Practical Manual

Wildlife Management

FWM-437 2 (1+1)

Dr. Dipika Ayate

2020

College of Horticulture & Forestry
Rani Lakshmi Bai Central Agricultural University
Jhansi-284003

Wildlife Management Practical FWM 437 2(1+1): Exercise on the census methods - direct method - total count, block count, water hole count, capture - recapture method, point transect, and line transect method – use of soft ware for analysis. Exercise on the census methods - indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for other ungulates. Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife. Direct and indirect methods of studying food habits of different wildlife. Studying habitat management and manipulation techniques. Wildlife damage and control: Questionnaire survey. Wildlife photography.

Name of Student.....

Roll No. .....

Batch.....

Session.....

Semester.....

Course Name: .....

Course No. : .....

Credit.....

Published: 2020

No. of copies: ……..

Price: Rs.

CERTIFICATE

This is to certify that Shri./Km. .....ID No.....has completed the practical of course.....course No. ..... as per the syllabus of B.Sc. (Hons.) Forestry ..... semester in the year.....in the respective lab/field of College.

Date: Course Teacher

INDEX

Practical No. 1

Objective: To study different zoogeographic regions of world

1. Write down Different zoogeographic regions of world

Palaearctic region: ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Nearctic region:

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Neotropical region:

……..……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Oriental region:

……..……

……

……

……

……

……

……

……

……

……

……

……

……

……..……

Ethiopian region: ……..……

……

……

……

……

……

……

……

……

……

……

……

……

……

Australian region: ……

……

……

……

……

……

……

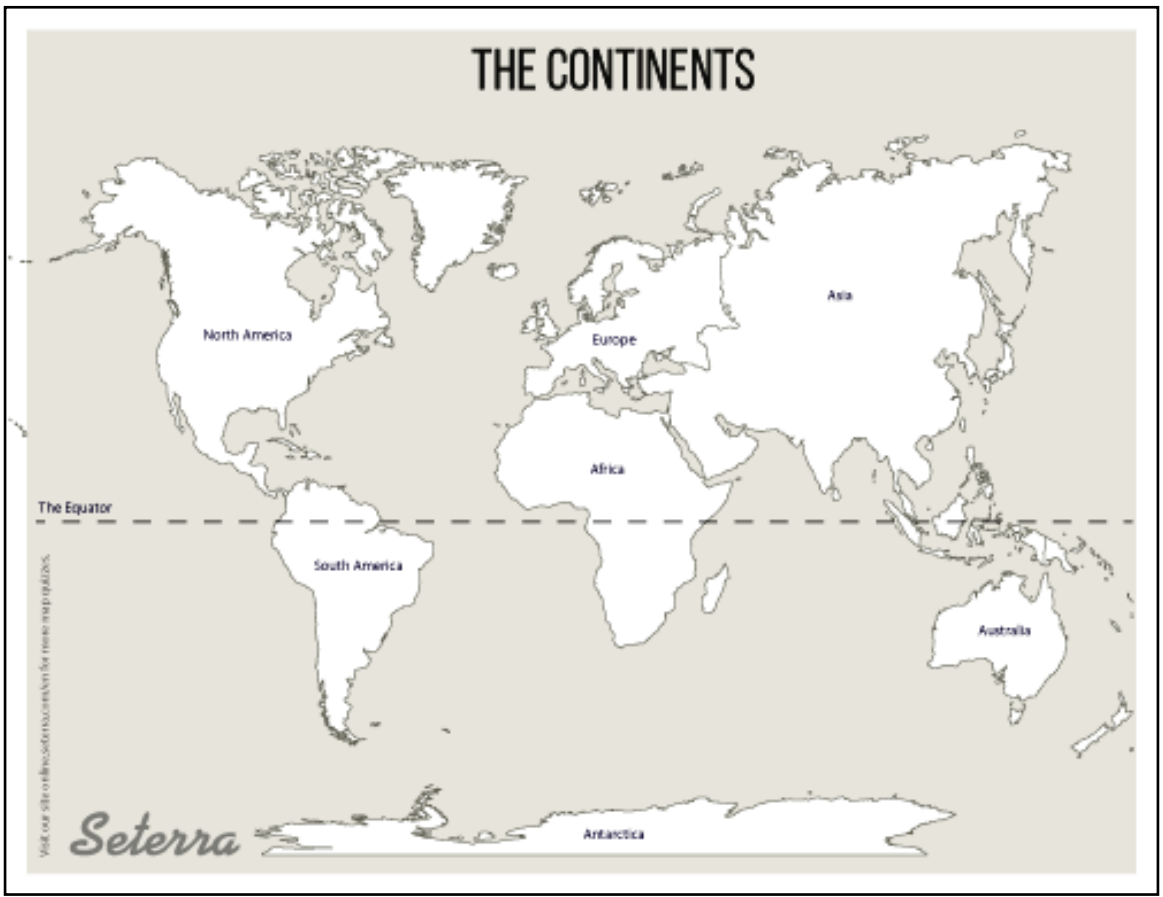
……

……

……

……

2. Depict the locations of zoogeographic regions on world map



Practical No. 2

Objective: To Study the IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned

1. Write down about IUCN red list: ……

……

……

……

……

……

……

……

……

……

……

2. Write down about the IUCN red list categories

Extinct: ……

……

……

……

……

……

……

……

Extinct in the wild: ……

……

……

……

……

……

Vulnerable: ……

……

……

……

……

……

……

Near Threatened: ……

……

……

……

……

……

……

……

Least concerned: ……

……

……

……

……

……

……

3. Give the details in following table

S. N.	Name of wild animal	Scientific name	IUCN category
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Practical No. 3

Objective: To study different biogeographic regions of India

1. Give the details about different biogeographic regions of India in table

S. N.	Biogeographic regions	Provinces
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2. Depict biogeographic regions of India on map

Practical No. 4

Objective: To study Wildlife Census purpose and techniques

1. Write down types of wildlife census purpose: ……

……

……

……

……

……

……

……

……

2. Write down wildlife census techniques

Total count: ……..……

……

……

……

……

……

……

……..……

……

……

……

……

……..……

Sampling: ……

……

……

……

……..……

……

……

……

Practical No. 5

Objective: To study wildlife census direct method - Total count, block count and water hole count

1. Write down types of wildlife census methods ……

……

……

……

……

……

……

……

2. Give detail about total count ……

……

……

……

……

……

……

……

3. Block count ……

……

……

……

……

……

……

……

4. Water hole count ……

……

……

……

……

……

……

Practical No. 6

Objective: To study Capture – Mark Recapture method, drive count and roadside count method

1. Write down complete procedure of Capture – Mark-Recapture method ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

2. Drive count method

……

……

……

……

……

……

……

……

……

……

.....

.....

.....

.....

.....

3. Roadside count method

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Practical no. 7

Objective: To study point transect and line transect method

1. Write down point transect method ……..……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

2. Line transect method

……

……

……

……

……

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Practical No. 8

Objective: To study dung count method

1. Write down procedure of dung count ……

Practical No. 9

Objective: To study pugmark census method

1. Write down complete procedure of pugmark census ……………………………………………………

………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………
………

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

2. Draw pugmark of tiger

Practical No. 10

Objective: To study pitfall trap and mist net method

1. Write down pitfall method for census ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

2. Write down mist netting method ……

……

……

……

……

……

……

……

2. Draw a diagram of pitfall

Practical No. 11

Objective: To study Sherman trap and camera trap method

1. Write down Sherman trap method ……………………………………………………………………………………
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

2. Write down camera trap method ……………………………………………………………………………
……
……
……
……
……
……
……
……
……
……
……
……

……

……

……

……

……

3. Other traps method ……

……

……

……

……

……

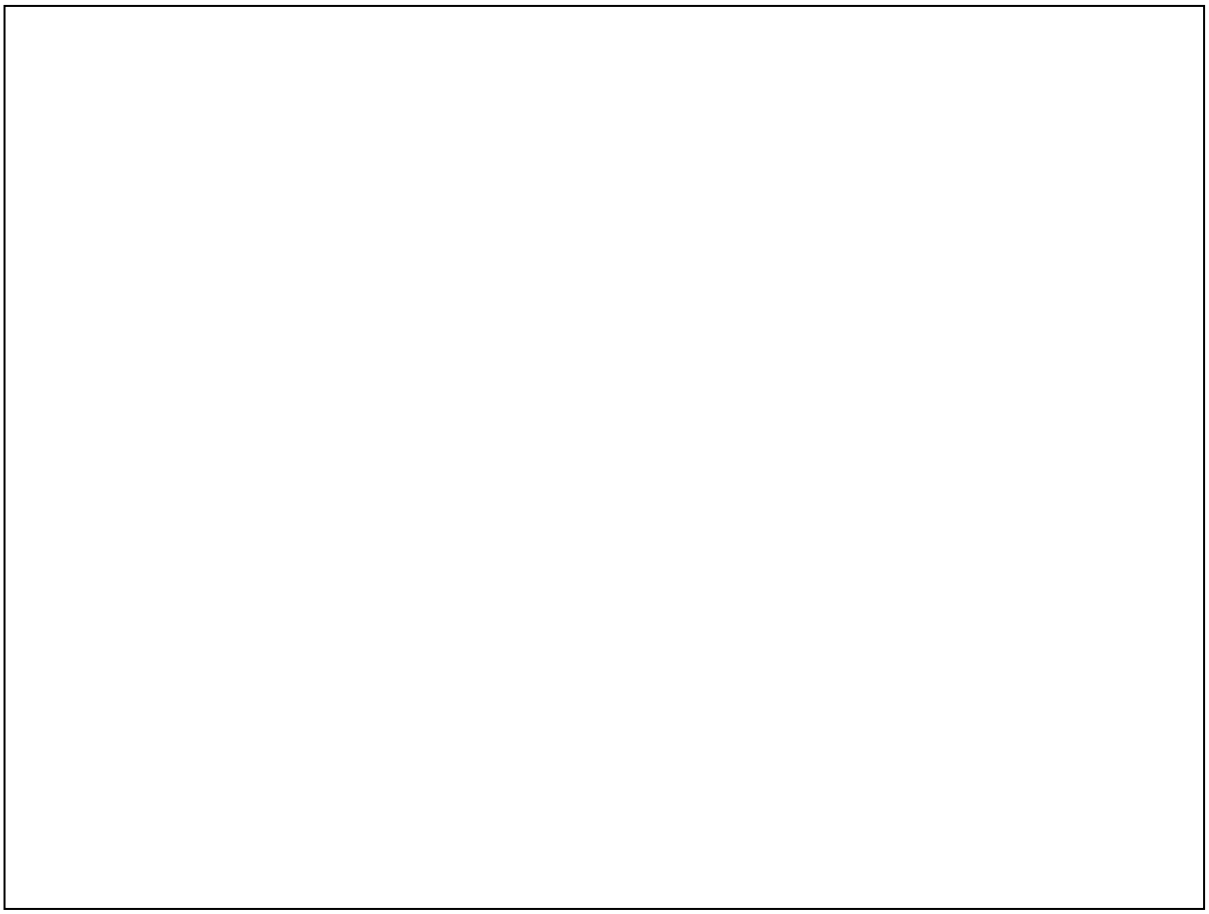
……

……

……

……

4. Draw Sherman trap and camera trap



Practical No. 12

Objective: To study wild animals by using telemetry - transmitters, receivers, visual tagging and marking

1. Radio telemetry or very high frequency radio tracking ……

……

……

……

……

……

……

……

……

……

2. List out instruments required for radio telemetry ……

……

……

……

……

……

……

……

……

……

……

……

……

……

3. Give different tracking methods ……

……

……

……

……

……

……

Practical No. 13

Objective: To study direct and indirect methods of studying food habits of different wildlife

1. Write down direct method of studying food habits of different wildlife animals

2. Write down indirect method of studying food habits of different wildlife animals

Practical No. 14

Objective: To study captive breeding method for ex-situ conservation of wildlife animals

1. Write down ex situ conservation method ……

……

……

……

……

……

……

……

2. Write captive breeding method ……

……

……

……

……

……

……

……

……

……

……

……

……

……

3. List out captive breeding program conducted by India

S. N.	Name of wild animal	Program name
1		
2		
3		
4		
5		

Practical No. 15

Objective: To study habitat management and manipulation techniques

1. Write down habitat management and manipulation techniques …………………………………………

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Practical No. 16

Objective: To study wildlife damage and control: Questionnaire survey

1. Write down the damages caused by wild animals

……

……

……

……

……

……

……

……

……

……

……

……..

