# Practical Manual

on

# Wildlife Biology

**FWM-136 3(2+1)**

**For B.Sc. Forestry students**

**Dr. Swati Shedage**

**2019**

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

**Wildlife biology FWM-136 3(2+1)**

**Practical:** Visit to various protected areas and observations on the morphological, behavioural feeding and reproductive activities of different species of wild animals in India. Various study methods on the wild animals, such as focal animal sampling, Sherman trapping, mist netting, camera trapping, for identification, determination of age and sexing of animals including the small mammals. Faecal analysis of wild animals.

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**APPENDIX**

## MORPHOLOGICAL, BEHAVIOURAL, FEEDING AND REPRODUCTIVE ACTIVITIES

**FAMILY: CERVIDAE (**Antelope) Scientific name: *Tetracerus quadricornis*

**Morphology:** The Four-horned antelope is one of the smallest Asian bovids. These antelopes have four horns, which distinguish them from most other bovids, which have two horns. Only males in this species grow horns. One pair of horns is located between the ears, and the other on the forehead. Four-horned antelopes have a slender body with thin legs and a short tail. Their coat is yellowish brown to reddish in color. The underparts and the insides of the legs are white. Facial features include black markings on the muzzle and behind the ears. A black stripe marks the outer surface of each leg.

**Behaviour:** Four-horned antelopes are active mainly during the day. They are solitary by nature but may form loose groups of 3 to 5 animals. These groups consist of one or more adults, sometimes accompanied by juveniles. Males and females interact only in the mating season. These antelope are shy and elusive. When alarmed, they stand motionless and may nervously leap away from the danger or even sprint. To escape predators, they often hide in tall grasses. Four-horned antelopes don't usually use alarm calls to alert others because they try to avoid the attention of predators. However, in extreme cases, these calls may be used to warn predators that they have been identified. Adults mark vegetation in their territories with a secretion of preorbital glands and maintain multiple latrine sites.

**Feeding habit:** Four-horned antelopes are herbivorous animals. They feed on grasses, herbs, shrubs, foliage, flowers, fruits and need to drink water frequently. Diet Herbivore, Graminivore.

**Reproductive habit:** Reproduction Season-July September, Pregnancy Duration- 8 months, Baby Carrying 1-2 calves, Independent Age-1year, Female Name – doe, Male Name- buck, Baby Name - calf.

Little is known about the mating system in Four-horned antelopes. The breeding occurs during the rainy season, from July to September. Females give birth to one or two calves after the gestation period that lasts around 8 months. Calves are born fully developed and weigh 0.7 to 1.1 kg (1.5 to 2.4 lb). They are kept concealed for the first few weeks of birth and remain with their mothers for about a year.

**FAMILY: FELIDAE (Lion)** Scientific name: *Panthera leo*

**Morphology:** Lions are the biggest cats in the world. A female lion is called a lioness. The color of lion vary from blonde to Tawny, Gold and Brown. The mane color of males vary from blonde to red, brown & black. Lions have extraordinary eyes and are great hunters at night.

**Behaviour:** The lions are nocturnal animals. They are the symbol of royalty and bravery. They spend much of their time on resting. They rest for about 20 hours a day. Although they can be active at any time. Lionesses are better hunters than males and do most of the hunting for a pride. Most lions live in a group called a pride. Habit of lion is open woodland, scrub, grassland. Lions are excellent swimmers. A lion in the wild can live up to 14 years but in a zoo, they can live up to 20 years.

**Feeding habit:** In Wild lion feed on Wildebeest, Zebra, Giraffe, Buffalo, Baboon etc. Occasionally they scavenge food, chasing away hyenas & other carnivores from their kills.

**Reproductive habit:** Age of Sexual Maturity:2 - 3 years, gestation period 110 days, average litter size is 3, age of weaning is 6 months. Lions show their affection by rubbing their heads against another's head, face or neck. Lions are the only members of cat family to display sexual dimorphism. A baby lion is called a cub

**FAMILY: CANIDAE (**Jackal) **Scientific Name:** *Canis aureus*

**Morphology:** Jackals grow to a length of about 85–95 cm (34–37 inches), including the 30–35-cm (12–14-inch) tail, and weigh about 7–11 kg (15–24 pounds). Golden jackals and African golden wolves are yellowish, the black-backed jackal is rusty red with a black back, and the side-striped jackal is greyish with a white-tipped tail and an indistinct stripe on each side. There are three species of jackal. There's the black-backed jackal; the golden, or common, jackal; and the side-striped jackal. All three species are about the size of domestic dogs. They grow to 27 to 33 inches (70 to 85 centimeters) shoulder to rump, with a tail length of about 10 inches (25 cm). They stand about 16 inches (40 cm) at the shoulder and weigh 11 to 26 lbs. (5 to 12 kilograms), according to the Animal Diversity Web. (ADW). The distinguishing characteristics of each species are denoted in their common names, according to the ADW. The black-backed jackal has black hair running from the back of the neck to the tail. The rest of the body is reddish-brown or ginger and the chest is white. Side-striped jackals are light grey to tan with a white stripe from elbow to hip and black side stripes. The golden jackal's coat is usually yellow to pale gold and brown-tipped, but the colour can vary with season and region

**Behaviour:** Some jackals are social creatures, while others are not. Some live together in small groups called packs, while others live alone or in pairs. Packs typically include around six members.
Jackal pairs do everything together, including eating and sleeping. They are also very territorial and defend their territory as a team. They also hunt together. According to the  HYPERLINK "http://animaldiversity.org/accounts/Canis_aureus/" ADW, jackal pairs who hunt together are three times more likely to get a successful kill than a single jackal.
Jackals are often both diurnal and nocturnal. This means that they are active during dawn, dusk and night. Side-striped jackals are the exception. They are strictly nocturnal.

