural ecosystems
- Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

**World Conservation Monitoring Centre( WCMC)**

- The WCMC is an executive agency of the United Nations Environment Programme, based in Cambridge in the United Kingdom.
- UNEP-WCMC has been part of UNEP since 2000

- It was previously an independent organization jointly managed by IUCN, UNEP and WWF established in 1988, and prior to that the Centre was a part of the IUCN Secretariat.
- The activities of UNEP-WCMC include biodiversity assessment, support to international conventions such as the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), capacity building and management of both aspatial and spatial data on species and habitats of conservation concern.

### **WWF- World Wildlife Fund**

- It is Funding organization for Conservation Projects working in about 100 countries and has about 5 million members; started in 1961
- In India, started in 1970 as WWF-India following IUCN conference in 1969
- Registered as Charitable non-public Trust under Bombay Public Trust Act
- Has two Major research wings in India : DCNR( Data centre for Natural resources) at Bangalore and ESP ( Environmental service Group( at New Delhi)
- Hq of WWF-India is at Mumbai

### **WWF Mission is the Conservation of Nature by way of:**

- protecting natural areas and wild populations of plants and animals, including endangered species;

- promoting sustainable approaches to the use of renewable natural resources; and
- promoting more efficient use of resources and energy and the maximum reduction of pollution

### **How WWF works**

- Place-based Approach
- By 2020 WWF will conserve 19 of the world's most important natural places
- Community Action
- WWF builds a sustainable balance between people and nature by way poverty alleviation programmes
- Partnerships
- Green product propaganda and work with business groups to achieve this aim
- Global Markets
- our planet is one delicate and complex set of relationships between species, people, habitats, governments and global market forces. WWF tries to transform that forces that threaten people and nature.

### **Places targeted by WWF**

- Amazon
- Amur-Heilong
- Arctic
- Borneo and Sumatra

- Chihuahuan desert
- Coastal East Africa
- Congo Basin
- Coral triangle
- Eastern Himalaya
- Galpagos
- Gulf of California
- Madagascar
- Mekong
- Meso American reef
- Namibia
- Northern Great Plains
- US South east rivers
- Southern Chile
- Yangtze

#### **Species, Human –WL conflict**

- WWF focuses special attention on flagship species: giant pandas, tigers, polar bears, endangered whales and dolphins, rhinos, elephants, marine turtles and great apes
- WWF has a number of projects around the world to reduce Human-Wildlife Conflict and improve the livelihoods of the people affected.
- Climate Change projects.

**CHAPTER: 19**  
**CONSERVATION EFFORTS**

With Specific Reference To:

BIOSPHERE RESERVES, PROJECT TIGER, PROJECT ELEPHANT

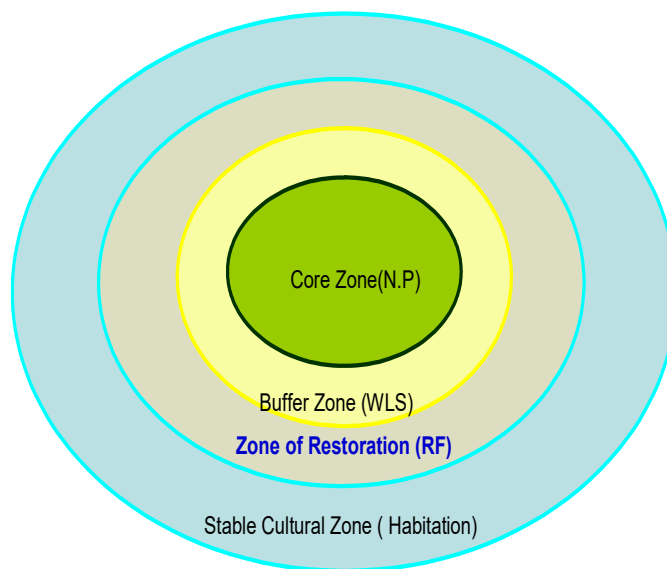
**Biosphere Reserve**

Biosphere Reserve is a management concept involving large planning areas integrating ecosystems in Protected Areas, human settlements and resource exploitation zones. It is an internationally designated Protected Area managed to demonstrate the values of conservation. (Harold Eidsvik)

- Biosphere Reserves are areas of terrestrial and coastal ecosystems which are internationally recognized within the framework of UNESCO's Man and Biosphere (MAB) Programme(1971).
- Each Biosphere Reserve is intended to fulfill three basic functions, which are complementary and mutually reinforcing (UNESCO, 2005):
- A conservation function - to contribute to the conservation of landscapes, ecosystems, species and genetic variation;
- A development function - to foster economic and human development which is socio-culturally and ecologically sustainable;
- A logistic function - to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development.
- 266 B.R spread across 74 countries

- There are 15 Biosphere Reserves declared in India covering 8 Bio Geographic regions in India
- National Committee on environmental planning and coordination (NCEPC), 1972 identified sites for Biosphere Reserves.
- the International Coordinating Council (ICC) of Man and Biosphere (MAB) Programme of UNESCO approves designating areas as B.R
- First Indian Biosphere Reserve is Nilgiri Biosphere Reserve in 1986 covering areas of Kerala, Karnataka and T.N.
- During 1982-86, debate was on having separate Biosphere Reserve legislation; not yet materialized, hence there is identity crisis for Biosphere Reserve.

## BIOSPHERE CONCEPT



### **Zonations in B.R**

- **Core Zone:** prime area; absolute protection given; maintained in pristine condition; should represent one of the bio geographic zones of the world
- **Buffer Zone:** where some manipulation or management/ experiment is practiced; may be equated with WLS.
- **Zone of Restoration:** Area was meeting the requirement of people; but no longer productive; this has to be more productive by sustainable practices
- **Stable Cultural Zone:** Includes adjoining locations and villages where traditional systems practiced including agricultural practices.