……

……

……

……

……

……

2. Conduct small survey on damage by wildlife to agricultural land and village nearby wildlife sanctuary/ National park and give the following answers

i) Name of forest

……

……

……

ii) Total area ……

……

……

iii) Name of village near forest area

……

……

iv) Zone name

……

……

v) Give the names of wild animals caused frequent damage to agricultural crops ……

……

……

vi) Give the name of wild animals cause damage to village peoples ……

……

……

vii) Due to frequent grazing by domestic animals damage cause or not ? ……..

viii) Control measures by forest department

……

……

……

……

……

……

……

……

……

……

viii) Control measures by local authority ……

……

……

……

……

……

……

……

……

……

……

Practical No. 17

Objective: To study wildlife and their diseases

1. Write down disease names and their control measure ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

2. Write some important diseases found in wild animals

S. N.	Disease	Causal organism	symptoms	Susceptible animals	Control measures
1					
2					
3					
4					
5					

6					
7					
8					
9					
10					

Practical No. 18

Objective: To visit nearby wildlife Sanctuary/ National Park

1. Write down details of the following

i) Name of site ……

……...

ii) Visiting date and time ……...……

……...…

iii) Type of Forest ……..……

……...…

iv) Area ……

……

v) Natural water body present or absent/ artificial water holes present or absent ……..……

……...……

……..

vi) Elephant safari present or absent ……

……..……..

vi) List out the equipments carried for observation of wild animal ……

……

……

……

……

……

……

……

……

……

……

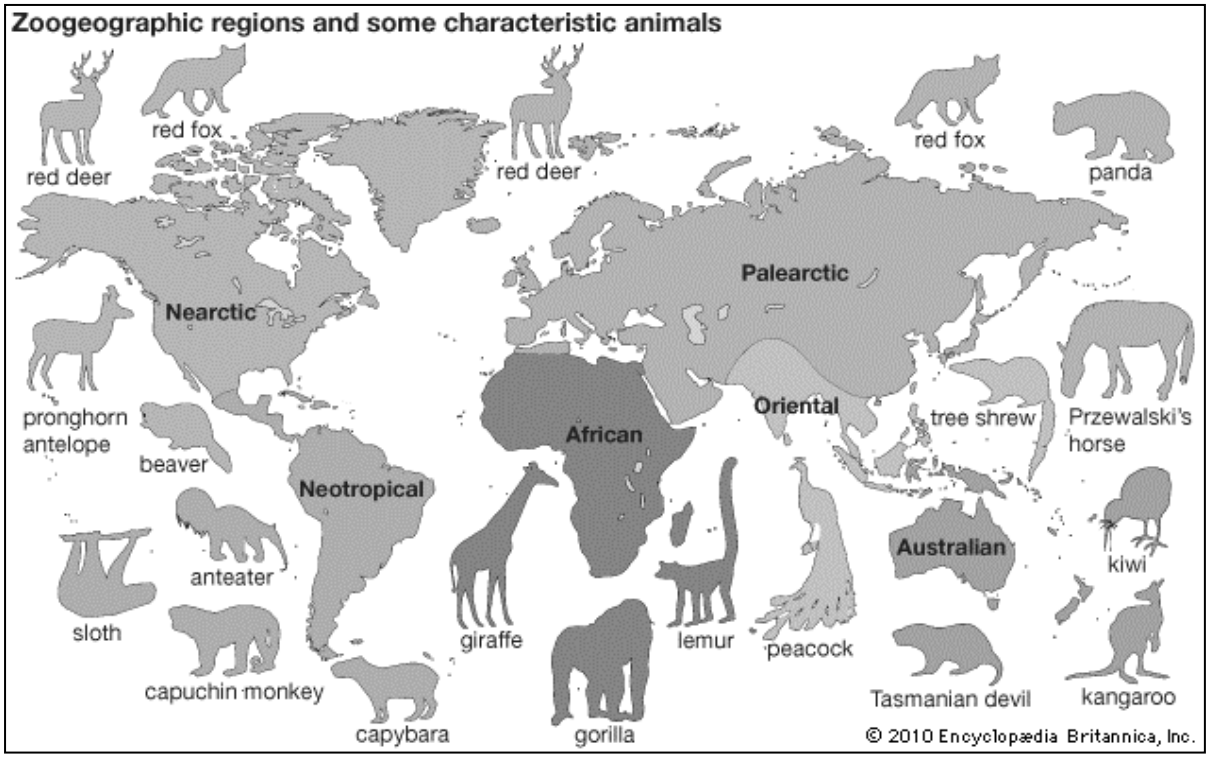
1. List out wild animals and present in sanctuary/ national park

S. N.	Name	Scientific name	Food habit
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

ZOOGEOGRAPHIC REGION

Zoogeographic Region which can be defined by the geographers on the basis of distinctive animal life. The leading ecologist and environmentalist A.R. Wallace attempted to classify the world animals into fauna regions in 1876. Since then, a number of attempts have been made by the ecologists to delineate the faunal regions of the world. The experts divide the world into the following faunal regions.

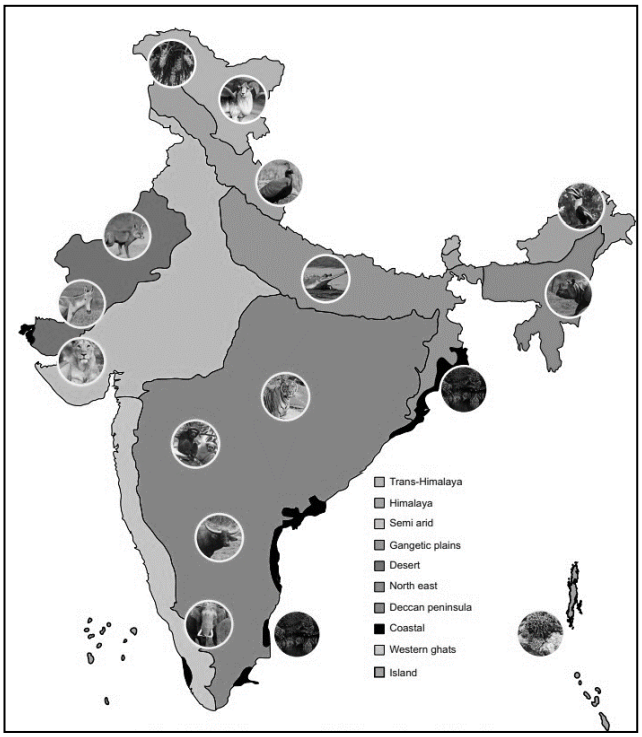
1. **Palaearctic Region:** This faunal region stretches over the greater parts of Europe and Eurasia, north of Himalayas. This faunal region includes 136 families of vertebrates, 100 genera of mammals, 174 genera of birds. The important animals of this region are Russian desmans, arctic-fox, arctic-hare, caribou, reindeer, polar bear; Mediterranean moles, rats, saiga and chiru antelope, ancestors of crocodiles, lizards, moose, mole, deer, lemming, musk-fox, Lynx, wild-ass, horse, camel, hamster, jackal, etc., red-fox, black bear, hedge-hog, jerboa, cotton-tail etc.
2. **Nearctic Region:** This faunal region sprawls over North America, Greenland and the Canadian Islands west of Greenland. This is also known as the Arctic Fauna Region. The main animals of this region include deer, lynx, mouse, mules, wolf; bison, jack-rabbit, prairie-dog, gopher, fox; lizards, snakes, kangaroo, jerboa, hamster, hedgehog, cotton-tail, etc.
3. **Neotropical Region:** The neotropical regions consists South America, Central America, tropical low land of South Mexico and West Indies. The general climatic condition is tropical; the southern part of South America has temperate zone. Due to the tropical climate, extensive evergreen forests are found in the Amazon Valley while in Argentina and Saveinna tracts have drier patches and in the Western South America sub-desert conditions are found.
4. **Oriental Region**: The oriental region sprawls to the south of Himalayas in South and South-East Asia. Climatically this region falls in the tropical climate. This faunal region represents 164 families of vertebrates, 118 genera of mammals and 340 genera of birds. The main animals of this faunal region are Indian-elephants, rhino, several species of deer, antelopes, tigers, lizards, snakes, gibbons, monkeys, sun-bear, stag, tree-shrew, etc.
5. **Ethiopian Region:** This faunal region stretches over the greater parts of the continent of Africa, excluding the Mediterranean region. It also covers the adjacent islands like Madagascar. This region represents 174 families of vertebrates, 140 genera of mammals, and 294 genera of birds. The main animals of this region include springbok, jerboa, zebra, gnu, giraffe, elephant, ostrich, lions, cheetah, gorilla, chimpanzee, monkey, forest elephants, etc.
6. **Australian Region**: The Australian region stretches over the continent of Australia, New Zealand, New Guinea and the adjacent islands. There are 141 families of vertebrates.



World map with zoogeographic regions and some animals

BIOGEOGRAPHIC REGIONS OF INDIA

Biogeographic zones	Biotic provinces
Trans-Himalayas	Ladakh mountain, Tibetian plateau
Himalaya	Northwest, West, Central and East Himalayas
Dessert	Thar, Kutch
Semi-arid	Punjab plains, Gujarat, Rajputana
Western-ghats	Malbar plains, Western ghat
Deccan peninsula	Central highlands, Chotta Ngapur, Eastern highlands, Central plateau, Deccan South
Gangetic plains	Upper and lower gangetic plains
Coast	West and East coast, Lakshwadweep
North-East	Brahmputra valley and Northeast hills
Islands	Andaman and Nicobar

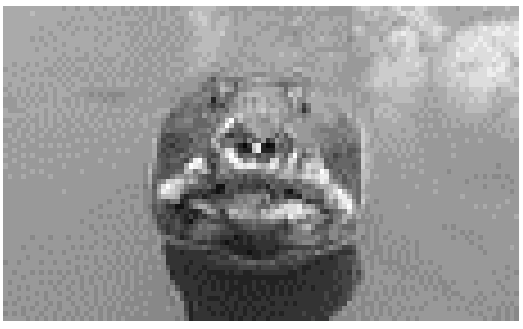


IUCN International Union for Conservation of Nature (IUCN) (1996): (IUCN) Red List or Red Data List) is founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. With its strong scientific base, the IUCN Red List is recognized as the most authoritative guide to the status of biological diversity.

Extinct: Extinction of a particular animal or plant species occurs when there are no more individuals of that species alive anywhere in the world - the species has died out. This is a natural part of evolution e.g., Dodo bird, blue whale, giant panda.

		
Giant panda	**Dodo bird**	**Blue whale**

Extinct in the wild : A species that is extinct in the wild (EW) is one that has been categorized by the International Union for Conservation of Nature as known only by living members kept in captivity or as a naturalized population outside its historic range due to massive habitat loss e.g., Black soft shell turtle, South China Tiger

	
South China Tiger	**Black soft-shell turtle**

Vulnerable : A vulnerable species is a species which has been categorized by the International Union for Conservation of Nature as likely to become endangered unless the circumstances that are threatening its survival and reproduction improve. Vulnerability is mainly caused by habitat loss or destruction of the species home. Vulnerable habitat or species are monitored and can become increasingly threatened. Some species listed as "vulnerable" may be common in captivity, an example being the military macaw.

Near threatened: A taxon is Near Threatened (NT) when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least concern: A **least-concern species** is a species that has been categorized by the International Union for Conservation of Nature (IUCN) as evaluated as not being a focus of species conservation. They do not qualify as threatened, near threatened, or (before 2001) conservation dependent. Species cannot be assigned the "Least Concern" category unless they have had their population status evaluated. That is, adequate information is needed to make a direct, or indirect, assessment of its risk of extinction based on its distribution or population status.