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Jackals are often both diurnal and nocturnal. This means that they are active during dawn, dusk and night. Side-striped jackals are the exception. They are strictly nocturnal. As omnivores, jackals like to eat both meat and vegetation. Their diet consists of leftovers from other animals' kills, ground-dwelling birds, reptiles, antelopes, fruits, insects, berries and grass. They're not picky, though. They will also eat human trash if something more suitable isn't available. Jackals will even eat decomposing or diseased flesh, according to Animal Planet

**Reproductive habit:** Jackals have one mate for life, and both parents help take care of the young. After a gestation period of 57 to 70 days, the female will give birth to two to four babies in her underground den. They are born with their eyes sealed shut and it take them around 10 days for their eyes to open. Baby jackals are called pups. Pups eat mother's milk and regurgitated food until they are weaned at 2 months. Most jackal pup deaths happen before they are 14 weeks old. Many are swooped up by eagles and eaten. To protect her pups, a mother jackal changes her den every two weeks. Pups start hunting at around 6 months, but mom and dad still take care of them as long as they need it. Jackals become sexually mature at 6 to 11 months of age. Some jackals leave their parents at 11 months. Some stay and babysit, protect and feed their younger siblings. Jackals typically live 10 to 12 years.

**FAMILY: ELEPHANTIDAE (Elephant)** **Scientific name*: Elephas maximus***

**Morphology:** Elephants are mammals of the family Elephantidae and the largest existing land animals. Three species are currently recognised: the African bush elephant, the African forest elephant, and the Asian elephant. Elephantidae is the only surviving family of the order Proboscidea; extinct members include the mastodons. The family Elephantidae also contains several now-extinct groups, including the mammoths and straight-tusked elephants. African elephants have larger ears and concave backs, whereas Asian elephants have smaller ears, and convex or level backs. Distinctive features of all elephants include a long trunk, tusks, large ear flaps, massive legs, and tough but sensitive skin. The trunk, also called a proboscis, is used for breathing, bringing food and water to the mouth, and grasping objects. Tusks, which are derived from the incisor teeth, serve both as weapons and as tools for moving objects and digging. The large ear flaps assist in maintaining a constant body temperature as well as in communication. The pillar-like legs carry their great weight.

**Behaviour:** Elephants are social creatures and live in complex hierarchical communities. Each herd has one female that is the matriarch. She dictates where the herd goes and helps to teach the younger elephant’s proper behaviour. Female elephants, or cows, live in multigenerational family groups with other females. Males stay with the family until they reach 12 to 15 years of age, when they leave the herd and live alone or join up with other bulls.

**Feeding habit:** Elephants eat between 149 and 169 kg (330-375 lb.) of vegetation daily. Sixteen to eighteen hours, or nearly 80% of an elephant's day is spent feeding. Elephants consume grasses, small plants, bushes, fruit, twigs, tree bark, and roots**.**

**Reproductive habit:** Male and female elephants live separately with bulls only visiting when some of the females are in their mating season, known as estrus. Elephants mature later than many other animals. Females reach sexual maturity at 10 to 12 years of age, males at around 25. A male doesn't generally start breeding until age 30, when it has reached a sufficient weight and size to compete with other breeding males. At that point, it will start to seek out females in estrus. Bulls enter a state called musth once a year, and older bulls tend to stay in musth longer than younger bulls, up to six months. During this period, they have increased levels of testosterone. At 22 months, elephants have the distinction of having the longest gestation period of all animals and give birth to live young. Pregnancy almost always results in a single birth; twins are rare. The offspring are cared for by the mother and other female family members until age eight, and females occasionally nurse young other than their own. When threatened by a predator, adult elephants will form a protective ring around the young elephants. Females stay in the family group while males eventually are driven away.

**FAMILY: EQUIDAE (Horse) Scientific name*:*** *Equus caballus*

**Morphology:** Morphology of a horse: large hoofed and maned domestic animal of the ungulate family. Raised by humans for pulling loads and for transportation. Ear: organ of hearing. Nape: back of the neck. Throat: front of the neck. Mane: long hair growing from the neck of a horses. Neck: part of the horse between the head, the withers and the chest. Withers: part of the horse between the back, the neck and the shoulder blade. Back: upper part of a horse's trunk. Hip: joint connecting the rear leg to the pelvis. Rump: hindquarters of a horse. Buttock: fleshy part under the tail. Tail: extension of the spinal column of a horses. Thigh: upper part of the rear leg. Leg: part between the thigh and the hock of the rear leg. Hock: point of the part of the gaskin behind the knee. Cannon bone: the part fo the gaskin behind the knee. Fetlock: tuft of hair behind the fetlock joint. Pastern: part of the horse that corresponds to the first phalange. Stifle: part of the leg of a horse between the thigh and the kneecap. Flank: side of the trunk of a horse. Fetlock joint: joint between the cannon and the pastern. Toe: front of the hoof. Hoof: developed nail that enclosed the end of the toes of a horse. Coronet: upper part of a horse's hoof. Canon bone: part of the foreleg between the hock and the fetlock joint. Knee: joint of the leg. Shoulder: joint that connects the foreleg with the body. Breast: the front of the horse's body. Throat: front of the neck. Cheek: side of the head. Jowl: rear side part of a horse's jaw. Lower lip: fleshy part that covers and protects the lower teeth. Mouth: entrance to the digestive tract. Upper lip: fleshy part that covers and protects the upper teeth. Nostril: entrance to the respiratory system. Tip of nose: end of the nose. Nose: front of a horse's head, just above the nose. Eye: sight organ of a horses.