### **Biosphere Reserves in India:**

Corresponding to IUCN Category V of Protected Areas

#### **List of Biosphere Reserves, their area, date of designation, and location**

| <b>S.No</b> | <b>Name of the<br/>Biosphere Reserve<br/>&amp; total geographical<br/>area (Km<sup>2</sup>)</b> | <b>Date of Designation</b> | <b>Location in the State<br/>(s)/Union Territory</b>                                               |
|-------------|-------------------------------------------------------------------------------------------------|----------------------------|----------------------------------------------------------------------------------------------------|
| 1           | Nilgiri (5520)                                                                                  | 01.08.1986                 | Part of Wynad,<br>Nagarhole, Bandipur<br>and Madumalai,<br>Nilambur, Silent<br>Valley and Siruvani |

|   |                                 |            |                                                                                                    |
|---|---------------------------------|------------|----------------------------------------------------------------------------------------------------|
|   |                                 |            | hills in Tamil Nadu,<br>Kerala and Karnataka<br>.                                                  |
| 2 | <b>Nanda Devi<br/>(5860.69)</b> | 18.01.1988 | Part of Chamoli,<br>Pithoragarh and<br>Almora districts in<br>Uttarakhand.                         |
| 3 | <b>Nokrek (820)</b>             | 01.09.1988 | Part of East, West<br>and South Garo Hill<br>districts in<br>Meghalaya.                            |
| 4 | Manas (2837)                    | 14.03.1989 | Part of Kokrajhar,<br>Bongaigaon, Barpeta,<br>Nalbari, Kamrup<br>and Darang districts<br>in Assam. |
| 5 | <b>Sunderban (9630)</b>         | 29.03.1989 | Part of delta of<br>Ganges &<br>Brahamaputra river<br>system in West                               |

|    |                                   |            |                                                                                                                      |
|----|-----------------------------------|------------|----------------------------------------------------------------------------------------------------------------------|
|    |                                   |            | Bengal.                                                                                                              |
| 6  | <b>Gulf of Mannar<br/>(10500)</b> | 18.02.1989 | India part of Gulf of Mannar extending from Rameswaram island in the North to Kanyakumari in the South of Tamilnadu. |
| 7  | <b>Great Nicobar (885)</b>        | 06.01.1989 | Southern most island of Andaman and Nicobar Islands.                                                                 |
| 8  | <b>Similipal (4374)</b>           | 21.06.1994 | Part of Mayurbhanj district in Orissa.                                                                               |
| 9  | Dibru-Saikhova (765)              | 28.07.1997 | Part of Dibrugarh and Tinsukia districts in Assam.                                                                   |
| 10 | Dehang-Dibang<br>(5111.5)         | 02.09.1998 | Part of Upper Siang, West Siang and Dibang Valley districts in Arunachal                                             |

|    |                                                   |            |                                                                                                                                                        |
|----|---------------------------------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                   |            | Pradesh.                                                                                                                                               |
| 11 | <b>Pachmarhi (4981.72)</b>                        | 03.03.1999 | Part of Betul,<br>Hoshangabad and<br>Chhindwara districts<br>in Madhya Pradesh.                                                                        |
| 12 | Khangchendzonga<br>(2931.12)                      | 07.02.2000 | Part of North and<br>West districts in<br>Sikkim.                                                                                                      |
| 13 | Agasthyamalai<br>(3500.36)                        | 12.11.2001 | Part of Thirunelveli<br>and Kanyakumari<br>districts in Tamil<br>Nadu and<br>Thiruvanthapuram,<br>Kollam and<br>Pathanamthitta<br>districts in Kerala. |
| 14 | <b>Achanakmar-<br/>Amarkantak<br/>(3,835. 51)</b> | 30.03.2005 | Part of Anuppur and<br>Dindori districts of<br>Madhya Pradesh and                                                                                      |

|    |                           |            |                                                                                                                                      |
|----|---------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------|
|    |                           |            | Bilaspur district of<br>Chattisgarh.                                                                                                 |
| 15 | Kachchh (12,454)          | 29.01.2008 | Part of Kachchh,<br>Rajkot,<br>Surendranagar and<br>Patan districts in<br>Gujarat.                                                   |
| 16 | Cold Desert (7,770)       | 28.08.2009 | Pin Valley National<br>Park and<br>surroundings;<br>Chandratal & Sarchu;<br>and Kibber Wildlife<br>sanctuary in<br>Himachal Pradesh. |
| 17 | Seshachalam<br>(4755.997) | 20.09.2010 | Seshachalam hill<br>ranges in Eastern<br>Ghats encompassing<br>part of Chittoor and<br>Kadapa districts in<br>Andhra Pradesh.        |
| 18 | Panna (2998.98)           | 25.08.2011 | Part of Panna and                                                                                                                    |

### **Project Tiger**

- Project Tiger Launched in 1973 to save tiger As well as other species on which it is dependent.
- Tiger population dwindled from 40000 during 1900 to 1827 in 1972.
- Various tiger reserves were created in the country on a 'core-buffer' strategy.

Management plans are drawn up for each tiger reserve, based on the principles outlined below:

Elimination of all forms of human exploitation and biotic disturbance from the core area and rationalization of activities in the buffer zone.

1. Restricting the habitat management only to repair the damages done to the ecosystem by human and other interferences, so as to facilitate recovery of the ecosystem to its natural state.
2. Monitoring the faunal and floral changes over time and carrying out research about wildlife.

The project started as a 'Central Sector Scheme' with the full assistance of Central Government till 1979-80: later, it become a 'centrally Sponsored Scheme' from 1980-81, with equal sharing of expenditure between the center and the states.