WILDLIFE CENSUS

Many wildlife studies carry out to record the presence or absence of species in particular area and used to prepare the distribution of list of a particular species. Sometimes the presence of certain threatened species is also located through the studies. These studies are helpful to prepare checklist of flora and fauna of a study area. It has some drawbacks due to simplicity of giving presence or absence of particular flora and fauna to particular area. Estimating the population size or density of flora and fauna is one of the fundamental aspects to understand their status and demography of species. Resource inventory is a pre-requisite for any management process. This holds good for wildlife management too. Practice of making inventory is not new to the forest department. Scientific management of forests in our country started in the late 19th century with preparation of working plans for the forests. List of plants and animals found in an area was carefully documented in the working plans and were updated regularly during the plan revisions. Wildlife received the much-needed attention and the practice of managing areas exclusively for wildlife started growing across the world. This led to the systematic inventory making of the wildlife resources at all levels (from a protected area to national to global level). Along with this, attempts were made to estimate the population of a species in an area. This process of estimating the population of a species/animal community is called as census.

Census started with simple counting of all individuals of a species in area to more complex methods involving statistical analysis. For a manager, is this number regarding a species enough? Not really, additional information about the population structure like age class and sex ratio helps the manager in proper decision making. Is information about just a species enough? Obviously No, because they live in communities along with various other species; all are inter-dependent and collectively they influence the ecosystem. This necessitates collecting information on all major species so that by appropriate management interventions, they can be perpetuated for posterity. Further, the number of animals occupying a place too varies by season. Hence, census of animals in an area is not conducted as one-time affair but done a periodical basis. Census can be either conducted by direct counting or by indirect counting methods. In the direct count method, the individuals are seen and counted whereas in indirect count method evidences left by animals are recorded to estimate the population.

1. **Direct Count Method:** Under the direct count method either all the animals present in an area can be counted (total count) or can be done by sample counts. Sampling could vary from a simple random sampling to complex stratified sampling. Counting all the animals in area particularly large tracts involves lot of resources and hence should be avoided. Among the direct count method Vehicle transect and King's census method is widely used in India.

   Complete census is usually done to count the total number of animal present over a specified area to obtain correct and estimate of their abundance without any statistical interferences or underlying assumptions. This technique is often very much labor intensive and is suitable only for conspicuous species usually present in open, discrete and well-defined habitats.

   i. **Vehicle Transect or Road Count Method:** Vehicle transect involves counting of animals on roads by travelling in a vehicle at a fixed speed and during a fixed time. The distance for such transects is fixed and the counting is done on the transect regularly.

Density of the animal is calculated using the formula given below:

$$\text{Density of Animal} = \frac{\text{Number of animals sighted}}{\text{Lenght of transect} \times \text{Width of transect}}$$

When the density figures of corresponding period are compared, they give a clear picture about the trend of the population. Say density of Peacock calculated in the month of April should be compared with the density figure of April the next year to arrive at a reasonable conclusion regarding the population trend. Transects should be placed in such a way that they cover

all types of ecosystems found in an area. Adequate number of transects should be placed to capture the real picture of the area.

ii. **King's Census:** Under the King's census, data regarding sighting of animals is collected from transects by the observers walking on transects. Transects are laid to cover all the ecosystems present in an area. Any single transect laid should as far as possibly cut across all the vegetation type/ecosystem. If there are grasslands, shrub land and forests, then the transect should run through all these three-vegetation type and not just one. An observer along with one more person walks on the transect preferably in the early morning hours and record all the sightings on the transect with the angle of sighting and distance (angular distance). With the angular distance and angle of sighting the perpendicular distance of animals from the transect line is calculated. This perpendicular distance is used in calculating the area of the transect walked. The density of animals is calculated with the use of the formula. Width of the transect could be varying like the one illustrated above or may be fixed. In the fixed width transect (generally done in areas with good ground visibility), the width of the transect is fixed and the observations beyond the fixed width is not recorded. Density calculated for a particular transect is then extrapolated for similar areas to arrive at density figures for the entire area.

2. **Indirect Count Method:** The pug mark technique is one of the indirect count method still widely used in our country for estimation of larger carnivores like tiger and leopard. Generally, Pellet count method is used to estimate the ungulate density in most of the protected areas in our country. Under pellet count method, pellet groups are counted in sample plots preferably laid out on the transects (laid for conducting King's Census) and the density of the animals (species wise is estimated) is calculated with the data collected on the number of pellet groups. Information on defecation rate for animal surveyed, knowledge on pellet size and pellet rate in a day is required.

3. **Other Methods:** Apart from the methods discussed above there are certain methods which are not included in the direct or indirect count method viz.: i. Water hole census ii. Capture-recapture method

   i. **Water Hole Census:** In absence of trained and experienced staff, generally "Water Hole Census" is conducted to estimate the densities of animals. In this method, observations on sighting are collected at water holes (during summer) for 24 hours preferably from 6 PM to 6 PM on full moon days. The basic assumptions made in this method are that every animal has an equal opportunity to visit a water hole and every animal drinks water at least once in a day. Number of animals sighted are counted and recorded throughout the 24 hours and later on, the data is compiled species wise to arrive at the density figures. This method also gives an index or trend regarding the population and not the estimate of the population. If information on frequency of water consumption by animals for the area is collected, the figures compiled can be corrected for the repeat visitors and the trend can be refined a little. This is one of the easiest methods and with little training (along with volunteers from colleges, NGO's, etc.) even the illiterate staff can collect some useful information. For these reasons, this is the most popular method in many parts of our country.

   ii. **Capture-Recapture Method:** This is neither a direct method nor indirect method but a combination of certain elements from both. This method is used in monitoring works of turtles, tortoises, crocodiles, birds, etc. First, certain numbers of animals are captured, marked and released. Second, again some animals are captured from the same area and checked for the marked animals.

   From the ratio of the marked and unmarked animals an estimate regarding the population can be made using the following formula:

$$\frac{\mathbf{N\ (Population\ Size)}}{\mathbf{S\ (No.\ of\ animals\ captured\ \&\ marked)}} = \frac{\mathbf{n\ (Number\ of\ animals\ captured)}}{\mathbf{s\ (Number\ of\ animals\ marked\ earlier)}}$$

Sample and total counts, indices, encounter rates and densities, block counts, road side counts, dung counts, pug mark census, water hole census, line transect

There are three main methods for counting wildlife. 1. Total counts 2. Sample counts 3. Index counts.

The choice of how to do the count, whether on foot, from a vehicle or from an aircraft, will depend on the species to be counted, the size and relief of the area, the resources available and the objective of the count.

1. **Total count:** A total count aims to count all the animals in a specific area. This area is called the census unit. Because of under-counting (it's unlikely all the wildlife will be seen) total counts can only provide a minimum estimate of the total population size. Total counts should be used only when: the wildlife area is relatively small (under 10 km^2) and completely fenced, which means that no animals can enter or leave. A single species is being counted in a restricted area. Other than in small or restricted areas, total counts are rarely used because:
   - they only provide a minimum estimate,
   - they level of precision cannot be measured and,
   - they are much more costly than sample counts.
2. **Sample count:** A sample count aims to estimate the numbers of animals in the total area within the census units from the number counted in a smaller area (sample unit). Sample counts make two important assumptions:
   - that all the animals in the sample area or unit are seen and accurately counted;

- that animals are spread evenly throughout the whole wildlife area or census unit for which the population is being estimated.

The extent, to which these assumptions are valid, is at the root initially the total area is divided up into blocks or transects, of all the problems associated with counting wildlife. It is known as sample units. A selection of these transects is then unlikely that all the animals in the sample area will be seen and searched and counted. The total population estimate is found counted or that animals will be evenly distributed throughout by multiplying the average number of animals in this sample of an area. For example, we know that animals naturally transect by the total number of transects across the total area. Congregate in areas of good habitat and where there is water. So careful planning has to take this uneven distribution into account if accurate and precise results are to be obtained. The average number of animals over the four transects, called visibility of animals. The results of sample surveys are more the sample mean, is 10.5 animals. Therefore over 10 transects accurate for large, dark bodied animals such as elephant, the estimated total population is 10 x 10.5 or 105 animals. Buffalo and sable, which are easily seen. As animals are never distributed evenly within the sample type and state of habitat. It is more difficult to carry out area, each transect differs in the number of animals it has. This sample surveys in hilly or mountainous areas. Sample means that a number of different total population estimates surveys are normally carried out in the dry season when can be obtained, depending on which transects are actually animals are easier to see because the trees will have lost counted. If a further set of 4 transects is counted, a number that their leaves. is higher or lower than the true number of 105 animals present animal behavior. Sample surveys of animals found in large will emerge. The greater the number of samples transects, the herds can be inaccurate, as they are not easily counted. Closer the estimate will be to the true number. Distribution of habitat. Wildlife is usually found where there is food, water and shelter. So, the survey needs to sample all types of habitat equally.
Three factors will determine how to carry out a sample survey: 1) the size of the wildlife area 2) the kind of habitat 3) the resources (human and financial) at your disposal.

In very large wildlife areas (usually more than 1000 km^2) the only feasible method of undertaking a sample count is from an aircraft. Even though it is a sample count, it will be very expensive because of this. In areas where there is a strong element of community involvement in natural resource management, sample surveys may be carried out on foot.

Index method: An index method aims, by using a standard approach, to produce an indirect measurement of the status of the population in the total area. For an index to provide useful management information, data for it must be collected repeatedly over a period of time using exactly the same method each time. Four types of method or index are commonly used:

1) An index of abundance gives an indication of the status of an animal population based on the numbers of animals seen per unit of time or distance, in a particular area over several seasons.

Census techniques used in wildlife survey: Two types of census techniques used in wildlife surveys are broadly classified as 1) direct census techniques & 2) indirect census techniques

1. Direct techniques: In direct techniques animals are counted through direct sighting and are usually adopted for species with relatively high densities, especially medium to large size mammals, etc.

i) Capture-mark-recapture technique: This technique has been used since long back in wildlife studies to estimate population abundance. Let us assume that within a second a closed population of animals (N) two samples (n_1 & n_2) are captured, marked and released at time 1 (m_1) & again the number of marked animals recaptured at time 2 (m_2). The CMR techniques estimating abundance assume that the proportion of marked animals recaptured in second sample (m_2/n_2) should equal to the proportion of the total animals captured at time 1 in the total population (n_1/N),

This can be the mathematically expressed as: $m_2/n_2 = n_1/N$ or, $N = n_1 n_2/ m_2$

Capture-Mark-Recapture (CMR) can be viewed as an animal survey method in which the count statistic is the total number of animals caught, and the associated detection probability is the probability of capture. The method involves capturing a number of animals, marking them, releasing them back into the population, and then determining the ratio of marked to unmarked animals in the population.

ii) Drive count: Drive count is used to get a fair estimation of the population of certain species, especially deer, and usually involves less manpower. This method requires only two observers- one who drive through the area and the other one count the individuals leaving or entering the area. To yield the net count, sum of animals passing forward along the drive line is subtracted from the sum of animals entering the area ahead of the driving crew. This method is very popular to count the

number of game animals, as well as, those inhabit dense forested habitat method is often not feasible to be adopted in large protected areas of this country due to the dense vegetation and uneven visibility.

iii. Roadside count: Roadside counts are performed by walking or cycling along narrow paths or driving vehicles on motorable roads and counting the number of individuals of a local species encountered while travelling. These surveys are usually done in the morning. Then the relative density of the species being censured is simply expressed a number of individuals recorded per kilometer. Each trip along should be determined considering the availability of manpower and other resources, so that each tract can be monitored repeatedly at regular interval. These tracts should be placed in a way so that they represent all habitats within the study area. For roadside counts, maximum distance that could be traversed in two hours should be chosen. The roadside counts are influenced by condition of road-side cover and activity of the animals influenced by the hour of day, weather condition, seasonal food supply along the road side etc. So researcher need select specific tracts and should choose a particular mode to traverse them in order to minimize bias. Vehicle should be driven at slow speed for proper observation and same observer should perform the survey repeatedly. Roadside count is a simple and widespread method to get indices of relative density the population abundance measures of the local species spread over large geographic area. Roadside surveys are also considered as one of the most popular survey methods for diurnal raptors, which has been frequently used to study distribution and abundance of raptors in a locality.

iv. Transect method: These are very common type of survey conducted from the ground which generally invokes traversing a specified route along roads or trails. Transect method broadly classified as two a) Line transect method, a measured line is placed across as along fixed transect line instead of searching over an entire plot. The species touching the line is either recorded along the entire length of the line or at specific points situated along the line.

b) Belt transects method: It is similar to line transect method but the sampling area is wider than line, and counts are limited to objects within a fixed distance of the transect line. As a defined distance from the line is measured, thus the sampled plot becomes rectangular strip extending a specified distance on either side of the transect line. Such rectangular plots called belt transect. In this method, samples can be taken all the way along the line, at specific intervals or even randomly.

v) Point count method: This method is another most commonly used survey technique for determining species composition and abundance. Point counts are also considered as transect of zero length of width. In this technique, survey stations are placed throughout the study area either randomly or systematically and around each of those fixed radius from the survey stations the observer performs the count in a 360^0 arc. In point count the number of individuals of each species within a circle of a certain radius is counted by the observer standing in specified location and for all the counting stations the radius size should be same. Point counts are usually conducted for a pre-determined and fixed time period. This method can only be selected for ground or boat-based survey and not in aerial surveys.

vi) Distance sampling method: During transects and point count methods, all animals cannot be detected over all distance. Often animals present at a distance from the transect line or the survey point are overlooked. Such decline in detection varies with different species and habitats. Distance sampling takes this decreasing delectability of animals with increasing distance from the observer into account and does not assume that all individuals present in a particular area are counted. Rather, distance sampling can only be used if the following assumptions are satisfied:

- Transects or observation points are placed in a manner so that they are representative of the habitat.
- All animals, which are present on the transect line or on the observation point are detected.
- Perpendicular distance from the transect line or radial distance from the observer point to every individual animal must be accurately measured.
- Animals need to be detected in their initial position and the distance is measured before they move in response to the observer's presence.
- There should be no double counting of animals.