**Behaviour:** Horses are social animals that under feral conditions (or on pasture) live in bands (harems) that consist of several mares, their offspring up to 2–3 yr of age, and at least 1 and as many as 6 adult males. The core of the group is the mares, which stay together even if the stallion leaves or dies. The group size ranges from 2 to 21 horses; multiple-male bands are larger than single-male bands. Groups are not limited to a specific geographic area and will travel in search of resources. Colts and fillies leave the group usually before 2 yr. of age (when they become sexually mature), stay alone for a few months, and then join a different group or establish a new one. Some colts may form a "bachelor band" with up to 16 males, and later join other groups in which the stallion has died or been chased away.

**Feeding habit: T**he natural feeding habit of the horse is to eat small amounts of roughages often. Domestication has brought a change to this. Modern management practices of horses incorporate stabling, increased grain-based concentrate consumption, meal feeding and limited access to pasture.

**Reproductive habit:** Puberty in horses varies a lot with breed. It can occur from 8-24 months. Well-fed horses usually reach puberty at around 12 months, but feral horses would be much later. The mare's oestrous cycle is stimulated by increasing daylight so she is sexually active in spring and early summer. She comes into heat 4-18 days after foaling so the foal can be in a dangerous situation from the stallion during this period in the wild. A mare is pregnant for 11 months. If not mated she will cycle every 3 weeks and she is on heat for 5-15 days.

**Heat signs are:** Plenty of vocalisation - especially if she sees other horses. Frequent stopping to urinate. Standing with hind legs parted and in a crouch with tail held up. Swollen vulva. Viscous vaginal fluid running from the vulva. Eversion of the vulva called clitoral flashing or winking. Restless - always looking for company. Tail twitching Stud mares are tested for standing oestrus using a "teaser" or small pony stallion who is too small to mate the mare. But don't believe that as some get very cunning! Mares not quite right on heat are happy to meet the stallion, but will squeal, kick and bite him. They are best tested over a gate to prevent injury to both parties. A mare right on heat will stand firm when the stallion mounts and lean back to take his weight. After mating the stallion will stand around resting and the mare may come and try to stimulate him again. Hand mating can be a dangerous time for the handlers as there is always the risk of being kicked or bitten. Full protective clothing including head protection and body armour should be worn and strangers should be kept away.

**FAMILY: PRIMATE (Gibbon) Scientific name:** *Holook holook*

**Morphology:** They are also known as lesser Apes or smaller Apes. Exhibits less sexual dimorphism. They are tailless. They form long term pair bonds. Primary mode of locomotion - Brachiating or arm swinging (55km/hr.). Biped walking. Fastest among tree dwellers. Dark to light brown or shades of black and white in color. Common examples: i. Siamang (*Symphalangus syndactylus*) ii. The White – Handed / Lar gibbon *(Hylobates lar)* iii. Hoolock gibbons (3 species**).** Long hand and feet. Wrist sometimes work as ball and socket type. Fur color ranges from black to gray. Voice is very loud.

**Behaviour:** Like all primates, gibbons are social animals. They are strongly territorial and defend their boundaries with vigorous visual and vocal displays. Call can be heard up to 1km. Gibbons often retain the same mate for life (that is sexual monogamy). Sometimes go for extra pair copulation. They are natures best brachiates.

**Feeding habit:** 60% fruit based, also consume twigs, leaves, insects, flowers and occasionally bird eggs

**Reproductive habit:** Reach maturity at 7 to 8 years of age. They can breed any time of the year. The gestation period is 190-214days.

**FAMILY: AVES (Vulture)** **Scientific name:** *Cathartes aura*

**Morphology:** A vulture is a scavenging bird of prey. The two types of vultures are the New World vultures and the Old-World vultures. New world vultures include Californian and Andean condors. Old World vultures, including the birds that are seen scavenging on carcasses of dead animals on African plains. Vultures are medium- to large-sized birds of prey, which are known for eating carrion (the bodies of dead animals). There are 23 species of vultures. One of their characteristic behaviors is to soar in circles high above the Earth's surface, using rising air currents to maintain their elevation.

**Behaviour:** The most characteristic behaviour of vultures is their soaring behaviour. As the sun warms the Earth, it also warms the air. This causes the air to rise in upward currents called "thermals." Vulturess take advantage of these thermals by flying into the rising air, spreading their wings and soaring to great heights without beating their wings. Once in the air, they can spot carrion with their very good eye-sight, although some species use a well-developed sense of smell ("olfaction"). The larger vulture species require a habitat that allows them to see or smell carrion while they soar in the sky. This means their habitats usually include plains or savannas, although some live-in open mountain regions. Some smaller vulture species can be found in suburban areas

**Feeding habit:** Although they are classified as birds of prey, they rarely kill other animals. Vultures are almost exclusively carrion eaters. They usually feed in large groups, often with other vulture species and other carrion eaters. There is an immense amount of squabbling between these animals, but despite this, they can strip the body of the biggest mammal in just a few minutes.

**Reproductive habit:** It is believed that vultures form bonds for life with just a single other individual (monogamy). They become sexually mature at 5 – 7 years of age. The females of larger species usually lay only a single egg, whereas smaller species lay 2 –3. The parents can produce offspring once every 1 – 2 years. Vulture eggs are incubated for 38 – 68 days (depending on the species), and only 10% of the chicks survive their first year.