- The W.W.F. has given an assistance of US \$ 1 million in the form of equipments, expertise and literature

**Project Tiger envisages to develop,**

- a) Use of Information and Communication technology in Wildlife Protection and Crime Risk Management in Tiger reserves.
- b) GIS based digitized database and MIS development/networking in Tiger Reserves.
- c) Tiger Habitat & Population Evaluation System for the Indian Sub Continent including a 'Tiger Atlas of India' and a 'Tiger Habitat & Population Evaluation System for the country is being developed.

**National Tiger Conservation Authority (NTCA)**

A statutory , 27-member body responsible for implementing Project Tiger plan with Minister, MOEF as the Chairman.

The Authority will set guidelines for protection of tigers in reserves, parks and sanctuaries

It will monitor tiger estimation and carry out disease surveillance

Safeguards provided to protect interests of people living in forests and in and around tiger reserves

The Wild Life (Protection) Amendment Act, 2006 (No. 39 of 2006) has come into force on 4th September 2006 for creating the National Tiger Conservation Authority and the Tiger and Other Endangered Species Crime Control Bureau (Wildlife Crime Control Bureau).

The Tiger Conservation Authority will be required to prepare an Annual Report, which will be laid in the Parliament along with the Audit Report.

List of the Tiger Reserves in India with year of creation and area

| S.No. | Year of Creation | Name of Tiger Reserve | State             | Total area of the<br>Core/Critical Tiger Habitat<br>(in Sq. Kms.) |
|-------|------------------|-----------------------|-------------------|-------------------------------------------------------------------|
| 1     | 1973-74          | Bandipur              | Karnataka         | 872.24                                                            |
| 2     | 1973-74          | Corbett               | Uttarakhand       | 821.99                                                            |
| 3     | 1973-74          | Kanha                 | Madhya Pradesh    | 917.43                                                            |
| 4     | 1973-74          | Manas                 | Assam             | 840.04                                                            |
| 5     | 1973-74          | Melghat               | Maharashtra       | 1500.49                                                           |
| 6     | 1973-74          | Palamau               | Jharkhand         | 414.08                                                            |
| 7     | 1973-74          | Ranthambhore          | Rajasthan         | 1113.364                                                          |
| 8     | 1973-74          | Similipal             | Orissa            | 1194.74                                                           |
| 9     | 1973-74          | Sunderbans            | West Bengal       | 1699.62                                                           |
| 10    | 1978-79          | Periyar               | Kerala            | 881.00                                                            |
| 11    | 1978-79          | Sariska               | Rajasthan         | 681.1124                                                          |
| 12    | 1982-83          | Buxa                  | West Bengal       | 390.5813                                                          |
| 13    | 1982-83          | Indravati             | Chhattisgarh      | 1258.37                                                           |
| 14    | 1982-83          | Nagarjunsagar         | Andhra Pradesh    | 2527.00                                                           |
| 15    | 1982.83          | Namdapha              | Arunachal Pradesh | 1807.82                                                           |
| 16    | 1987-88          | Dudhwa                | Uttar Pradesh     | 1093.79                                                           |
| 17    | 1988-89          | Kalakad-Mundanthurai  | Tamil Nadu        | 895.00                                                            |
| 18    | 1989-90          | Valmiki               | Bihar             | 840.00                                                            |
| 19    | 1992-93          | Pench                 | Madhya Pradesh    | 411.33                                                            |

|    |           |                 |                   |          |
|----|-----------|-----------------|-------------------|----------|
| 20 | 1993-94   | Tadoba Andheri  | Maharashtra       | 625.82   |
| 21 | 1993-94   | Bandhavgarh     | Madhya Pradesh    | 716.903  |
| 22 | 1994-95   | Panna           | Madhya Pradesh    | 576.13   |
| 23 | 1994-95   | Dampa           | Mizoram           | 500.00   |
| 24 | 1998-99   | Bhadra          | Karnataka         | 492.46   |
| 25 | 1998-99   | Pench           | Maharashtra       | 257.26   |
| 26 | 1999-2000 | Pakke           | Arunachal Pradesh | 683.45   |
| 27 | 1999-2000 | Nameri          | Assam             | 200.00   |
| 28 | 1999-2000 | Satpura         | Madhya Pradesh    | 1339.264 |
| 29 | 2008-09   | Anamalai        | Tamil Nadu        | 958.00   |
| 30 | 2008-09   | Udanti-Sitanadi | Chhattisgarh      | 851.09   |
| 31 | 2008-09   | Satkosia        | Orissa            | 523.61   |
| 32 | 2008-09   | Kaziranga       | Assam             | 625.58   |
| 33 | 2008-09   | Achanakmar      | Chhattisgarh      | 626.195  |
| 34 | 2008-09   | Dandeli-Anshi   | Karnataka         | 814.884  |
| 35 | 2008-09   | Sanjay-Dubri    | Madhya Pradesh    | 831.25   |
| 36 | 2008-09   | Mudumalai       | Tamil Nadu        | 321.00   |
| 37 | 2008-09   | Nagarhole       | Karnataka         | 643.35   |
| 38 | 2008-09   | Parambikulam    | Kerala            | 390.89   |
| 39 | 2009-10   | Sahyadri        | Maharashtra       |          |

Total **3213SQKm**

### **Project Elephant:**

Implemented in 1992

- For protection and improvement of Habitats, reduce man-elephant conflict; care of domestic elephants and creating public awareness