Unique feature of distance sampling, as compared to transect or point count, is that in this method distance data from observer to the animals in the form of either perpendicular distance from the transect line or radial distance from the point count station is measured. Then the collected data is analyzed using the computer software "DISTANCE" (Thomas *et al.* 1998, 2000). This software is quite user friendly and offers a wide range of analysis option.

vii) Waterhole Census method: waterhole census is direct method, which is used to count large animals visiting the waterholes present within the study area. This method is well suited for the habitats where the water holes are not

numerous, but widely distributed throughout the study area. This method often implemented in arid and semi arid wilderness region of this country to count various mega fauna. In other areas, dry season is the appropriate time to conduct water hole census, as during this period water is the main limiting factor and most animal present in the area visit these natural or artificial source of water to quench their thirst.

Operational procedure: First an extensive survey should be carried out to locate all the water holes present in the study area. Then certain water holes should be selected from different habitat types of the study area and preferably be located wide apart from one another. Observers should have clear and uninterrupted view of the waterholes from their vantage hides to keep score of every animal visiting the waterhole. A pair of binoculars is used to identify species during times of poor visibility. Water holes must be selected for observation. Once the waterholes are selected, a machaan needs to be constructed in a suitable position adjacent to the waterholes, preferably on natural vantage points. At least two observers should be able to sit on the machaan to observe animals visiting the site to drink. Census can also be carried from tourist watchtowers, wherever available. Species of the animal, total number per group, time of arrival at the waterhole, time of arrival at waterhole, time when the first member of the group starts drinking water, when the last member of the group would finish drinking water and time when all the members of the group would disappear from the waterhole census. Data is then tabulated to specify the abundance of different animals in the study area. Waterhole counts are also suited to obtain data on population demographics of various species, which are not as easily obtained by the other census techniques. The data generated from waterhole census also helps to understand the number of animals depending on a particular waterhole and to explore the extent to which different species overlap in the use of water resources. Following precautions need to be taken to make the water hole census more accurate:

- Personnel should be alert and carry the census continuously for 24-hour period to ensure that no animal visiting the waterhole during survey period is missed and remain unrecorded. To ensure this waterhole census usually begins in the evening, so that the survey personnel can have adequate rest and sleep during the day and remain awake in the night.
- Personnel should be adequately trained to properly identify the animals counting to coming to waterholes not only in day times but also in the dim moon light at night hours. If fund is available then night vision cameras may be used to complement the data and reduce the chance of misidentification of animals, as well as missing any animal visiting the waterhole.
- The machaan preferably located to at a distance between 200 m -500 m from the waterhole and should be constructed in such a way so that their presence does not hinder the animals to visit the waterhole.
- Personnel present on the machaan should be absolutely quite and avoid using any perfume, smoking or drinking alcohol. They also avoid lighting fire at the base or on the machaan and not even light up a flash light during the entire span of survey. Because unnatural smell, light or any other unusual activities often deter the animals to visit waterholes.
- While data analysis, prior knowledge about the habit and frequency of drinking different animal is essential.

viii) Quadrat sampling method: Quadrat sampling method is technique generally used to study presence or absence of species, numbers of organisms, or the percentage cover of each species within square sampling units. Size, shape, number and location of the quadrats: If the site is large enough then quadrats are randomly placed. In most cases quadrats are generally square in shape. However, shape of sampling unit may vary based on the topography and vegetation pattern of the study area. An animal or plant present at the edge of quadrat creates a dilemma for the researcher, as whether it should be counted or not and often tends to be counted. This might lead to an overestimation of the abundance. This might lead to an overestimation of the abundance. Therefore, edge is a major criterion and needs to be carefully considered while determining the shape of the quadrat. The shape showing minimum ratio of edge length to inner area should preferably be selected. The ratio of edge length to inner area changes as follows: circle < square < rectangle. Theoretically, using a circular sampling plot would minimize edge effects, but the area of circle is more difficult to calculate than the area of square. Apart from shape, appropriate size of the quadrat is another very important parameter for any survey. The size of the quadrat can vary from 0.25 cm x o.25 cm to 100 x 100 m. Small quadrats can be surveyed relatively, quickly, but yield a smaller individual sample of habitat. On the other hand, larger quadrats provide larger amount of data and usually require a smaller number of samples to represents the habitat, but require more time and effort to conduct a survey. Size of quadrat determined to suit the objective of the sampling taking the practical constraints into consideration. The minimum size for each quadrat can be determined using 'Species-area' curve. The number of quadrats is usually determined by the following formula:

Number of quadrats = 20% area of the total study are/ Area of each quadrat

Quadrat sampling method generally used to record the abundance or density of a particular SPECIES OF PLANTS AND OTHER slow-moving animals. For each quadrat smpling plot, following data can be recorded:

- **Vegetation cover:** The most common data generated from any quadrat is the vegetation cover. It is estimated by measuring the percentage of the quadrat covered by each plant type. This also gives a measurement of plant abundance.
- **Species density:** Species density is assessed by counting the number of different species found within the quadrat. The mean value for all quadrats is then calculated giving a total number of a particular species per unit area.
- **Species frequency:** Species frequency is determined by calculating the percentage of quadrats where a particular species is present. Such species frequency can be separately calculated for every species found in all quadrats present within the study area.
- **Species diversity:** The total number of species found in all the quadrates present within the study area is then used to measure the diversity of the study site.

ix) Territory sampling: Territory mapping involves repeated visits to a nearly square gridded study plot. Square plot minimizes the length of its perimeter and reduce the number of borderline territories that are partly outside the plot. By using lager plots, the investigator can detect more species and reduce the length of the perimeter per unit of plot area. But the plot should be as large as the investigator can handle efficiently. The base map of the study plot should be prepared that indicates plots boundaries, grid marks, and topography or physical features. A separate simple outline map is needed to record observations of multiple species of bird's each time the study plot is visited. The observer walks slowly along survey route and records all animals through sight or calls, paying particular attention to those with possible territorial significance, such as singing, chasing and fighting. The observations are then plotted on the visit map by writing the abbreviated species name along with a symbol representing the birds' activity when it was detected. Plot identification, date, start and end times of the visit, start and end points name of the observer, weather conditions, the time of the sighting and symbol of sex or age should be mentioned on those visit maps. Individual visits should be made in the morning preferably in the first 3-4 hours after sunrise, as during this time territorial behavior is normally at its peak and most animals are relatively easy to detect. Moreover, surveys should preferably be done on clear and calm days with no rain. It is also recommended that more than one visit should be made to a particular study site in a day. Such visits carried out during the breeding season, when most terrestrial species within the study are establish and defend territories and manifest peak of territorial activity. Date thus accumulated over a period of days or weeks and plotting them on visit maps eventually result in clusters of plotted locations of each species, which are then interpreted as distinct coveys and activity centers of territorial individuals of the local species.

Application: This method is often costly and demands substantial efforts and is therefore, suitable only for intensive surveys in small study areas. Besides, territory mapping works best with species that are highly detectable.

2. Indirect method: Indirect census techniques are suitable for species with very low densities, which are difficult to see due to poor habitat visibility or cryptic behavior of the animals. These methods are suitable for obtaining relative indices of population and are often used to study carnivores, small and nocturnal mammals, large mammals in dense habitat. Most popular indirect census methods are: call count, dung count, pellet, nests or pugmark count.

i) Track count: It is one of the most ancient animal census techniques, where the animal abundance is assessed just by seeing the number of marks along their tracks on ground. The tracks of animal were often used by erstwhile hunters to follow the herds for hunting. In addition to the numbers, tracks of many animals also convey information on the age and sex of the individual. Track counts can only be carried out in grounds which are impressionable enough to permit the marking of tracks.

ii) Droppings are considered as one of the most confirmatory parameters of the animal's presence within a particular habitat. Therefore, dung count is an indirect census method which is frequently being used to assess animal abundance. This method is often useful for the secretive species which are difficult see. The collection droppings during this census method may later be subjected to further analysis in the laboratory to comment on the diet, health, condition and also the genetic makeup of the animal.

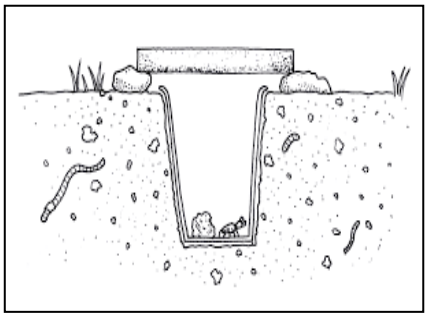
According to Rodgers (1991) dung count can give a fairly reliable population estimate if the following assumptions are made:

- Dung or droppings of different species need to be identified properly. The best way to identify is to actually collect the dung in a transparent bag when the animal is actually seen defecate.
- Different groups of droppings should be properly recognized and separated. Animals usually defecade in a stationary position and dung is deposited at one spot. But, if the animal moves while defecating, then dung may be found to be present over a few meters in the direction where animal moved.
- Sampling units should run across diverse micro habitats. The sample plots should be designed to allow easy searching of all representative habitat of the study area.

- Sampling units need to be adequately large so that at least one or two dung groups are present. Too large plots demand for excessive time or large number of field personnel to cover it, while if the sampling plots are too small then dung may not be present in many of them resulting in adequate data for analysis.
- Entire area of the sampling unit should be thoroughly. Prior information on the estimated defecation rate of the focal species and knowledge on the rate of dung degradation in the study area are two important parameters for these surveys.

iii) Total capture or extermination: Total capture or extermination is a method where capturing or killing of total population is usually done. This is practiced to eliminate the old or diseased population before introducing the fresh one in the shooting preserves of some of the countries where hunting legally permitted. As hunting is not permitted in India, so this technique cannot be used.

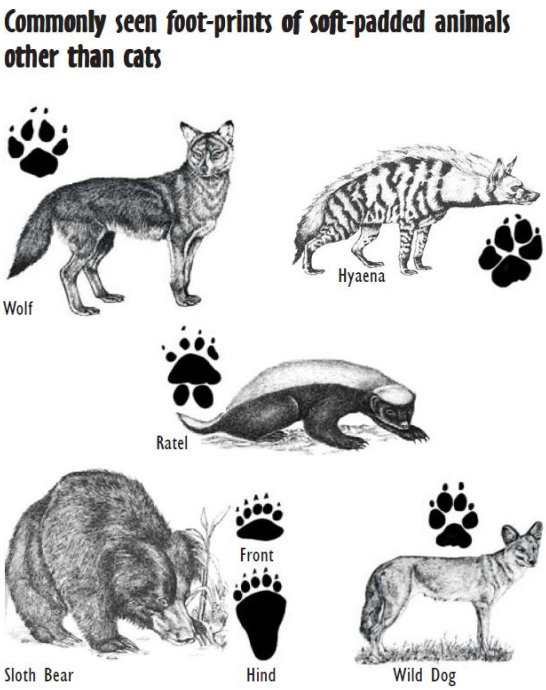
Pitfall trap: A pitfall trap is a trapping pit for small animals, such as insects, amphibians and reptiles. Pitfall traps are mainly used for ecology studies and ecologic pest control. Animals that enter a pitfall trap are unable to escape. In this method deep pits are dug into the ground in order to trap animals. Like cage trap, they are usually employed for catching live animals without harming them



Mist netting: Mist–netting is an important technique for capturing small birds. Some earlier studies on mist–netting for monitoring avian population, migration and community studies served as an impetus for this study. This method is generally used to survey birds in a forested Habitat with dense undergrowth under where other direct census methods are unsuitable due to poor visibility and fast-moving nature of the small feathered creatures.