**FAMILY SERPENTINE (King Cobra)** **Scientific name:** *Ophiophagus hannah*

**Morphology:** The King Cobra is a slender, long and agile species with a roughly-wedged head which is broad and flattened. The snake consists of an olive-green, black or tanned colouring with faint yellow cross bands that are distributed throughout its body length. The head of a mature King Cobra is massive, bulky in appearance with 15 rows of dorsal scales that run along the center. While males exhibit 235 – 250 scales along the ventral side, females have in total 239 – 265 scales. The subcaudal scales are either single or paired that further enhance the intricate scales on its glistening body. The snake sheds or moults several times a year and a new skin is grown with eye caps after every stage of moulting.

**Behaviour:** King Cobras are shy predators that only show their presence during the mating season, a time during which they are very territorial and aggressive. King Cobras are generally docile but may be vicious when felt threatened. They are solitary in nature and can be cannibalistic if there is a scarcity of food. There have been observations that a male King Cobra attacked a pregnant female during the mating season. This behaviour had puzzled biologists for a long time before they came with a suitable explanation for this. It is now believed that King Cobras, especially aggressive males, tend to kill their own kind either for food or when a snake travels through their territory. he mating itself has a duration of 20 minutes at a minimum wherein the two entwine their bodies together, and are often remaining attached afterwards for hours or even days. Around eight weeks later, during the month of April or early May, the female King Cobra produces several eggs in a nest that she builds particularly using twigs and leaves. 20 to 30 days before this clutch, the female formulates the nest by collecting twigs and leaves by looping her tail around the scattered stack. The nesting mound can measure 3 to 5 meters in radius in which the female will lay around 21 - 40 eggs. The incubation period carries forward for 11 to 12 weeks wherein the female ensures that the temperature remains stable (28 degrees of Celsius) for the eggs to hatch.

**Feeding habit:** Known as being a facile climber and swimmer, the King Cobra inhabits forests that are located close to streams and ponds. The reason behind this is that the species prefers a tropical climate where food is abundant. A rich and blooming forest that houses a number of small rodents and reptiles make up a large part of the King Cobra's diet. It preys primarily on small snakes, both venomous and non-venomous, birds and rodents.

**Reproductive habit:** King Cobras are territorial during the breeding season; a time wherein female Kings give off pheromones that attract potential mates. The mating season starts in January and begins with a molt in which these pheromones are attached. A male King Cobra may fight or compete for the same female by a method known as the 'neck wrestle'. Both snakes curl around one another and try to push down the other as an act of dominance. This is when the courtship begins and the male flicks his tongue over the female and waits for acceptance. Although many male King Cobras vie for the same female, they are known to be very picky.

**SHERMAN TRAPPING**

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. The traps are used to catch a wide variety of animals

including shrews, voles, mice, rats, chipmunks, flying squirrels, ground squirrels, and so much more. The most common reported uses are population studies, collection, teaching and ecological or environmental impact studies. Others use them for summer nature camps, or simply personal observation and pleasure. They are even used to promote fossil research. The Sherman trap made up of sheet metal (either galvanized steel or aluminum). Sherman traps are often set in grids and may be baited (provoke) with grains and seed. The trap has hinged (movable part, gate of trap is swinged open and close). This makes it compact for storage and easy to transport to field locations (e.g. in a back pack). Both ends are hinged, but in normal operation the rear end is closed and the front folds inwards. When an animal enters far enough to be clear of the front door, their weight releases the latch and the door closes behind them.

## MIST NETTING

Mist nets are used by ornithologists and bat biologists to capture wild birds and bats for research projects. Mist nets are typically made of nylon or polyester mesh suspended between two poles, resembling a volleyball net. Mist nets have shelves created by horizontally lines that create a loose, baggy pocket. When a bird or bat hits the net, it falls into this pocket, where it becomes tangled. The mesh (material made up of network of wire) size of the netting varies according to the size of the species *targete* for capture. Net height for avian mist netting is typically 1.2 - 2.6 m. Net width may vary from 3 to 18 m, although longer nets may also be used.

**Usage of mist netting:**

- Mist nets were used by Japanese hunters for nearly 300 years for capturing birds.
- They were first introduced into use for ornithology in the United States of America by Oliver L. Austin in 1947
- Mist netting is a popular and important tool for monitoring species diversity.
- There are two ways in which mist nets are primarily utilized: target netting of specific species or individuals, and broadcast netting of all birds within a particular area.
- Targeted netting is typically used for scientific studies that examine a single specie
- Some uses of data collected using mist net sampling are:
- Humane capture and relocation of small birds or bats (e.g., migrate birds relocate their home range or sometimes birds enter in the buildings or in the urban areas in such condition there is need to capture them and relocate in their home range).
- Tagging and tracking (to see the movement of particular species)
- Testing health of bird or bat species and for studies
- Examination of avian phenology in response to climatic and other variables
- Examination of patterns of molt (feather)
- The purchase and use of mist nets requires permits, which vary according to a country or state's wildlife regulations.
- Bird and bat handling require extensive training to avoid injury to the captured animals.
- Bat handling may be especially difficult since bats are captured at night and may bite.