### **ELEPHANT RESERVES IN INDIA**

I Eastern India

(South West Bengal-

Jharkhand-Orissa) - Mayurbhanj ER West Bengal

2. Singhbhum ER- Jharkhand

3. Mayurbhanj ER- Orissa

4. Mahanadi ER- Orissa

5. Sambalpur ER- Orissa

6. Baitarni ER- Orissa

7. South Orissa ER- Orissa

8. Lemru ER- Chattisgarh

9. Badakhhol-Tamorpingla-Chattisgarh

10. North Brahmaputra(Arunachal –Assam)- Kameng ER -Arunachal Pradesh

11. Sonitpur ER Assam

12. South Brahmaputra(Assam- Arunachal) Dihing-Patkai ER-Assam

13. South Arunachal ER-Arunachal

14. Kaziranga(Assam- Nagaland) Kaziranga – KarbiAnglong ER Assam

15. Dhansiri-Lungding ER Assam

16. Intanki ER -Nagaland

17. Eastern Dooars-(Assam- W. Bengal) Chirang-Ripu ER-Assam
18. Eastern Dooars ER-W. Bengal
- 19.E. Himalayas (Meghalaya)- Garo Hills ER-Meghalaya
20. Khasi Hills ER- Meghalaya
21. Nilgiri –Eastern Ghat- Mysore ER -Karnataka
22. Wayanad ER - Kerala (Karnataka- Kerala-Tamilnadu-Andhra)
23. Nilgiri ER -Tamilnadu
24. Rayala ER - Andhra
25. South Nilgiri(Kerala- Tamilnadu)-Nilambur ER -Kerala
26. Coimbatore ER-Tamilnadu
27. Western Ghat(Tamilnadu- Kerala)-Anamalai ER-Tamilnadu
28. Anamudi ER - Kerala
29. Periyar(Kerala- Tamilnadu)Periyar -Kerala
30. Srivilliputtur ER-Tamilnadu
31. Northern India(Uttarakhand-U.P.)- Shivalik ER-Uttarakhand
32. Uttar Pradesh ER-U.P.

#### **OTHER IMPORTANT CONSERVATION EFFORTS**

- **Sea Turtle Project**: in 1999; being implemented in 10 coastal States with thrust on Orissa
- Done in collaboration with UNDP with WII as the Implementing Authority
- Prepare Inventory maps, identification of nesting sites, charting the Migration routes.
- **Gir Lion Project,Crocodile breeding project,Project Hangul etc.**

## **CHAPTER 20**

### **MANGEMENT OF HUMAN –WILDLIFE CONFLICTS**

#### **Wildlife Involved in the Conflicts:**

Mega fauna like crocodiles, macaques, jackal, wolf, Dhole, sloth bear, black bear, Jungle cat, Asiatic lion, leopard, tiger, snow leopard, elephant, wild ass, wild pig, gaur, Nilgai, blackbuck etc. are capable of causing problems to people.

Lesser species like fishes such as sharks, snakes, mongooses, porcupine, flying fox, rats and mice, birds such as pea-fowl, pigeons

Plant species such as obnoxious weeds like Parthenium hysterophorus, Lantana camera, Prosopis juliflora, Eupatorium odoratum, Ipomea cornea, Mimosa invisa. (Strangely enough, all are from south America)

#### **CAUSES**

Habitat loss, Fragmentation of habitat, Firewood collection, Poaching, Monoculture, Irrigation Canals

Large stretches of monoculture exotics deprive elephants their feeding grounds

Irrigation Canals can break the continuity of the stretches

Management of the Conflicts

1. People oriented activities
2. Crisis management activities
3. Long term approach

### **People Oriented Activities**

Advance meeting with villagers, Panchayats, local politicians, FPC members

Taking up Awareness programmes and advance warning.

Advocating change in agricultural crop and cropping pattern taking the help of Agricultural department.

Co-ordination with people's representatives and NGOs, district administration and police at all levels.

Timely and immediate payment of compensation against death cases and crop losses

Free treatment of the injured

### **Crisis Management Activities**

Construction of Energized fencing

Creation of Wildlife Squads

Engaging driving Parties for specific occasions

Scientific driving through forest areas as much as possible and avoiding non forest areas

Supply of burnt mobil oil and diesel, crackers etc. to the villagers esp. in the case of elephants

Experimental application of repelling agents

### **Long Term Planning**

Regular Awareness programmes

Staff training to combat depredation as well as training to cope up with the situation

Treatment of injured animals or capture of injured animals.

Periodic capture / elimination of problematic animals.

Radio collaring of elephants for monitoring movement through satellite and give advance warning

Initiating private Insurance schemes.

Habitat improvement of the forest tracts

### **Managing Man-Animal Conflicts**

Man-Elephant conflict

Man-Panther conflict

Monkey menace

Crop damage by wild pigs

Awareness campaign, Electric fencing,

Chemical restraint, trenches, Timely

compensation

Tranquilization, Capture

Electric Fencing, Tranquillization

Electric Fencing

### **Elephant Proof Trench**

If vertical slopes: 1.8 m depth x 1.2m width

Sloping sides : 2.5m x 1 m and 2m depth

Vertical slopes are most effective but useful in clay soil

The excavated earth can be placed on the outside Sloping sides

### **Setting up Electric Fences**

An electric fence is a barrier that uses electric shocks to deter animals from crossing a boundary

The voltage of the shock may have effects ranging from uncomfortable to painful or sometimes even lethal

An electric fence system comprises of 3 main items: an energizer, wire and power supply (either solar or battery).

The power consumption of a fence (in good condition) is low, so a lead-acid battery can power several hundred metres of fence and may last for several weeks on a single charge.