PUGMARK CENSUS

Pugmark denotes paw prints of most feline animals (like tiger, leopard) where as foot prints of herbivores (such as deer, antelope) are called hoofmark. Every species has distinct pugmark and hence, this is used for identification purposes. Among all field methods of animal census, especially in tiger counting, pugmarks are most common and earliest method to get reliable information and fair estimate population. Pugmark plays a major role in identifying a specific animal in terms of sex, age or size. So, pugmark census is used to assess the total number of individuals of a particular species. Pugmark is also helpful in tracking animals that stray away from the wilderness areas. Pugmark census was invented in 1966 by Indian forester S. R. Choudhary. All India tiger census was conducted in summer 1972 using pugmark census technique along with tiger tracer.



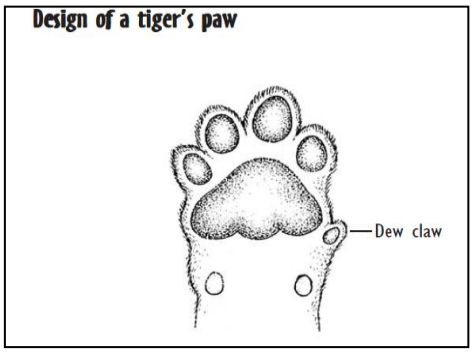
This method is simple and easy to count the animal in a very special manner. In this census method thousands of forestry department personnel simultaneously search for tiger tracks across India for period of 1-2 weeks. They are expected to locate tiger tracks and obtain plaster casts (tracings) of the imprints of the left hind paws of nearly all the tigers in the entire country. The pugmark collected are later compared to identify individual tigers based on perceived differences in shape and other measurements obtained through ancillary local knowledge.

- Census of wild animal species is taken by a variety of direct methods like sample-animal census, aerial count, beats, road side count of wild animals, breeding bird census, water hole-count method, salt lick-count method etc.

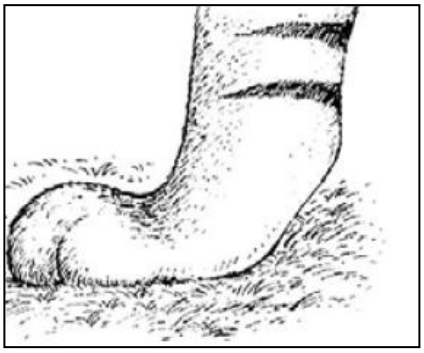
- Similarly, many indirect methods are also adapted for taking the census of the concerned wild animal species, like kill-evidence count, fecal-deposit count, parasite-count method, counting of tracks, pellet-group count, count on burrows or dens of wild animal species, nest count etc. Hence, you have to understand that pug mark identification and documentation are highly required esp. in case of tiger related census, as followed throughout this country.

Material required: Pug mark design-models of different wild animal species, Glass material, Permanent marker pens, Plaster of Paris, Wax material and Heating source

Tiger pugmark: Prior to the implementation of pugmark census in counting tiger members, it is very important to know design of the paw, which actually generates pugmarks. The pad of tiger paw consists of a pad and four toes. A fifth toe, commonly called dew claw, is placed high on the front limbs only. These dew claws are retractable, do not touch the ground and usually serve as a part of tiger's weaponry. Ordinarily, the pad is 3 lobed at the rear end. The difference between pugmark of front and hind foot, as well as between the hind pugmark of tiger and tigress varies.

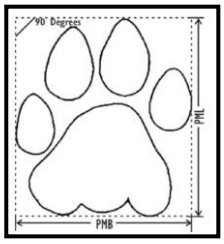


Design of paw of Tiger

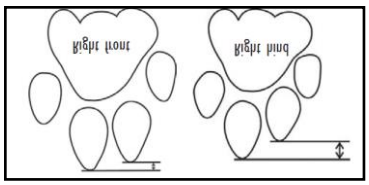


Placement of paw on ground

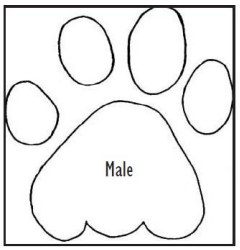
Measurement of pugmark: Pugmark length (PML) is the measurement form tip of the farthest toe to the base of the pad along the line of walk and pugmark breadth (PMB) is the measurement between the outer edges of the first and last toe. PML and PMB are measured by drawing a box touching the extreme ends of the pugmark.

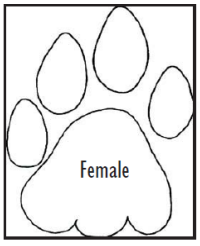


Measuring a pugmark



Distinguishing from hind from front pugmark





Distinguishing pug mark of male and female

HABITAT MANAGEMENT AND MANIPULATION TECHNIQUES

Development of Methods Associated with Animal Population Dynamics: Conservation and management of natural animal populations requires knowledge of their dynamics and associated environmental and management influences. Specifically, informed management requires periodic estimates of system state (e.g., population size) and models for projecting consequences of management actions for subsequent state dynamics. However, it is very difficult to draw strong inferences about system state and dynamics for natural animal populations and communities. The primary challenges are: (1) the tendency of animal densities to vary substantially over space and (2) the likelihood that any method of sampling animals (capture, direct observation, etc.) will produce counts that represent some unknown fraction of the true number of animals in the sampled locations.

Development of Patch Occupancy Models for Assessing the Spatial Distribution of Organisms: A variety of important questions about the conservation and management of natural resources requires information about the spatial distribution of organisms. For species of conservation concern, the size of a species' range is a criterion used to assign species status as threatened or endangered. For invasive species and disease organisms, the dynamics of the species range expansion are relevant to efforts to both control invasions and to protect vulnerable species. In this period of rapid global change, it will be important to be able to understand and predict dynamics of species ranges as habitats change in suitability.

Bird Banding Laboratory: The Bird Banding Laboratory (BBL) is an integrated scientific program supporting the collection, archiving, management and dissemination of information from banded and marked birds in North America to monitor the status and trends of resident and migratory bird populations. As birds are good indicators of the health of the environment, the status and trends of bird populations are critical for identifying and understanding many ecological issues and for developing effective science, management and conservation practices.

CAPTIVE BREEDING PROGRAMMES

It is *ex situ* conservation techniques advocated by the IUCN, and may perhaps be the most important techniques when it comes to efforts to prevent the total extinction of some endangered species. Although it would be desirable not to have to resort to these programmes, they sometimes represent the only alternative and the last chance to avoid the extinction of these species in their natural habitat. And it is better to recognize this in time in order to implement a programme while sufficient individuals still remain in the wild in order to avoid one of the main pitfalls of captive breeding: i.e., that if the captive population starts with too few founding individuals it will be too small to keep the genetic variability of the species at levels ensuring subsequent viability.

The captive breeding of a species is a process which aims to achieve a population size large enough to allow, through reintroduction or reinforcement, its re-establishment in one or more of the areas where the species was historically distributed. Although there are some specialized centers for the breeding of endangered species, efforts mostly rely on the help of a multitude of zoos around the world. This means individuals are dispersed in small groups across multiple breeding programmes, which makes more space available and so allows a larger total captive population to be kept. But above all, it avoids the risk that the entire captive population is affected in the event of illness or an epidemic. The participation of zoological institutions in the conservation of endangered species through captive breeding programmes has been crucial, particularly over the last 30-40 years.

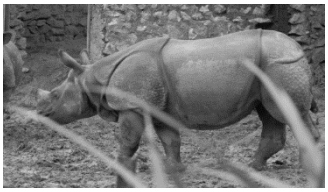
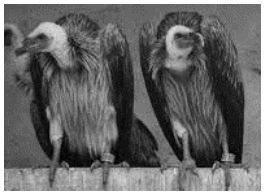
Captive wildlife: Zoos and safari parks are ideally placed to foster compassion for animals and raise awareness and understanding of the welfare and conservation needs of individual animals and species. A zoo's purpose should be to promote the interests of wildlife conservation, biodiversity and animal welfare to the public. Zoos should be able to entertain, while educating and empowering visitors to take action for the benefit of species and habitat conservation. Visitors attending zoos should be encouraged to learn about the natural history of individual species, their natural behaviors, the threats to their survival and the need to conserve their habitats. Zoos have the potential to become centers of research excellence in the fields of animal welfare, environmental enrichment, conservation education, enclosure design, and species and habitat conservation. Only when abusive animal performances have stopped will zoos be able to develop as important institutions for the dissemination of information with regards to species and habitat conservation, and play a more active role internationally in species conservation and education. Recommendations Animals Asia understands the concerns of zoo personnel worried about the potential loss in income as a direct result of the ban on animal performances and close interaction between visitors and animals. We also recognize the threat a ban on animal performances can have to the survival of the animals used in the performances and to the jobs of the performing-animal staff. However, there are many activities and initiatives that zoos can develop to ensure the welfare of the performing animals is protected, employment opportunities for the performing animal staff are provided, and measures taken to compensate for the ban through the development of zoos as centers for conservation education and animal protection. These initiatives are outlined below:

a. Development of in-situ conservation programmes China contains a glorious array of animal and plant species within a diverse range of habitats including tropical and temperate forests, upland grassland and deserts. Rapid development has led to extensive habitat degradation leaving many species on the edge of extinction.

b. Investment in enclosure design Visitors come to zoos to view species they are unlikely to have the opportunity to see in their wild environment. Therefore, the animals' enclosures play a crucial role in the education of the visitor and the impression they receive while viewing the animal at the zoo. Animal exhibits should be designed with three basic principles in mind:

- The provision of facilities and opportunities to ensure that the "five freedoms" of animal welfare are fulfilled.
- The provision of facilities to allow keepers to care for the animals adequately and promote good welfare.
- The provision of safe visitor access, with facilities and activities to educate visitors and provide an enjoyable experience.

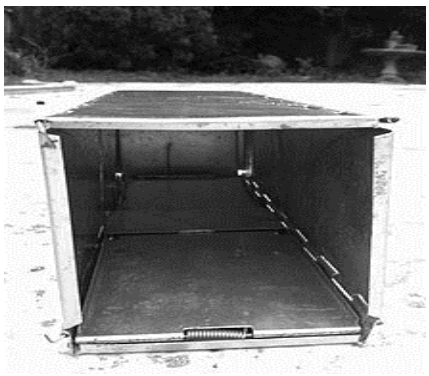
From the initial point of enclosure-design everything should be done to ensure that housing and husbandry stimulate the animals, both physically and psychologically. Ideally enclosures will be designed to imitate aspects of an animal's natural environment and provide visual detail to visitors on the habitat within which a species life. Enclosure design must also provide access for keepers, veterinary care, and isolation facilities. There are a number of constraints that need to be taken into consideration including space, existing buildings, regulations and, of course, finances.

Captive breeding program Rhinos and vultures

THE SHERMAN TRAP AND CAMERA TRAP METHOD

The Sherman trap is a box-style animal trap designed for the live capture of small mammals. It was invented by Dr. H. B. Sherman in the 1920s and became commercially available in 1955. Since that time, the Sherman trap has been used extensively by researchers in the biological sciences for capturing animals such as mice, voles, shrews, and chipmunks. The Sherman trap consists of eight hinged pieces of sheet metal (either galvanized steel or aluminum) that allow the trap to be collapsed for storage or transport. Sherman traps are often set-in grids and may be baited with grains and seed. The hinged design allows the trap to fold up flat into something only the width of one side panel. This makes it compact for storage and easy to transport to field locations. Both ends are hinged, but in normal operation the rear end is closed and the front folds inwards and latches the treadle, trigger plate, in place. When an animal enters far enough to be clear of the front door, their weight releases the latch and the door closes behind them. The lure or bait is placed at the far end and can be dropped in place through the rear hinged door.