## CAMERA TRAPPING

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. A camera trap is a remotely activated camera that is equipped with a motion sensor or an infrared sensor, or uses a light beam as a trigger. 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. The great advantage of camera traps is that they can record very accurate data without disturbing the photographed animal. Camera traps are increasingly being used to raise conservation awareness worldwide, with Non-governmental organizations (NGO)s. Wildlife conservation groups such as Panthera, Wildlife Conservation Society (WCS), World Wildlife Fund (WWF) have found camera trap videos and photos to be an important part of campaigns to save threatened or endangered species**.**

**Camera types:**

- The earliest models used traditional film and a one-shot trigger function. These cameras contained film that needed to be collected and developed like any other standard camera.
- Today, more advanced cameras utilize digital photography, sending photos directly to a computer.
- Even though this method is uncommon it is highly useful and could be the future of this research method.
- Some cameras are even programmed to take multiple pictures.
- 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 to increase the chances of capturing a useful image.
- Infrared beams can also be used to trigger the camera.
- Video camera is also an emerging option in camera traps, allowing researchers to record running streams of video and to document animal behaviour.

## FAECES OF ANIMALS

Animal dropping provide important clue in the field from which certain basic information can be drawn out (Their spatial-temporal utilization of habitat and their feeding habit). This evidence gives analysis of the habitat i.e., variation in utilization pattern of habitat due to seasonal changes. The dropping of carnivores is called as "scats". The dropping of herbivores is called as "pellets", Dung, Bolus.

**Scats:** In tigers and leopard much of flesh and bones are digested but the hair of the prey is excreted along with other undigested material. The presence of hair is clearly indicating the dropping of carnivores.

**Non-collectible type and collectible type**

- After feeding on a prey the first production of scat is semi-liquid form (non-collectible). The collectible form of scat has an aggregate of hair as well as undigested portion of bone.
- Scats also depend upon size of prey e.g. tigers after feeding on four horned antelope hardly produce any dropping but may do so in plenty after feeding on adult gaur.
- Carnivores have habit of licking their own body so that hair pass in to faeces.
- Certain omnivorous like sloth bear have mislleneous material in their droppings.
- Scat of wild dog and jackal have the same form. Wild dogs have tendency to defecate in group and dropping of dogs found in proximity.
  - Consistency of dropping depend mainly on food material
  - Dry food leads to hard faecal matter and soft food may result in soft consistency.
  - Sloth bear feeding on pod of *Cassia fistula* produce liquefied material with deep violet colour.
  - Bear feed on termites may produce mass of earth faeces with termite's exoskeleton

Dropping of deer and antelope are similar in form but their size may vary. Pellets of sambar deer are larger in size than the spotted deer. Due to larger body size of sambar deer. The dropping of nilgai is similar to sambar but nilgai defecate in the same point day after day. Frequent shower makes pellet lose and they may aggregate together in to dung like. This may be caused due to high mucous content and soft consistency of pellets. Langur produce irregular droppings which change according to their feeding habit. The dropping of wild hare resemble small groundnuts with some amount of undigested cellulose Dung of elephants are very large and easy to identify. They contain plenty of fibrous material. The dropping of porcupine is typical which has dark violet colour. Dropping of wild pig is sausage (cylindrical long) like in form.

## PUGMARK IDENTIFICATION

A footprint has two important characters: footprints gives idea about spatial and temporal utilization of habitat and direction of animal movement (movement from one place to another in search of food etc.)

- Form- It is species specific character
- Size- size helps to determine age of the animal.
- Sex determinations also possible- Adult, young
- Food print also provide clues some aspects of animal behavior:
- Footprints of sambar deer more abundance in dense forest then the open forest
- The interpretation is that sambar deer prefer dense forest for their habitat
- Two types of foot prints

  **Paws:** A. With retractile (mechanism capability of drawn back) claws e.g. Cats; B. With Non- retractile claws e.g. Dogs

Pugmark of a Dog

Pugmark of a Cat

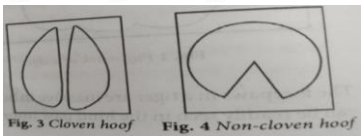
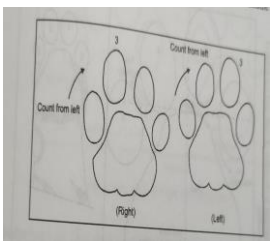


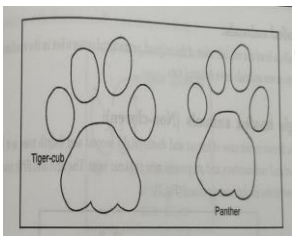
Fig. 3 Cloven hoof Fig. 4 Non-cloven hoof

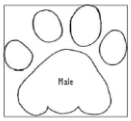
**Hooves: (hard part of foot):** Cloven: 2 portions with the cleft in between (e.g. Deer)- split in two hoofs; Non-cloven: single portion (e.g. Horse)

**Tiger pugmarks:** In case of the tiger shape of the toe indicate the sex of the animal.

- Pugmarks of male tiger has square or circular outline and female appear elongated and rectangular.
- The male tiger leaves rounded impression on both fronts and hind legs.
- Female toe pad is distinctly more pointed in the front
- Fore paws are massive in both sexes
- In normal ground condition only four toes



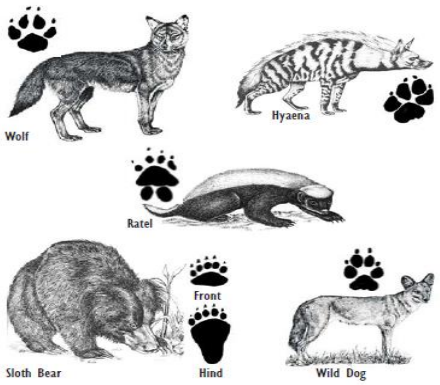




imprinted

- The first toe impression is found only in wet area (as foot goes deep in the soil).
- Third toe is always largest it can be used for reference for distinguish between left foot and right foot.