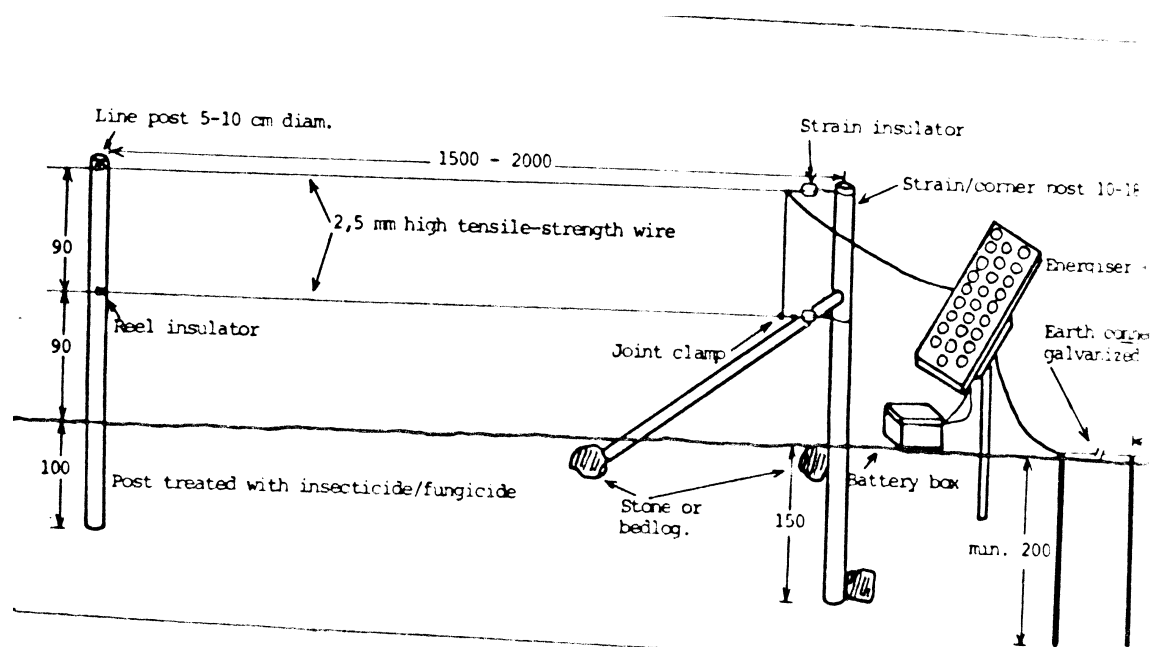
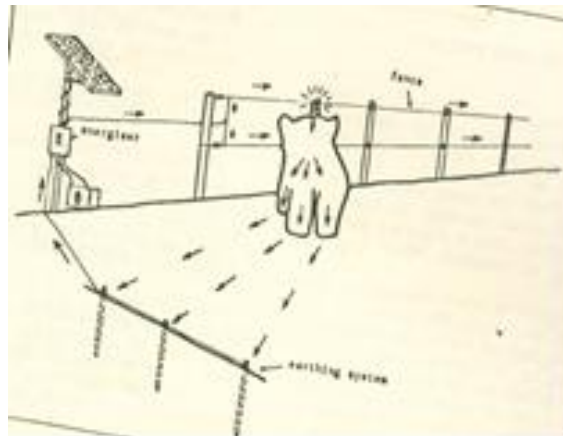
Voltage to be checked to see if it is between 5 - 8 kV. If it is less than that, the fence line is checked for

1. improper connection or
2. partial earthing due to touching to the vegetation or
3. draining of the power from battery which is to be charged

### **How it works**

The energizer sends an electrical pulse down the wire when the animal touches the fence and give a sharp shock as it creates an earthing and completes the circuit.

The pulsating current makes it unharmed to animals; The lag between the energy – pulse allows the animal to free from the fence. Pulse duration is only for 3 /10000 seconds.



## Design

Posts : from any durable timber.

a. Heavier Strain Posts between which up to 500m length of wire are stretched

b. Regular Line Posts that merely keep the wires in place

Insulators: two types- 'Guy' Insulators attach the long length wire; Reel Insulator through which wire runs freely

High tensile Galvanized steel wire of 12 -13 gauge (2.5mm)

Good earthing is provided by three or more 18-25 mm GI pipe 2m long set about 4m apart. Earthing is connected to the Energizer with a 8 gauge wire

A battery or solar powered Energizer which has a single insulated wire connected to the fence wires

No. and height of strands depends on the target species

## **PUBLIC PARTICIPATION IN PROTECTED AREA MANAGEMENT**

### **SANCTUARY ADVISORY COMMITTEE**

-vide Section : 33B of the WL (protection) Act

State Govt shall constitute an advisory Committee consisting of :

CWLW or local CF : Chair person

DFO / ACF i/c of the PA :Member Secretary

local MLA,

3 reps. from the Panchayat,

2 from NGOs,

3 WL conservationists,

1 from Vet. dept,

1 from Home ministry,

Hon. WLW

The Committee shall render advice on measures to be taken for better conservation and management of the Sanctuary including participation of people living in and around the Sanctuary

The Committee shall regulate its own procedure including quorum

## **CONSERVATION RESERVE MANAGEMENT COMMITTEE**

1 Forest officer(M.S)+1 from Panchayat+3 NGO+ 1 dept of Agri + 1 from dept of AH.

### **COMMUNITY RESERVE MANAGEMENT COMMITTEE**

5 from Panchayat/ Gram Sabha + Forest Officer

Committee prepare and implement M.P as well as protection of the C.R

Committee shall elect Chairman who shall be the Hon, WLW of the C.R

Eliciting Public Support,Politicians,Bureaucracy,Fringe villagers or Forest dwelling communities,Young people &Other citizens,A.V Aids, Media, Field visits,Literature and Field visits,Eco development ,Nature camps & Orientation classes,Environmental Education

### **Management Plan of the PA**

Management Plan of PA is an extension of the Wildlife Circle as well as the Protection Circle in regular Working Plan

#### **Part :I**

Present Scenario and the basic information

#### **Part : II**

Management Prescriptions

#### **Part : III**

Annexure and maps

Eco development Sub plan

Tourism sub plan.

### **GATHERING OF INFORMATION**

Information or data helps you to take right decisions and is a vital element in running an administration.

## **SOURCES OF INFORMATION**

- Office records and documents
- Staff, general public
- General publications (newspapers, magazines, telephone and business directories, etc.)
- Business and service agencies (banks, hotels, tax agencies, telephone, credit, insurance, etc).
- Law enforcement agencies (records of offences, arrests, court proceedings, investigative reports, gun registrations, fingerprints, traffic accidents etc.).
- Crime scene investigation.
- Informants ,Surveillance.