Camera trap definition: It is a non-invasive technique of wildlife monitoring compromising of remotely activated camera that is equipped with a motion sensor or an infrared sensor, or uses a light beam as a trigger to take the photograph of animal when it is present in its vicinity. A camera trap is a camera that is automatically triggered by a change in some activity in its vicinity, like presence of an animal. It is typically equipped with a motion sensor – usually a passive infrared (PIR) sensor or an active infrared (AIR) sensor using an infrared light beam.

Camera traps, also known as trail cameras, are used to capture images of wildlife with as little human interference as possible. Camera trapping is a method for capturing wild animals on film when researchers are not present, and has been used in ecological research for decades. In addition to applications in hunting and wildlife viewing, research applications include studies of nest ecology, detection of rare species, estimation of population size and species richness, as well as research on habitat use and occupation of human-built structures.

Application: The great advantage of camera traps is that they can record very accurate data without disturbing the photographed animal. These data are superior to human observations because they can be reviewed by other researchers. They minimally disturb wildlife and can replace the use of more invasive survey and monitoring techniques such as live trap and release. They operate continually and silently, provide proof of species present in an area, can reveal what prints and scats belong to which species, provide evidence for management and policy decisions, and are a cost-effective monitoring tool. Infrared flash cameras have low disturbance and visibility. Camera traps are also helpful in quantifying the number of different species in an area; this is a more effective method than attempting to count by hand every individual organism in a field. It can also be useful in identifying new or rare species that have yet to be well documented. Camera traps are helpful in determining behavioral and activity patterns of animals, such as which time of day they visit mineral licks. Camera traps are also useful to record animal migrations. Types of camera traps are as follows:

1. **Non- triggered camera traps:** There are non-triggered cameras that either run continuously or take pictures at specific time intervals. The more common ones are the advanced cameras that are triggered only after sensing movement and/or a heat signature to increase the chances of capturing a useful image. Infrared beams can also be used to trigger the camera. Video is also an emerging option in camera traps, allowing researchers to record running streams of video and to document animal behavior.

2. Triggered camera traps: Triggered camera traps are inactive until they are triggered by an event of some kind, usually the arrival of an animal. The trigger may be mechanical, such as the animal stepping on a pressure plate that fires the camera, but typically the trigger is an infra-red-light source.

Different types of camera trap systems and their field application

System	Most applicable	Least applicable
Non-triggered	When animals are resident, occur in the open or have high rates of visit or when recording continuous data is important	For rare species or infrequent events
Triggered – general	When camera traps need to be left in the field for a long period of time, but events are important	When events of interest are frequent or continuous
Triggered-mechanical	When activity of interest requires an animal to physically step in a specific location or pull on a bait or object of interest	When activity of interest may not be recorded by physical trigger
Triggered- infrared - General	When activity of interest does not require animal to physically step in a specific location or pull on an object; when animal is too light to fast for a mechanical trigger	When activity of interest involves a physical activity by animals
Triggered-infrared - active	When it is important that non-target species do not trigger the trap, especially if film or digital images are limited. In general, when activity of interest is in a precise location but would not be detected by a mechanical trigger	In areas where vegetation growth is so fast that it will obscure the beam between maintenance visits. In areas where wind, rain, or snow frequently breaks the light trigger or blows vegetation or other objects across it
Triggered- infrared - passive	When a larger zone of detection of largest target species is desirable. In areas where wind, rain, and snow are common	In hot environments where equipment may fail to detect the differential temperature of target species

CAMERA TRAPS IMAGES AT DAY AND NIGHT

INDIRECT CENSUS TECHNIQUES

Indirect census techniques are suitable for species with very low densities which are difficult to see due to poor habitat visibility or cryptic behavior of the animals. These methods are suitable for obtaining relatives indices of population and are often used to study carnivores, small and nocturnal mammals and large mammals in dense habitats. Almost popular indirect census methods are call count, dung, pellet, nests, burrows or pugmark counts.

i) Track count: Track count is one of the most ancient animal census techniques, where the animal abundance is assessed just by seeing the number of marks along their tracks on ground. The tracks of animals were often used by the erstwhile hunters to follow the herds for hunting. In addition to the numbers, tracks of many animals also convey information on the age of the individuals. Pugmark census is one kind of track count can only be carried out in grounds which are impressionable enough to permit the marking of tracks. So, this method is inoperative in areas of thick forest, undergrowths, long grasses or hard grounds. Besides, interpretations of the result are also difficult and require well –trained experts.

ii) Dung count survey: Droppings are considered as one of the most confirmatory parameters of the animal's presence within particular habitat. It is also called as pellet count. Therefore, dung count is an indirect census method which is frequently being used as assess animal abundance. This method is often useful for the secretive species which are difficult to see. The collected droppings during this census method may later be subjected to further analysis in the laboratory to comment on diet, health condition and also the genetic make-up of the animal. For this survey following assumptions must meet to carry dung count method are as follows:

1. Dung or droppings of different species need to be identified properly: The best way to identify is collect the dung in a transparent bag when the animal is actually seen to defecate. Droppings thus collected should be preserved for future reference in field when the droppings are found, but the animal is not seen. Size, shape, pattern of indentations or protuberances at the end of each of pellets is the key features of differentiation.

2. Different groups of droppings should be properly recognized and separated: animals usually defecate in a stationary position and dung is deposited at one spot. But, if animal moves while defecating, then dung may be found to be present over a few meters in the direction where the animal moved. So, if droppings found in small area are similar in size,

shape, colour or condition, when they might be assumed to be from same individual. Hence, separating dung of same species in different groups requires a fair bit of experience. Sampling units should run across diverse micro habitats: the sample plots should be designed to allow easy searching of all representative habitat of the study area.

Sampling units need to be adequately large so that at least one or two dung groups are present. Too large plots demand for excessive time or large number of field personnel to cover it, while if the sampling plots are too small then dung may not be present in many of them resulting in inadequate data for analysis. Entire area of the sampling unit should be thoroughly searched: Prior information on the estimated defecation rate of the focal species and knowledge on the rate of dung degradation in the study area are two important parameters of these surveys. Dung surveys through pellet count is often carried out n cold and dry regions where the dung does not degrade quickly, remains in actual shape and are often found in proper condition for further analysis. Therefore, dung surveys of many species of herbivores and carnivores of temperate wildlife studies of the tropical countries. Because, i) dung degrades quickly in tropical humid conditions, where many others creatures expedite the process and forest floors in tropical region are often covered with dense undergrowth.

iii) Total capture or extermination: Total capture or extermination is a method where capturing or killing of total population is usually done. This is practiced to eliminate the old or diseased population before introducing the fresh one in the shooting presses of the countries where hunting is legally permitted. As hunting is not permitted in India therefore this technique cannot be used.

STUDY OF WILD ANIMALS BY USING TELEMETRY - TRANSMITTERS, RECEIVERS, ANALYSIS OF DATA, VISUAL TAGGING AND MARKING

Since its inception in the 1960s, wildlife radio telemetry has become a valuable tool to track the movement and behavior of animals. This technique uses the transmission of radio signals to locate a transmitter attached to the animal of interest. It is often used to obtain location data on the animal's preferred habitat, home range, and to understand population dynamics. The different types of radio telemetry techniques include very high frequency (VHF)transmitters, global positioning system (GPS) tracking, and satellite tracking. Recent advances in technology have improved radio telemetry techniques by increasing the efficacy of data collection. However, studies involving radio telemetry should be reviewed in order to determine if newer techniques, such as collars that transmit the location to the operator via satellites, are actually required to accomplish the goals of the study.

Transmitters: The operator attaches a transmitter to an animal that gives off unique electromagnetic radio signals, which allows the animal to be located. Transmitters are available in a variety of forms and consist of an antenna, a power source, and the electronics required to produce a signal. Transmitters are chosen based on the behavior, size, and life history of the specific species being studied. In order to reduce the impact of the transmitter on the animal's behavior and quality of life, transmitters typically weigh no more than five percent of the animal's body weight. Unfortunately, the smaller the transmitter, the weaker and shorter-lived it is. Transmitters are often designed to fall off the animal at the conclusion of the study due to the unlikelihood of recapturing the tagged animals. Large animals require transmitters in the form of collars, which leave room for the animal to grow without falling off. Ear tag transmitters are commonly attached to the ear of large animals that have changing neck sizes. Lightweight, adhesive transmitters are glued to the backs of smaller animals, such as bats. Necklace packs are transmitters that fit around the neck of upland game birds. Subcutaneous transmitters are applied to aquatic animals, which allow them to freely navigate underwater. In some species of fish that have ceased feeding, transmitters are inserted inside the animal’s body cavity as a means to minimize the stress of tagging. Whip antennas are an omni-directional transmitter design that produces more signals over a greater distance. A harness loop antenna design, implemented for small birds, involves a transmitter being wrapped around the body.

Receivers: The operator uses an antenna that is attached to a receiver, which is programmed to the transmitter's frequency, to pick up the electromagnetic signals given off by the transmitter affixed to the target animal. Receiver antennas may be hand-held or mounted on an object, and they are available in a variety of forms and functions. These antennas are also tuned to the proper frequency for the transmitter. The receiver produces a tone that increases in loudness or has a visual signal strength indicator that pulses as the operator approaches the transmitter. Omnidirectional antennas have no additional elements and are used to determine the presence or absence of a signal, not its exact location. Elements are added segments of an antenna to increase the range of detectability of the receiver. Adcock antennas consist of two elements and are used to locate the direction of the signal. Loop antennas are small and useful for locating low frequency transmitters. The yagi antenna contains 3 or 4 elements and is a strong, directional antenna commonly used to determine the location of a transmitter. Antennas can also be affixed to towers. This allows the antenna to be positioned higher, avoiding interference from buildings and trees. Boat, aircraft, and vehicle-mounted antennas allow the operator to exploit a larger area while tracking.

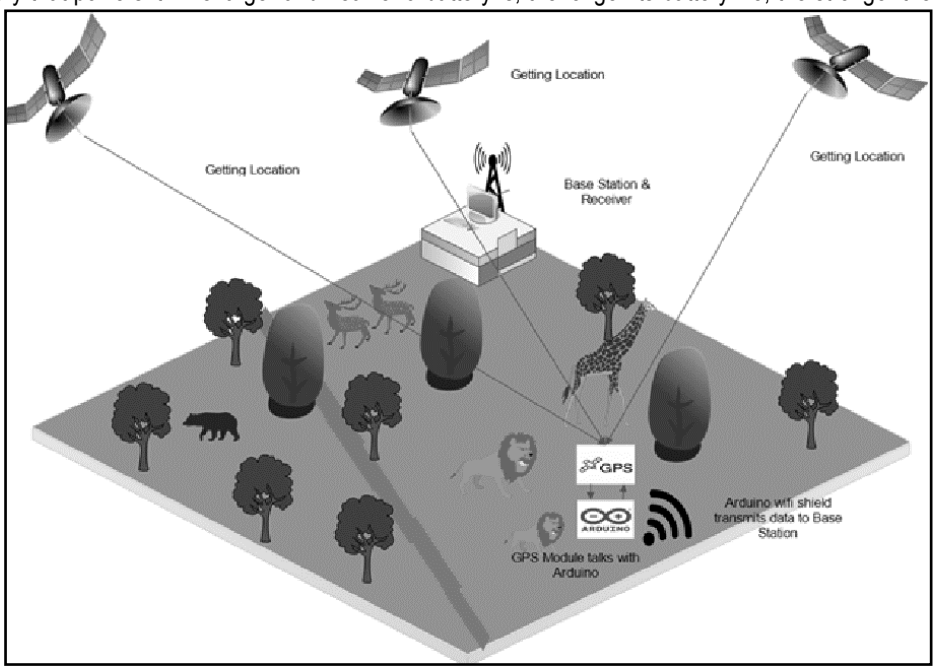
Tracking animals: Direct tracking and triangulation methods allow the operator to locate a tagged animal. Direct or VHF tracking involves using a directional antenna to follow the signal given off by the transmitter to the exact location of the tagged animal. The operator rotates the antenna until the loudest signal is found. The operator follows the signal, checking

the direction of the signal frequently until he or she reaches the tagged animal. Triangulation is often used when an animal is on private or inaccessible property because it allows the operator to remotely determine the location of the tagged animal. The operator obtains three or more azimuths or bearings from locations around the signal and calculates the intersection of the azimuths to estimate the location of the transmitted animal. Global positioning tracking involves a receiver that picks up signals from satellites to determine the location of a transmitted animal over time. The GPS transmitter is attached to an animal and records the location of the animal on the device by estimating the time taken for radio signals from at least three satellites to travel to the GPS transmitter. The data is collected by recapturing the animal to remove the GPS transmitter or remotely downloading the data off the transmitter. These units are often heavier and shorter-lived than the ones used for VHF tracking. Global positioning tracking is useful for migrating animals because their locations can accurately be determined, regardless of the distance they are from the operator. Satellite tracking is similar to GPS tracking and allows animal movement to be tracked globally. This form of tracking is useful for remote or inaccessible areas. Many of these systems implement platform terminal transmitters (PTT) that send electromagnetic signals to Argos equipment found on satellites. The Argos receivers estimate the distance to the transmitter to determine its location. This data is received by the Argos data collection relay system. The PTT transmitters require larger batteries, causing them to be heavier than VHF transmitters. Satellite tracking is more accurate at locating larger animals that are more exposed to the sky, such as birds or animals living in prairies, open deserts, or savannas.