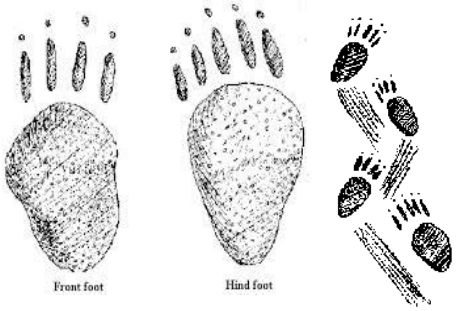
**Dog Family foot print**

- Foot print made by the animals from dog family e.g. Jackal, fox, dhol, wolf
- It is not possible to differentiate pugmarks of dog family as it all similar.
- Spoor of the hyena is typical and different from the Jackal, fox, wolf etc



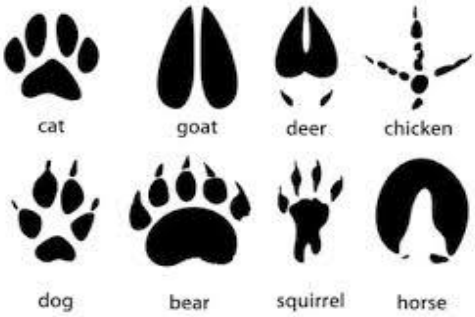

**Foot prints of other animals**

- Foot print of sloth bear appears flat because of its flat sole
- The foot print of porcupine on dusty path shows the impression of five toes along with the quill (Large feather from the wing) dragging in the rear.
- In hoofed animals two types
- Non-cloven: Horse and donkey, second and fourth toes are highly reduced and present near the knee joint.
- The first and fifth toe lost in the evolutionary process
- Coven hoof: (Deer and cattle's):
- The first toe has disappeared
- The second and fifth toes are situated high above the hoof and are called dew claws.




Footprint of porcupine

**Foot print of langur**




## DETERMINATION OF AGE AND SEX OF ANIMALS

A knowledge of sex and age data is essential in wildlife management. It is important to know the structure and status of a population with respect to habitat, health and behaviour. Such data have predictive and historical values and allow assessment of past management decisions. • Not much work done in India most of the concepts are based on work done in USA.

**Basic principles of age determination**

1. **Embryonic development:** Common methods used are egg candling and foetus examination on necropsy
2. **Continuous morphological development:** Investigation are done with respect to teeth annuli and changes in eye lens, horn rings and bone annuli.
3. **Growth maturation:** In growth maturation studies epiphyseal closure and the baculum changes are noted.
4. **Replacement and wear:** The condition of teeth, change in pelage, replacement of feather and their colouration are taken into account.
5. **General development:** observations are made with respect to weight, morphology, the general consistency and hardness of bone.
6. **Sexual maturation:** The development of primary and secondary sex organs is noted in case of birds; in some, the development of baculum is noted. For other animals, the of the penis and the length of testes are observed.

## AGE DETERMINATION OF MAMMALS

Various criteria used for age determination viz., the body height, Size, Size of horns, Size of tusk or antelers

- Male Elephant develop their tusk in two and half to three years of age. At the age of four they become sharp and thin.
- Antlers typical in deer family and they shed annually. In case of spotted deer during the first year, a small protuberance appears, and the brow tine is seed in second year, further development takes place in third year onward and by 7 the year the antler development is complete.
- In black buck numerous spirals are seen in the horns up to 5 years of age, each spiral is added annually to the horn latter the addition is the rate of half a spiral per annum.
- The coat colour of younger mammals is lighter than the adult. In very old animals the coat become dark. (sometimes it depends on species)
- Age mammals can be also determined on the basis of tooth eruption. An age wise chart of tooth eruption for each species would facilitate ready comparison for ageing.
- The size of pugmark and spoor also gives an indication of age.
- The length of coat strip also increases with the age
- Size and shape of droppings also use for age determination.
- In some species bear and dog the male has penis bone known as baculum, the changes associated with baculum serve as useful indicator of aging.

## SEX DETERMINATION IN MAMMALS

- Sex determination in mammals can be done easily by noting the external genitalia and secondary sexual characters.
- Some species exhibit sexual dimorphism which facilitate sex identification from distance e.g male lion has mane unlike female
- Among deer and antelope family male have antelers and horns respectively and the female lack of them.
- Different behavioural pattern also noticed in male and female. Females usually adopt a more submissive behaviour than the former.
- Footprint of certain animals like tiger also indicate sex. Male tiger has squarish footprint whereas female has rectangular one.
- The presence of suspensory tuberosities in the pelvic girdle also indicate the sex. As it presents in male.

## AGE DETERMINATION IN BIRDS

Accurate age determination is difficult task. Comparison of embryos of known age is helpful, Usually, eggs after known periods of incubation are opened up and the conditions are recorded and indicated in a chart for comparison. Embryos from deserted nests can be compared with such standardised chart for assessing age. Fledging or nestling stage: In this stage one can access the age in great extent. In most birds' young ones are either downy or naked (mode of downing is species specific). The body tail and feather arise in definite pattern. Body feathers usually start as small needles. Wing and tail feather also come out subsequently and after three to six weeks after hatching. Sub-adult stage: the stage between chick and adult. It can be easily recognised by size, body weight and plumage. The size of the comb and spur also give an indication of age. As far as waterfowl are concerned, the tips of tail feather are very delicate in juvenile birds. Cloacal characters: these are prominent sexing and aging as far as ducks and geese are concerned. The cloaca of bird is common outlet used both for reproduction as well as excretion. The bursa of fabricious is small structure which arise at dorsal wall of cloaca. This structure starts disappearing in some species as the bird approaches sexual maturity. Plumage is also useful in age and sex determination. Generally, birds new feather prior to the breeding season. The breeding plumage in male is more striking and different from those of female. In many gallinaceous birds (poultry or game birds) , the jaw does not calcify till about one year of age. Similarly, the bones of skull are also not ossified (turn in to bone) till adulthood and get crushed at the slightest pressure. Size of droppings also indicates the age. Bigger birds have larger droppings. In all birds most reliable criterion for aging is the weight of eye lens. The eye lens keeps on gaining weight throughout the life span of the birds. A comparative chart cane be prepared by recording the weight of lenses from birds of know age. Which will serve as a reference.