## **INFORMANTS**

- Who can be an informant?
- Any person is a potential source of information.
- Any personnel outside the department.
- An associate of the suspect - present / past.
- How do you categorize informants?
- Confidential informants:** Persons wishing to remain anonymous for various reasons.
- Public informants:** People who have no reservations about being identified as the source of information.
- Special employees:** Persons who are full-time informants working with your agency.

### **When to use an informant?**

- To conduct surveillance in areas where a law enforcement person cannot go undetected.

- To gather information from sources not readily available to you.
- To conduct controlled undercover negotiations.
- To testify for the government at legal proceedings.

-Observe what motivates the Informer

Fear

Revenge

Money

Personal Ego

Perversion

Repentance

Social commitment

-How does one develop an informer ?

1. Treat each and every person as a potential informant.
2. Understand the motivating factor for the informant and fulfill it.
3. Reassure the informant of the amount of protection that can be given. Do not make promise difficult to keep. Be honest.
4. Meet informant frequently at safe places. Maintain good rapport and trust.
5. Corroborate information given by informant and assign a credibility rating to the informant.
6. Be truthful and fair in all dealings with the informant.
7. Ensure protection of your informant.
8. A person will give information only if he feels safe.

## **GATHERING INTELLIGENCE**

- Setting up a system of information gathering, analysis and evaluation is the most important facet in anti-poaching or anti-smuggling.
- The collection of information must be carefully planned, coordinated, and directed against a specific target, or gaps in information. It must be reviewed at different stages of the process.
- Collection of information can be through investigators, law enforcement agency records and from other sources.
- Collection of information can be through physical or electronic surveillance, informants or undercover agents.
- Collection of data must be done in accordance with the laws of the land.
- All information must be verified by an independent source if possible .
- Strict confidentiality must be maintained.
- Analysis and plan counter-operation.
- Basic training in identification of species and products should be given.

## **UNDER COVER OPERATIONS**

Based on Intelligence information

Initiation

Operation

Booking the offenders

## **DEVISE A PROTECTION PLAN**

- Prepare a Protection / Anti-poaching Plan on the lines of a Working Plan.
- Lobby for filling up of vacancies, consider daily-wage personnel, local villagers.
- Provide basic amenities to staff of anti poaching squad and their families like arranging school facilities for children, special financial incentives, rotational posting.
- Request the help of NGOs and Hon. WL Wardens .

- Train staff in arms handling, ambush and counter-ambush, interrogation, undercover operations, identification of species, and litigation.
- Requisition for adequate arms and ammunition. Work out annual replacement schedules.
- Check layout and maintenance of fixed and mobile units. Even NGOs and donor agencies may provide the same
- Shift patrolling duties so that every staff member is acquainted with entire terrain.
- Establish an Intelligence network.
- Set up specific patrol parties.
- Work out system to ensure timely fund flow.
- Hold village meetings, consider setting up village patrols, consult your Honorary Wildlife Warden.
- Cultivate media at regional and national level by feeding them news and talking to them.
- Cultivate officers in charge and request specific help. Offer the assistance of your agencies wherever possible.
- Utilize the services of NGOs to make courts and magistrates aware.

### **Patrolling Plan**

- A patrolling plan must be drawn up by each Range Officer on a monthly basis or on a pre-decided frequency.
- Plot the plan onto a topographical sheet of the area.
- The plan can follow the demarcations of a range, section and beat, with the range officer, forester and specified forest guard in charge of each area.
- Patrolling paths should ideally be plotted in a random manner. In areas where this is not possible, paths already made by man or animal may be used.

- Patrolling paths must be varied regularly. This may be based on a random choice to maximize coverage, or based specifically on intelligence reports.
- A minimum of three persons per patrol is necessary for effective challenge in case of an encounter.
- If manpower is insufficient, reduce number of patrols and shift paths more frequently. Do not reduce number of persons in a patrol party.
- The patrol path must be plotted so that communication with nearby check posts, guard huts or the main headquarters is possible at any given time. Ideally, walkie-talkies should be provided to each team.
- If this is not possible, construct protection camps or check posts so that patrol parties are always within a couple of kilo metres from a check point.
- In case of interior areas, communication equipment is essential.
- Train patrolling parties in camouflage, ambush etc. Arms training must be regularly refreshed and practised.
- Daily patrol findings must be logged in a patrol book kept at the Section/beat office.
- This must be submitted to the range office at regular intervals for analysis and to plan new patrol routes and strategies.
- Rotate patrol parties at regular intervals.
- Liaise with local villagers during a patrol to gain information and their confidence.

### **Use and Care of Arms**

- Never forget that even the safest weapon can be dangerous to you and others if not handled correctly. Before handling any weapon, insists for training by experts
- Thoroughly familiarize with its functions and handling procedures by carefully reading the instruction manual.
- Always handle an unloaded weapon as if it were loaded.

- Keep your finger off the trigger until you actually wish to fire the gun.
- Whether loaded or unloaded, do not point the weapon at anyone. The barrel should always face the ground or the sky when not in use.
- Never use force when using, cleaning or assembling a weapon.
- Only weapons in perfect working order are safe to use.
- Always have your firearm inspected by a qualified gunsmith if it has suffered from corrosion, other external damage or if it has been dropped

### **Maintenance of Fire arms**

- Mostly, 12 Bore guns( either double barrel or single) are used; In WL areas, Rifles like .22 or 313 or even SLR are provided
- A monthly maintenance drill is essential for proper upkeep of the firearm.
- Before going out on patrol, wipe the barrel out with a dry flannel cloth as well as a Gun cleaning rod.
- After firing, clean the barrel thoroughly with a flannel cloth, then apply a thin film of ' machine oil' to the bore. Lubricate the action slightly.
- During periods of high humidity keep the gun dry by wiping it frequently to avoid rusting. Apply thin layer of lubricant as waterproofing.
- Wipe again with a rod-flannel if oil is applied inside the barrel.
- Always keep a screwdriver, flannels and gun oil at hand.
- Inspect barrel for mud deposition.
- Check fit of barrel into butt to avoid misfires, backfires or bursts.
- Do not drag the firearm in the mud while on patrol. The gun should always be on the shoulder and should never be used to clear obstacles.