Applications: Wildlife radio telemetry has advanced the research opportunities available for studying animal populations. It can be applied to many areas of management and research to determine the habitat use of tagged animals, such as roost and foraging habitat preferences. Radio telemetry has been used to study the home range and movement of populations. Specific migratory routes and dispersal behavior can be followed through radio tracking. Survivorship is often monitored with radio telemetry by studying age and mortality rates. It is important that any negative effects of attaching radio-transmitters to animals are reported to improve methods and reduce harm to individuals in future studies. Since the 1960s, scientists have been using radio telemetry to locate animals and track their movements. Radio telemetry uses radio signals, which are made up of invisible and silent electromagnetic waves, to determine location. A radio telemetry system is made up of three parts: a radio transmitter, a radio antenna and a radio receiver. The radio transmitter is worn by the animal and is the part that transmits, or sends, the radio signal. Scientists use the antenna to pick up the radio signals, which are then transformed into a beeping sound by the receiver. As the receiver gets closer to the transmitter, the beeps get louder, meaning the animal wearing the transmitter is close by. The researcher can use this audible clue to locate and follow the animal wearing the transmitter.

What are the pros and cons of using radio telemetry?

Radio transmitters, also called radio tags. They also come in a variety of sizes and weights. The part of a radio tag that weighs the most is the battery that powers it. The larger and heavier a battery is, the longer its battery life, the stronger the signal it can transmit and the farther the signal will travel. But a transmitter should not weigh more than 5 percent of an animal's body weight, or it could interfere with the animal's ability to move. So, when designing a study using radio telemetry, researchers consider the size and weight of a transmitter that can be used on an animal, and what that means for the battery life and signal strength. There are radio tags that are light enough to use on birds that weigh as little as 6.6 grams—just a little heavier than a nickel!



Radio tags this small have a relatively short battery life of just a few weeks and a signal that can travel only about 0.6 miles (1 km). Radio tagging gives scientists a lot of information about the movement of birds. However, the scientific questions that can be answered with radio telemetry are limited, because scientists have to be relatively close to the tagged birds to determine location. For example, scientists can use radio telemetry to follow the movements of migratory birds during their breeding season, because they stay within the same area while nesting and raising their young. But once the birds leave the

breeding area to migrate, they quickly move beyond the range of the transmitter, and scientists can no longer detect where they are. The other limitation is the size and lifespan of the battery required to power the transmitter. Because it takes a lot of power to send a radio signal even short distances, most radio tags only last from a few weeks to a few months. This means that scientists can only use radio telemetry to study the movement of birds during a short period of time, rather than across their annual cycle.

Description: Antennas, receivers and additional assortments (e.g. cables, headphones etc.) for receiving radio signals from radio transmitters attached to researched animals in the field. Several (3) equipment units allows simultaneous and therefore more precise triangulation of the transmitters' location in the field.

Specification: The operating receiver is programmed to the specific transmitter's frequency, to pick up the electromagnetic signals given off by the transmitter affixed to the target animal. The hand-held Yagi antenna contains 3 elements and is a strong, directional antenna commonly used to determine the location of a transmitter. Antenna and receiver are connected by cable. Headphones are used to dim ambient sounds and improve chances to hear weak signals from transmitters.

Technical specifications, antenna: Weight: 800g Frequencies: 138 – 230 MHz Bandwidth: ± 2MHz Gain: 6dB over dipole Beam width (3 dB): 80 0 Back-to-front ratio: 18 dB Impedance (nominal): 50 ohms Receiver connector: BNC Replaceable Cable length: 1.5 m.

Technical specifications, receiver: Rainproof & dust-tight Up to 30 MHz frequency band (within 138-174 MHz) Small, light & tough 256 user-programmable channels Scanning function Frequency table upload from a PC Services. Direct tracking and triangulation methods allow the operator to locate a tagged animal. Direct tracking involves using a directional antenna to follow the signal given off by the transmitter to the exact location of the tagged animal. Triangulation is often used when an animal is on private or inaccessible property or must not be disturbed by the researcher. Triangulation allows the operator to remotely determine the location of the tagged animal. The operator obtains three or more azimuths or bearings from locations around the signal and calculates the intersection of the azimuths to estimate the location of the transmitted animal. Wildlife radio telemetry can be applied to many areas of research to determine the habitat use and preferences of tagged animals, finding their roosts etc. Radio telemetry is widely used to study the home range and movements of different animals. Specific migratory routes and dispersal behavior can also be followed through radio tracking.

Satellite telemetry: Satellite tracking, or 'satellite telemetry', involves attaching a special piece of tracking equipment, called a Platform Terminal Transmitter (or PTT) to a sea turtle's carapace (shell). The PTT sends a message to a satellite each time the turtle comes to the surface to breathe. We then receive messages via the satellite regarding the location of the turtle and plot them onto a map. There are thousands of satellite transmitters being used around the world today to monitor ocean circulation, natural hazards, water resources, polar currents, fishing vessels, shipping and offshore oil and wildlife such as albatrosses, whales, polar bears and of course, sea turtles!

WILDLIFE HEALTH AND DIFFERENT DISEASES

Wildlife health and disease are becoming increasingly important aspects of wildlife conservation and management. They are a severe threat to endangered wildlife species and indigenous livestock breeds and can affect the ecological integrity of protected areas. Mortality in some wildlife species can also affect local food chains, by reducing available prey. Majority of emerging zoonotic diseases that threaten human health originate in wild animals. These animals require a routine management. For example, Hoof and nail trimmings are necessary when overgrowth in elephant's rhinoceros, ruminants, equids, and large carnivores' animals. Routine examination including parasite checks shall be carried out regularly and preventive medicines (including vaccination) be administrated as per schedule. The newly arrived wild animals has to be properly taken care of by taking the wild animals in a safe manner to the quarantine unit and the related health care measures may be carried out in a planned manner. It is very difficult to diagnose and treat the diseases in wild animals because they are free ranging animals. The diseased animals hide itself in very remote or core-areas of the jungle being incapable and unsafe losing its protection and resistance. Some of the important diseases in wild animals:

Diseases	*Causal Organism*	Symptoms	Susceptible animals	Control measures
Foot and Mouth Diseases	*Picorna* Virus	Mouth ulcers, salivation, body temp. increases by 2º to 3ºF	Wild boar, Cheetal, Gaur and Sambhar	Vaccination, Consulting veterinary doctor
Rinderpest	Paramyxo virus (*Morbilli virus*)	Fever, dysentery and inflammation of the mucous membranes	Epidemicsin ruminant cattle's such as Cheetal, gaur Sambhar, wild buffalo, etc.	Vaccination, consulting veterinary doctors, diseased animals should be watched and the dead animals should be buried immediately preferably mixed with potassium permanganate, lime and phenyl to avoid its spreading through scavengers.
Anthrax	*Bacillus anthrasis*	Bleeding through mouth, nose and anus and vulva n females,	Mammals	Dead body should be buried to avoid from scavengers

Brucellosis	*Brucella* bacteria	Tumor arises in the joints, damaged foetus	Cheetal, Sambhar, etc. including man	Female calves should be vaccinated when they are 4 months and 1 year old
Botulism	*Clostridium botulinum*	Continuous tearing, kind of paralysis	Aquatic birds	Refrigerating food within 2hrs. after cooking, avoid use of damaged food container
Tuberculosis	*Bacterium tuberculosis*	Damaged liver, weakness and cough,	Common in monkeys	Cleaning waterholes, separation of infected animal
Rabies	Rhabdo virus particular y Lyssa virus	Furious like mad, hydrophobia, salivation, erect tail	Warm blooded animals	Vaccination
Distemper	Paramyxo virus	Fever affecting CNS, watering through eyes and nose, cough, swelling in eyes and nose	Foxes, raccoons, Dogs etc	Vaccination
Haemorrhagic septicemia	*Pasteurella multocida*	High fever, redness in eyes, throat swelling, hoarse voice etc.	hoofed animals like deer,boar, sheep etc.	Vaccination
Babesis (red water disease and tick fever disease)	*Babesia felis* (protozoa)	High fever red urine, diarrhea, etc.	Felidae and Canidae family, cattle's	Hygienic shade, separation of infected animal
Black quarter	*Clostridium chauvoei*	High fever, redness in eyes, dullness etc.	Sheep's, goats etc.	Vaccination

Foot and mouth disease

Rabies

WILDLIFE DAMAGE AND CONTROL

Agricultural crops: The most damage cause by wild animals and birds to agricultural crops. Mostly buffer zone area is damaged by wild animals like wild boars, deers, gaur and cheetals. Birds may often cause severe damage to fruit or agricultural crops, and for several reasons the incidence of damage seems to be increasing. The nature of modern agriculture, with its emphasis upon monoculture and highly specialized crops, and the high cost of bringing the crop to the harvesting stage, when bird damage usually occurs, are among the factors involved. Accurate estimates of the value of fruit or grain destroyed by birds are extremely difficult to obtain.

Wildlife damage to forest and range: Animals like deers eats mostly young seedlings and saplings. It reduces new regeneration of forest tree species. Two other types of damage widespread in the forest are clipping and browsing of timber species by big game, rabbits and hares, and others; and the bark and root damage caused by rodents, such as pocket gophers, mice, and porcupines. In most areas, however, population control is now being achieved through regulated hunting and this type of damage is far less widespread than in the past.

Non agricultural problems: There are other problems related to wildlife like some diseases carried by wild animals and spread in mammals and they are contagious so causes several losses due unknown causal virus. Wild animals and mammals act as carriers or reservoirs for certain diseases of man and domestic animals. A few of these, such as rabies, are of great economic importance, but the majority are local or temporary and do not usually result in control demands any magnitude. In certain urban and industrial situations, however birds have become serious pests and have created unusually difficult control problems. Best known are starling and pigeon roosts on building or the roosting in city shade trees of tremendous aggregation of starlings and other birds. A variety of control methods are partially successful, but most are awkward, expensive and ineffective.