## SEX DETERMINATION IN BIRDS

**Plumage:** Usually three types of plumage are seen in the birds

- **Unimorphic:** here both the sexes have similar plumage viz. common crow and perching birds.
- **Dimorphic:** In some birds, the plumage of male and female differed; e.g. patridge, pea fowl and pigeons.
- **Breeding plumage:** In some species, male birds develop a special plumage. Which is quite distinct from those of the female, during the breeding season this is known as breeding plumage e.g. Herons, Jacanas, Pigeons
  - In some birds either the crest (white egrets) or back of the feathers (pond heron) elongated
  - Tail feather is elongated (paradise fly catcher and pheasant tailed jacanas)
  - Entire body plumage may change (e.g. Weaver)

- Calla can also be used for sexing; males have different call from female
- Colour of the iris of eye (male black stork has red iris and female has yellow iris)
- Body weight also use for differentiating male and female, males are heavier than female in perching birds, whereas females are heavier than male in unimorphic birds
- Some birds have dropping differentiation e.g. turkeys

## IMPORTANT TERMS

**Biological diversity** - The variety of life forms in a given area. Diversity can be categorized in terms of the number of species, the variety in the types of plant and animal species, the genetic variability of the animals, or a combination of these elements.

**Browse** - Palatable twigs, shoots, leaves and buds of woody plants. The term often is used to describe a category of deer foods.

**Carnivores** - The category of animals that prey or feed upon animals and insects. (carni-, flesh; vore-, eater)

**Carrying capacity** - The maximum number of animals that a specific area can support without causing habitat degradation.

**Community** - A collective term used to describe an assemblage of plants and animals living together.

**Conservation** – the protection, improvement, and wise use of natural resources by humans for present and future generations (sustainable and multiple use). See **preservation** for contrast.

**Cover**-A description of the protection and seclusion afforded by a combination of vegetation and topography. Some types of cover are:

- **Brood cover -** Low vegetation such as grasses or forbs that afford protection for ground nesters to raise their young.
- **Escape cover -** Thickets, vine mats, hollow trees, rock crevices, blowdowns or burrows that are a means of concealment from predators or hunters.
- **Nesting cover -** Vegetation that protects nesting sites: forbs, grasses, downed logs, shrubs, and trees for quail, grouse, many species of songbirds, and rabbits.
- **Roosting cover -** Overnight cover such as coniferous stands for wild turkey, shrubs for quail, dense pine saplings for doves, beaver ponds for wood ducks, or snags with cavities for woodpeckers, songbirds, squirrels, and other cavity users.
- **Winter cover -** Cover required for over-wintering, such as den trees for squirrels, raccoons and bear, or dense evergreen thickets for deer.

**Daylighting** - The cutting back of canopy and mid-story vegetation that borders logging roads. Exposing road surfaces to sunlight increases drying and prevents erosion, and "daylighting" promotes rapid regrowth of herbaceous plants and shrubs that provides cover for wildlife along the road.

**Den tree (cavity tree)** - A tree that contains a weather-tight cavity used for nesting or protection.

**Dispersal** – An animal's abandonment of its home range, in search of habitat for a new home range. This can include leaving a natal site (where the animal was born) to move into a territory with less direct competition to live and reproduce.

**Diversity** - The distribution and abundance of different plant and animal species within a given area.

**Domesticated** – A species altered by humans via an evolutionary process with the goal of benefiting humans, though the animals often benefit as well.

**Ecosystem** – A dynamic complex of plants, animals, and other organisms, along with their non-living environment, interacting as a functional unit.

**Ecosystem management** - The concept of resource management that considers land, water, air, plants, and animals to be an entire system that should be managed as a whole. All of these elements are interrelated (including humans).

**Ecotone** - The transition zone between communities. For example, the transitional area between field and forest. Ecotones often are rich in species as they harbour species from adjoining communities and their predators.

**Eco-tourism** – A form of tourism where visitors travel to enjoy, study, and appreciate nature as a way to promote conservation and support the socio-economic status of local human communities.

**Edge effect** - Refers to the diversity and abundance of wildlife that are attracted to areas where two or more vegetative types or age classes meet. Edge effect often is a result of the stark contrast between adjacent landcover created by humans (e.g., cropland, closed canopy forest, and urban).

**Endangered species** - A species is endangered when the total number of remaining members may not be sufficient to produce enough offspring to ensure survival of the species.

**Endemic species** – A native species living within a restricted geographic area and not occurring anywhere else.

**Exotic or Alien or Non-native species** – A species that occurs in a given region or area as a result of direct or indirect, intentional or accidental, introduction by humans.