### **Anti poaching checklist**

1. Is an anti-poaching plan in place?

Prepare an anti-poaching plan on the lines of a working plan.

2. Do you have enough men to effectively patrol the area?

Fill sanctioned posts, lobby for more posts, consider daily-wage personnel or local trusted villagers.

3. Is the motivation level high enough for maximum effectiveness?

Provide basic amenities to staff and plan specific morale building exercises. Request NGOs and HWLWS to help.

4. Are the staff trained in all aspects of anti-poaching and follow-up?

Train staff in arms handling, ambush and counter-ambush, interrogation, undercover operations, identification of species, and litigation.

5. Are the staff well armed?

Requisition for adequate arms and ammunition. Work out annual replacement schedules.

6. Is the existing communication system adequate?

Check layout and maintenance of fixed and mobile units. Request NGOs and donor agencies for help.

7. Are vehicle numbers sufficient?

Check number, maintenance and appropriateness. Request NGOs and donor agencies for help.

8. Are staff acquainted with terrain?

Shift patrolling duties so that every staff member is acquainted with entire terrain.

9. Is an intelligence network in place?

Establish a network.

10. Is the area regularly patrolled?

Set up patrol parties.

11. Is the flow of funds to the lowest level smooth and timely?

Work out system to ensure timely fund flow.

12. Are the local villagers being used in anti-poaching ?

Hold village meetings, consider setting up village patrols, consult your Honorary Wildlife Warden.

13. Is the media on your side?

Cultivate media at regional and national level by feeding them news and talking to them.

14. Are the local police stations, customs unit, army unit helping you?

Cultivate officers in charge and request specific help. Offer the assistance of your agencies wherever possible.

15. Are the local magistrates and courts sympathetic?

16. Do you have good links with NGOs?

Cultivate local, regional and national NGOs and work with them.

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### **Reference & Suggested Reading**

1. Manual of Wildlife Techniques for India-**J.B. Sale & K. Berkmuller**
2. Fundamentals of Wildlife Management-**Rajesh Gopal**
3. Managing Protected Area in the tropics-**Mc. Kinnon & Mc. Kinnon**
4. A field manual of techniques for wildlife census in India-**W.I.I**
5. Wildlife in India-**V.B. Saharia**
6. The Wildlife of India-**E.P.Gee**
7. Wildlife in India- Its conservation & control-**P.D.Stracy**
8. A review of Wildlife management-**James. M. Peck**
9. Wildlife biology-**R.F. Dasmann**
10. Wildlife Management Techniques-**R.H. Giles**
11. Ecology and Conservation Biology-**R L Smith**
12. Planning a Protected Area Network for India-**W.A. Rodgers & H.S.Panwar**
13. National Wildlife Action Plan-**Govt of India**
14. **Conventions on Biodiversity-CBD Report**
15. National Biodiversity Action Plan- **Govt of India**
16. World Conservation Strategy-**UNEP**
17. A manual for the management planning of Protected areas and  
Managed Forests-**V. B. Sawarkar**
18. A manual for the ecodevelopment planning of Protected areas-**W I I**
19. An introduction to Animal Behaviour- **Krebs and Davies**
20. Ecotourism: A guide for Planners and Managers- **Lindberg**
21. Game Management- **Aldo Leopold**
25. Wild Animals in Central India- **Dunbar Brander**
26. The Book of India Animals- **S.Z. Prater**

27. The Book of Indian Birds- **Salim Ali**
28. The Book of Indian Reptiles and Amphibians-**J.C. Daniel**
29. Handbook of Birds of India & Pakistan -10 Vols. Or Compact  
Edition-**Salim Ali & S. Dillon Ripley**
30. Birds of Indian Subcontinent- **Grimett, Inskipp and Inskipp**
31. A pocket guide to the Birds of Indian Subcontinent  
**-Grimett, Inskipp and Inskipp**
32. A field guide to the Birds of India- **Krys Kazmeirkzac**
33. **Collins** guide to the Birds of Indian Subcontinent
34. Butterflies of the Indian Region - **M.A. Wynter Blyth**
35. Butterflies of Sikkim Himalayas- **Meena Haribal**
36. The Deer and the Tiger- **George B. Schaller**
37. Man-eaters of Kumaon - **Jim Corbett**
38. Temple Tiger
39. My India
40. Man eating Leopard of Rudraprayag
41. Jungle Lore
42. Tree Tops
43. In the Tiger Land With Camera - **F.W. Champion**
44. Indian Wildlife Insight Guide
45. Mountain Monarchs- **George Schaller**
46. Stones of Silence – **George Schaller**
47. In Danger -**Ranthambhor Foundation.**

# **ANNEXURES**



# भारत का राजपत्र The Gazette of India

असाधारण

EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (ii)

PART II—Section 3—Sub-section (ii)

प्राधिकार से प्रकाशित

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पर्यावरण एवं वन मंत्रालय

अधिसूचना

नई दिल्ली, 7 जनवरी, 2009

का.आ. 120(अ).—जैव-विविधता अधिनियम, 2002 (2003 का 18) की धारा 61 के खण्ड (क) द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, केन्द्र सरकार एतद्वारा दिनांक 17 नवम्बर, 2008 की अधिसूचना संख्या का.आ. 2708 (अ) में आगे निम्नलिखित संशोधन करती है, नामतः :—