IMPORTANT DEFINITIONS

Adaptation: The morphological, physiological, and behavioural characteristics and processes organisms have acquired and utilize to survive.
Alien Species = Exotic Species, = Introduced Species, = Nonnative Species: Species introduced outside its normal distribution
Animal traceability: The ability to follow an animal or group of animals during all stages of its life.
Big game: Relatively large animals sought or taken by hunting or fishing especially for sport. Term used to designate larger species that are hunted.
Biological diversity or biodiversity: 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.
Biological resources: Include genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity.
Buffer zone: Areas between core protected areas and the surrounding landscape or seascape which protect the network from potentially damaging external influences and which are essentially transitional areas
Captive wild animal: An animal that has a phenotype not significantly affected by human selection but that is captive or otherwise lives under direct human supervision or control, including zoo animals and pets.
Carnivore: Meat eating animals or an animal belonging to the order Carnivora, including predominantly meat eating mammals
Carrying capacity: The maximum number of people, or individuals of a particular species, that a given part of the environment can maintain indefinitely.
Catch and release: The process of capturing a fish, usually by line and hook (angling), and releasing it alive.
Commensal: A species that lives in close association and gets some benefit from another species but does not return any benefit.
Conservation: The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.
Consumptive use: Any use that involves activity resulting in the loss of wildlife i.e. hunting.
Containment zone: A defined zone around and including suspected or infected establishments, taking into account the epidemiological factors and results of investigations, where control measures to prevent the spread of the infection are applied.
Corridor: Way to maintain vital ecological or environmental connectivity by maintaining physical linkages between core areas or Area of suitable habitat, or habitat undergoing restoration, linking two or more protected areas (or linking important habitat that is not protected) to allow interchange of species, migration, gene exchange, etc
Critically endangered: An IUCN Red List category. A taxon is Critically Endangered when the best available evidence indicates that it is considered to be facing an extremely high risk of extinction in the wild.
Deforestation: The long-term removal of trees from a forested site to permit other site uses. It implies the long-term or permanent loss of forest and implies transformation into another land use.
Depredation: The act of killing, damaging or consuming animals, crops or other agricultural resources.
Domesticated species: A species in which the evolutionary process has been influenced by humans to meet their needs.
Domestication: The process by which evolution has been influenced by humans to meet their needs; e.g. non-shattering seeds.
Ecological niche: The set of habitat resources (food, cover types, water etc.) used by a species, as determined by its geographic and ecological range and its adaptations.
Ecosystem: A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit.
Ecosystem diversity: The variety of ecosystems that occurs within a larger landscape, ranging from biome (the largest ecological unit) to microhabitat.
Ecosystem services: The benefits people obtain from ecosystems. These include provisioning services, such as food and water, regulating services, such as flood and disease control, cultural services, such as spiritual, recreational and cultural benefits, and supporting services, such as nutrient cycling, that 25 maintain the conditions for life on earth. Sometimes called ecosystem goods-and-services. Or Benefits humans derive from natural ecosystems. The UN 2004 millennium ecosystem assessment defines four broad categories: provisioning, regulating, supporting and cultural. Find out more about ecosystem services.
Ecotourism: A type of tourism focused on watching or photographing wildlife
Endemic species: A species is endemic to an area, if it is not found anywhere else. For example, the proboscis monkey is endemic to Borneo and the sharpe's longclaw to Kenya. Or
Eradication: The complete removal of all living representatives of a species that is becoming (or is likely to become) invasive in a specified area or country. Or The elimination of a pathogenic agent from a country or zone or application of phytosanitary measures to eliminate a pest from an area.
Ethology: The scientific study of animal behavior, especially as it occurs in a natural environment.
Exotic species: Species that occur in a given place, area, or region as the result of direct or indirect, deliberate or accidental introduction of the species by humans, and for which introduction has permitted the species to cross a natural barrier to dispersal.
***Ex-situ* conservation**: The conservation of components of biological diversity outside their natural habitats.
Extinction: An irreversible process whereby a species or distinct biological population forever ceases to exist.
Feral animal: An animal of a domesticated species that now lives without direct human supervision or control.
Flagship species: Popular charismatic species that serve as symbols to stimulate conservation awareness and action locally, nationally, regionally or globally or a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause.
Flock: A group of birds feeding or moving together. or A number of animals of one kind kept together under human control or a congregation of gregarious wild animals. For the purposes of the Terrestrial Code, a flock is usually regarded as an epidemiological unit.
Flyway: An established air route of migratory birds or the biological systems of migration paths that directly link sites and ecosystems in different countries and continents.

Food chain: A sequence of feeding types, on successive levels within a community through which energy and biomass is transferred.
Forage: All browse and herbaceous plants that are available to feed livestock or wildlife. Or Food for animals, especially when taken by browsing or grazing or vegetation taken naturally by herbivorous animals (n); the act of searching for and eating vegetative materials.
Forest degradation: The reduction of the capacity of a forest to provide goods and services.
Free range: Farming method whereby animals are given the ability to roam freely instead of being restricted to a confined area.
Habitat: The place or type of site where an organism or population naturally occurs.
Habitat loss: The outcome of a process of land use change in which a 'natural' habitat-type is removed and replaced by another habitat-type, such as converting natural areas to production sites.
Hazard: A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect. Or A biological, chemical or physical agent in, or a condition of, an animal or animal product with the potential to cause an adverse health effect
Herbivore: Wildlife species that eat vegetation or an animal that feeds chiefly on plants.
Herd: A number of animals of one kind kept together under human control or a congregation of gregarious wild animals. For the purposes of the Terrestrial Code, a herd is usually regarded as an epidemiological unit.
Home range: The area traversed by an animal during a defined part of its life (e.g. day, season, year) in order to eat, find shelter, and reproduce.
Homing: The ability to return home after travelling great distances. Or The inherent ability of an animal to navigate towards an original location through unfamiliar areas. This location may be either a home territory, or a breeding spot.
Illegal trade: The trade of high-value wild animals and products derived from wild animals across borders.
Inbreeding: Mating among related individuals or the sexual reproduction of offspring from the mating or breeding of individuals or organisms that are closely related genetically.
Indicator species: A species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem. Or They reflect the quality and changes in environmental conditions as well as aspects of community composition.
Indigenous species: A naturally occurring species or plant species, animals, fungi and micro-organisms that occur naturally in a given area or region.
Infection: The entry and development or multiplication of an infectious agent in the body of humans or animals.
Infestation: The external invasion or colonization of animals or their immediate surroundings by arthropods, which may 45 cause disease or are potential vectors of infectious agents.
***In-situ* conservation**: The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.
Invasive alien species: An alien species whose introduction and/or spread threaten biological diversity.
Invasive species: Organisms (usually transported by humans) which successfully establish themselves in, and then overcome pre-existing native ecosystems.
Invertebrate: An animal without a backbone (spinal column). This group of animals includes butterflies, worms, insects, spiders, and aquatic species such as snails, crabs and jellyfish.
Keystone species: A species whose loss from an ecosystem would cause a greater than average change in other species populations or ecosystems functions, processes and integrity; species that have a disproportionately large effect on other species in a community or a species that plays a large or critical role in supporting the integrity of its ecological community.
Mating season: The period during each year when a particular bird, animal or fish mates.
Migration: The movement of animals to and from feeding or reproductive and nesting areas or the movement of animals, fish and birds in search of food or shelter, often on an annual basis according to the seasons.
Migratory species: The entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.
Native species: Any species of flora or fauna that naturally occurs in an area and that was not introduced by humans.
Omnivore: An animal that eats both animal and plant matter; a generalist, opportunistic feeder that eats whatever is available.
Or A species in which some or all reproduction is organized on a sustained basis by humans, typically with long-term effects on gene pools.
Outbreak: The occurrence of one or more cases in an epidemiological unit.
Pandemic: An epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people.
Poaching: The illegal shooting, trapping, or taking of game or fish from private or public property.
Population: The total number of individuals of a species or a group of units sharing a common defined characteristics or factors regulating population levels including natality, productivity and mortality.
Predator: An organism that lives by preying on other organisms.
Prey: An animal hunted or seized for food, especially by a carnivorous animal.
Protected area: A geographically defined area which is designated or regulated and managed to achieve specific conservation objectives.
Q**uarantine station**: An establishment under the control of the Veterinary Authority where animals are maintained in isolation with no direct or indirect contact with other animals, to ensure that there is no transmission of specified pathogen(s) outside the establishment while the animals are undergoing observation for a specified length of time and, if appropriate, testing and treatment.
Ranching: Rearing in a controlled environment of animals taken as eggs or juveniles from the wild, where they would otherwise have had a very low probability of surviving to adulthood.
Range: The environmental conditions, or geographic area, within which a species occurs or in biology, the range or distribution of a species is the geographical area within which that species can be found, and accomplish its ecological niche or the amount of space needed by an animal in order to meet its survival needs.
Ranger: Any of the officers employed by the government to supervise the care and preservation of forests, especially public forests or a government official who patrols and protects forests, wildlife, etc.

Raptor: A bird of prey (such as an eagle or hawk) that kills and eats other animals for food.
Rare species: Wildlife species not presently endangered but with numbers so low that there is concern.
Recolonization: Colonize a region or a habitat again or reoccupation by a taxon of an area, site, or habitat from which it had previously disappeared.
Reintroduction: The release of individuals into a formerly occupied area after the native population have become extinct.
Restoration: Returning a resource to some prior condition by reestablishing ecological processes and functions or the return of an ecosystem or habitat to its original community structure, natural complement of species, and natural functions.
Safari park: Specialized zoos where the captive animals are housed in any large naturalistic enclosures and the visitors are allowed to enter the enclosure to view the animals in a mechanized vehicle or a predetermined route from close quarters.
Species: Groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups.
Species diversity: All the different species, as well as the differences within and between different species. Species native to and restricted to a particular geographic area.
Species richness: The number of species within a given sample, community or area. [UNEP, 2007] The number of wildlife species found in a given area.
Stocking density: The number of body weight of animals per unit area on a vehicle/vessel or container or the density of livestock at a specified site, expressed as numbers of animals or as Livestock Units.
Taxonomy: A system of nested categories (taxa) reflecting evolutionary relationships or morphological similarities or the science of classifying and naming organisms.
Territory: Part or all of the home range that is defended to the exclusion of other animals, especially conspecifics. Territories may be defended by individuals, breeding pairs or social groups, either year-round or seasonally.
Threatened species: A species that is likely to become endangered within the foreseeable future, throughout all or a significant portion of its range.
Translocation: The human-mediated movement of living organisms from one area, with release3 in another.
Vaccination: The successful immunisation of susceptible animals through the administration, according to the manufacturer's instructions and the Terrestrial Manual, where relevant, of a vaccine comprising antigens appropriate to the disease to be controlled.
Wild animal: An animal that has a phenotype unaffected by human selection and lives independent of direct human supervision or control.
Wildlife: Living, non-domesticated animals.
Wildlife conservation: A suite of adaptive wildlife management processes to restore or maintain indigenous wildlife species in diverse landscapes and habitats for the benefit of people or activity to maintain long-term wildlife population and their habitats within ecological limits with its resilience.
Wildlife management: The guidance of decision-making processes and the implementation of practices to purposefully influence the interactions among and between people, wildlife and their habitats to achieve impacts valued by stakeholders' or the application of science-based and local knowledge in the stewardship of wild animal populations and their habitats in a manner beneficial to the environment and society.
Wildlife trade: Any sale or exchange of wild animal and plant resources by people. This can involve live animals and plants or a diverse range of products needed or prized by humans—including skins, medicinal ingredients, tourist curios, timber, fish and other food products.
Zoonosis: Any disease or infection which is naturally transmissible from animals to humans. [OIE, 2014] A disease or infection that can be transmitted from a wild or domestic animal to people.

LIST OF WILD ANIMALS AND THEIR SCIENTIFIC NAMES

S. N.	Name of wild animal	Scientific name
1	Bison	*Bos gaurus*
2	Black buck	*Antelope cervicapra*
3	Chinkara	*Gazella bennettii*
4	Nilgai	*Boselaphus tragocamelus*
5	Wolf	*Canis lupus*
6	Lion	*Panthera leo*
7	Elephant	*Elephas maximus*
8	Wild Ass	*Equus africanus asinus*
9	Leopard or panther	*Panthera pardus*
10	Kashmir stag or hangul	*Cervus canadensis hanglu*
11	Peacock	*Pavo cristatus*
12	Siberian crane	*Grus leucogeranus*
13	Fox	*Vulpes vulpes*
14	Rhinoceros	*Rhinoceros unicornis*
15	Tiger	*Panthera Tigris*
16	Crocodile	*Crocodylus palustris*
17	Gavial or Gharial	*Gavialis gangeticus*
18	Horse	*Equus caballus*
19	Zebra	*Equus quagga*
20	Buffalow	*Babalus bubalis*
21	Wild boar	*Sus scrofa*
22	Arabian camel	*Camelus dromedaries*
23	Giraffe	*Giraffa camelopardalis*

24	House wall Lizard	*Hemidactylus flaviviridis*
25	Hippopotamus	*Hippopotamus amphibius*
26	Rhesus monkey or baudar	*Macaca mulatta*
27	Dog	*Canis lupus familiaris*
28	Cat	*Felis domesticus*
29	Cheetah	*Acinonyx jubatus*
30	Black rat	*Rattus rattus*
32	House mouse	*Mus musculus*
33	Rabbit	*Oryctolagus cuniculus*
34	Indian Cobra	*Naja naja*
35	King cobra	*Ophiophagus hannah*