**Extinct** – A species becomes extinct when the last of its kind has died.

**Feral** – An animal of a domesticated species that now lives without any direct human supervision or control.

**Flyway** – An established air-route of migratory birds, such as ducks and other waterfowl.

**Food chain** – The sequence of plant and animal feeding interactions at different levels within a particular community. Energy is transferred from the lowest level to the highest level (e.g., plants are eaten by insects, which may be eaten by frogs, which may ultimately be consumed by birds).

**Forage** - All browse and herbaceous plant foods that are available to animals.

**Forb** - Any herbaceous plant other than grasses or grass-like plants.

**Forest type** - Groups of tree species commonly growing in the same stand because their environmental requirements are similar. North Carolina examples include oak-hickory, loblolly-shortleaf pine, oak-pine, and oak-gum-cypress.

**Game** – Game species include any wild birds, fish, and mammals that are legally hunted or trapped by humans for food or sport.

**Habitat** - An area that provides a species of animal or plant with adequate food, water, cover, and living space. Without reference to a specific species, the term habitat is somewhat meaningless because each plant or animal species has unique habitat requirements.

**Herbivore** - The category of animals that feed on plants. (herbi-, plant; -vore, eater)

**Home range** - The area used by an animal to acquire the food, cover, and water it needs to survive and reproduce.

**Inclusion** - Small areas within a stand which have an inherently different composition and structure (and possibly management history) than the stand in which they occur. They can be treated differently than the remainder of the stand.

**Insectivore** – The category of animals that feed on insects.

**Invasive species** – Plants or animals that are not native to an area and which establish themselves and overcome or outcompete pre-existing native species.

**Keystone species** – A species that plays a critical role in the stability and integrity of its ecological community.

**Legumes** - Plants that capture organic nitrogen from the air. These plants, which typically form seeds in pods, include soybeans, peas, alfalfa, lespedeza, and locust.

**Mast**-Fruits or nuts used as a food source by wildlife.

- **Hard mast** is the fruit or nuts of trees such as oaks, beech, walnut, chinquapin, and hickories.
- **Soft mast** includes the fruits and berries of dogwood, viburnums, elderberry, huckleberry, spicebush, grape, raspberry, and blackberry.

**Migration** – Movement of animals to and from feeding or reproductive areas, often on an annual or seasonal basis.

**Native species** – Any species of plant or animal that occurs naturally in an area, not introduced by humans.

**Neotropical migrants** - The category of migratory birds that spend the winter in Central and South America and return to North America to breed.

**Nest box / structure** - An artificial box, platform, or other structure that enhances the reproductive cover for desirable species.

**Non-game species** – Wildlife species that are not subject to legal hunting, fishing, or harvesting.

**Omnivore** - The category of animals that feed on both plants and animals. (omni-, all; - vore, eater)

**Plant diversity** - A variety of plant species provides a variety of food or cover for wildlife. Variation may occur at one point in time or over a period of time such as during the course of a season. Seasonal diversity of food and cover is often critical to the survival of a species.

**Poaching** – The illegal hunting, shooting, trapping, or taking of a plant or animal from public or private property.

**Predator** – An animal that lives by preying on (consuming) other animals.

**Preservation** – Protection of a natural resource or natural area by severely limiting or eliminating human influence. See **conservation** for contrast.

**Prescribed burning** - The controlled application of fire to wildland fuels to attain planned resource management objectives (brush control, wildfire hazard reduction, wildlife habitat improvements, etc.).

**Prescribed burning cycle (return interval)** - The time between prescribed burns. This frequency, along with intensity, largely determines the response of the plant community to fire.

**Prey** – An animal hunted for food by a carnivorous animal.

**Range** – The geographic area in which a species occurs.

**Restoration** - Returning a resource, ecosystem, or plant community to its original structure and composition of species.

**Species** – A group of living organisms consisting of similar individuals capable of interbreeding.

**Stand** – A group of trees that are approximately the same in species composition, age class, and condition, often managed as a unit.

**Stewardship Management (Total Resource Management)** - The practice of managing all the natural resources as a whole. Using and enjoying the natural resources with responsibility and care for the future.

**Streamside Management Zone (SMZ)** - Buffer strips, filter strips, or riparian zones adjacent to water bodies. Width varies depending on a variety of factors, but must be sufficient to effectively prevent sedimentation and meet regulatory requirements.

**Succession** - The change in species composition and community structure over time, as in the development of a plant community from field to mature forest. Early successional plant communities are characterized by forbs, grasses and some shrubs and late successional plant communities are characterized by shade-tolerant tree species.

**Successional disking or mowing** - Mechanical methods of maintaining or promoting the regrowth of non-woody plants. Periodic disking shifts plant composition to annual forbs and grasses. Mowing maintains a perennial community of herbaceous plants and woody sprouts, but may promote a build-up of thatch that restricts access by some wildlife species.

**Territory** – Part of all of the home range that is defended by an individual, breeding pair, or social group for breeding, courtship, feeding, or other reasons.

**Threatened species** – A threatened species exhibits declining or dangerously low populations but may still have enough members to maintain or increase numbers. Threatened species are vulnerable to becoming endangered in the near future.

**Total resource management** - See **Stewardship management**.

**Understory** - The underlying layer of vegetation beneath the tree canopy and mid-story, including grasses, forbs, and shrubs.

**Wildlife** - A broad term that includes non-domesticated animals but not exclusively mammals, birds, reptiles, and amphibians. Some definitions may include fish and invertebrates.

**Wildlife openings** - Openings maintained to provide food or cover for wildlife, often with the intent of attracting game species and improving hunter success. The openings may contain native vegetation or planted crops and can be maintained by burning, disking, mowing, planting, and fertilizing.