उपर्युक्त अधिसूचना में :—

तालिका में क्रम सं. 3, क्रम सं. 4 और उनके कॉलम सं. 2 और 3 में की गई अनुरूपी-प्रविष्टियों के बाद निम्नलिखित को न्तः स्थापित किया जाएगा, नामतः :—

| क्रम सं. | जैव विविधता अधिनियम, 2002 की धारा 61 (क) के अंतर्गत शिकायत दर्ज करने के लिए प्राधिकृत अधिकारी | अधिकार क्षेत्र                    |
|----------|-----------------------------------------------------------------------------------------------|-----------------------------------|
| (1)      | (2)                                                                                           | (3)                               |
| 4.       | वन अधिकारी जो रेंज ऑफिसर के रैंक से कम न हों                                                  | उनके अपने-अपने अधिकार क्षेत्र में |

[फा. सं. 28-14/2008-सीएस-III (एन बी ए)]

ए. के. गोयल, संयुक्त सचिव

टिप्पणी : मूल अधिसूचना दिनांक 17 नवम्बर, 2008 की अधिसूचना सं. का.आ. 2708(अ) के तहत भारत के राजपत्र, असाधारण में प्रकाशित की गई थी।

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 7th January, 2009

S.O. 120(E).—In exercise of the powers conferred by clause (a) of Section 61 of the Biological Diversity Act, 2002 (18 of 2003), the Central Government hereby make the following further amendments in the Notification No.S.O. 2708 (E), dated 17th November, 2008 namely :—

In the said Notification :—

In the TABLE, after Sl.No. 3, Sl.No. 4 and the corresponding entries in column No. 2 & 3 thereof, shall be inserted, namely :—

| Sl.No. | Officer authorised to file complaints under Section 61 (a) of the Biological Diversity Act, 2002 | Area of jurisdiction              |
|--------|--------------------------------------------------------------------------------------------------|-----------------------------------|
| (1)    | (2)                                                                                              | (3)                               |
| 4.     | Forest Officers not below the rank of Range Officers                                             | In their respective jurisdictions |

[F.No. 28-14/2008-CS-III (NBA)]

A. K. GOYAL, Jt. Secy.

Note : The Principal Notification was published in the Gazette of India, Extraordinary vide Notification No. S.O. 2708 (E), dated 17th November, 2008.

## MINISTRY OF ENVIRONMENT AND FORESTS

## NOTIFICATION

New Delhi, the 17th November, 2008

**S.O. 2708(E).**—In exercise of the powers conferred by clause (a) of Section 61 of the Biological Diversity Act, 2002 (18 of 2003), the Central Government hereby authorises the officers specified in column (2) of the Table below, to file complaints with regard to offences punishable under the said Act, within the areas of jurisdiction specified against each in the corresponding entry in column (3) of the Table aforesaid, subject to the condition that the Central Government may revoke such authorisation or may itself exercise the powers under the said section, if in its opinion such a course of action is necessary in the public interest, namely :—

TABLE

| Sl. No. | Officers authorised to file complaints under Section 61(a) of the Biological Diversity Act, 2002                                       | Area of Jurisdiction                                                           |
|---------|----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| (1)     | (2)                                                                                                                                    | (3)                                                                            |
| 1.      | Officers of the National Biodiversity Authority, not below the rank of Scientist 'C'                                                   | Whole of India                                                                 |
| 2.      | Officers of the State Biodiversity Boards, not below the rank of Scientist 'C'                                                         | Whole of the concerned State                                                   |
| 3.      | Officers of the Regional Offices of the Ministry of Environment and Forests, Government of India, not below the rank of Scientist 'C'. | Whole of the States under the jurisdiction of the respective Regional Offices. |

[F. No. 28-14/2008-CS-III (NBA)]

A. K. GOYAL, Jt. Secy.

## Mangrove sites in India

| State/Union Territories | Mangrove Sites                                                                                                                                                                                |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| West Bengal<br>Orissa   | 1. Sunderbans<br>2. Bhaitarkanika<br>3. Mahanadi<br>4. Subernarekha<br>5. Devi<br>6. Dhamra<br>7. Mangrove Genetic Resources Centre<br>8. Chilka                                              |
| Andhra Pradesh          | 9. Coringa<br>10. East Godavari<br>11. Krishna                                                                                                                                                |
| Tamil Nadu              | 12. Pichavaram<br>13. Muthupet<br>14. Ramnad<br>15. Pulicat<br>16. Kazhuveli                                                                                                                  |
| Andaman & Nicobar       | 17. North Andamans<br>18. Nicobar                                                                                                                                                             |
| Kerala                  | 19. Vembanad<br>20. Kannur (Northern Kerala)                                                                                                                                                  |
| Karnataka               | 21. Coondapur<br>22. Dakshin Kannada/Honnavar<br>23. Karwar<br>24. Manglore Forest Division                                                                                                   |
| Goa                     | 25. Goa                                                                                                                                                                                       |
| Maharashtra             | 26. Achra-Ratnagiri<br>27. Devgarh-Vijay Durg<br>28. Veldur<br>29. Kundalika-Revdanda<br>30. Mumbra-Diva<br>31. Vikroli<br>32. Shreevardhan<br>33. Vaitarna<br>34. Vasai-Manori<br>35. Malvan |
| Gujarat                 | 36. Gulf of Kutchh<br>37. Gulf of Khambhat<br>1. Dumas-Ubhrat                                                                                                                                 |
| <b>Coral Reef Sites</b> |                                                                                                                                                                                               |
| Gujarat                 | 1. Gulf of Kutch                                                                                                                                                                              |
| Tamil Nadu              | 2. Gulf of Mannar                                                                                                                                                                             |
| Andaman & Nicobar       | 3. Andaman and Nicobar Coral Reef                                                                                                                                                             |
| Lakshadweep             | 4. Lakshadweep Coral Reef                                                                                                                                                                     |