

## AN OVERVIEW...

*CZA funded Project on*  
**COMMON FOOT AILMENTS  
IN CAPTIVE ASIAN  
ELEPHANTS OF SOUTH INDIA**



Tamil Nadu Veterinary and Animal Sciences University, the first Veterinary University of its kind in south east Asia has undertaken a Pilot study on " Common Foot ailments in captive Asian elephants of South India " for a period of two years from 2008 to 2010 funded by Central Zoo Authority of India, New Delhi. As a part of the project, this management guide is published incorporating comprehensive information on health care of captive Asian elephants with special emphasis to foot care and management for the benefit of Veterinarians associated with the health care of captive elephants, Wildlife and Forest Officers.

**For further details and suggestions please contact**

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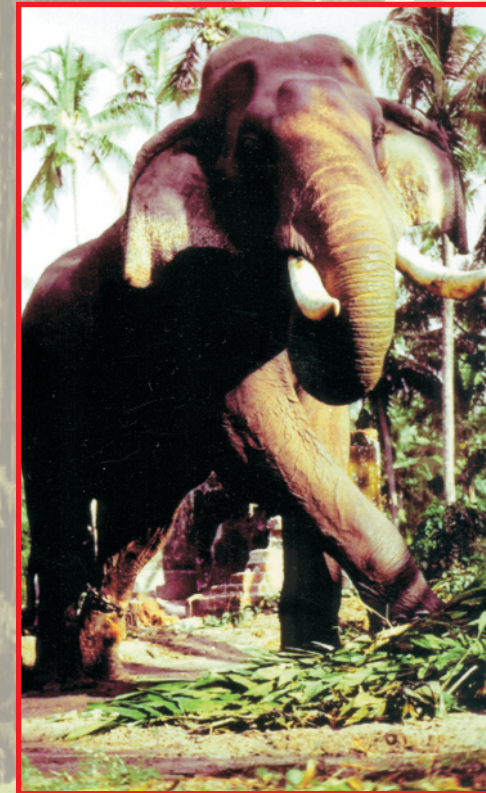
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## Veterinary Management of Captive Asian Elephants



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**2010**



Tamil Nadu Veterinary and Animal  
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# VETERINARY MANAGEMENT OF CAPTIVE ASIAN ELEPHANTS

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2010



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### FOREWORD

Elephants are portrayed and worshiped as the living symbol of Lord Ganesha in our country and intimately attached with Indian culture and tradition from vedic age. Our country is bestowed with more than 50 % of the world's Asian elephant population and especially South India has many age old temples with rich cultural heritage which are unique in maintaining elephants in captivity for celebrations and religious ceremonies. Scientific management and health care practices are most vital for the conservation of elephants, particularly the captive population which are considered as the future repository of genetic resources. Hence, the role of Veterinarians are increasingly important in the health care of captive elephants which is in a primitive stage and needs extensive research with dedicated personnel.

In order to provide basic information on scientific management and clinical approach in elephants, this book is compiled in a simple and comprehensive manner with informative diagrams and colour photographs. I am sure that this book will be a practical guide not only for the field Veterinarians associated with the health care of elephants but also to the students, researchers, forest and temple officials.

I congratulate the author and wish him to prepare many more useful books on wildlife health and conservation.

**(P.THANGARAJU)**  
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Place : Chennai – 600 051.  
Date : 20.01.2010

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## INTRODUCTION

Elephants are fascinatingly interlaced with the Indian culture, tradition and mythology from time immemorial. India is blessed with a huge share, more than 50% of world's Asian elephant population. In South India (Tamil Nadu, Karnataka and Kerala States) elephants are being traditionally maintained in captivity in the temples and by private owners. The existing population of Asian elephant is believed to be about 50,000 – 60,000 in the world which is very small, when compared to the population of about 7,00,000 of African elephants. No wild animal is more frequently portrayed in ancient Indian art than this mega herbivore. Because of their impressive, majestic size elephants have been used as a display of wealth and power since ancient times. There are approximately 3400 – 3600 captive elephants in India and out of which approximately 75% are owned by private individuals, 14% by the forest department, 6% by temples, 3% by circuses and 2% by zoo. Elephants are included in schedule –I of the Wildlife (Protection) Act -1972 since October 1977, which provides the highest degree of legal protection. During February 1992, Govt. of India launched a special scheme – Project Elephant exclusively for the conservation of Asian elephants and their habitat.

### Evolution of Elephants

According to the ancient Hindu mythology, the elephants are evolved from the Airavatha – the bull and Abirahmu – the female created by Brahma and given to the Devendra. Both of them were white skinned, had four tusks each and a pair of wings. As per the scientific aspects of evolution, the elephants evolved into the present form after undergoing changes for several million years from their ancestors viz., Moeritherium, Deinotherium, Trilophodon, Platybilodon, Mastodon and Mammoth. The first form of elephant is named as Moeritherium as the fossils of these creatures were found near Lake Moeris in Egypt. The Moeritherium resembled a pig. Scientists believe that it is from Moeritherium that other forms of elephant evolved by undergoing different morphometric changes

over the period of centuries and it is from the Mammoth that the present form of elephants have evolved. The fossil remains of Mammoth preserved in Siberia reveals that they were very tall measuring about 15 feet height.

Order : *Proboscidea*  
 Family : *Elephantidae*  
 Genus : *Elephas*  
           *Loxodonta*

## DISTRIBUTION OF ELEPHANTS

### AFRICAN ELEPHANTS ( *Loxodonta africana* )

There are two sub-species / races

1. Savanna / Bush Elephant - *Loxodonta africana africana*
2. Forest Elephant - *Loxodonta africana cyclotis*

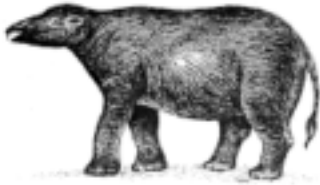
### ASIAN ELEPHANTS ( *Elephas maximus* )

According to the scientists working with Asian elephants in India, they are generally classified into six sub-species / varieties based on their physical features & geographical distribution and there are two races in Indian elephants.

	<b>Sub – Species</b>	<b>Distribution</b>
1.	<i>Elephas maximus indicus</i>	India
	<i>Elephas maximus bengalensis</i>	North Indian race
	<i>Elephas maximus dakamensis</i>	South Indian race
2	<i>Elephas maximus ceylonicus</i>	Sri Lanka
3.	<i>Elephas maximus burminicus</i>	Burma / Myanmar
4.	<i>Elephas maximus hirsutus</i>	Malaysia / Thailand
5.	<i>Elephas maximus sumatranus</i>	Sumatra / Indonesia
6	<i>Elephas maximus bornensis</i>	Pygmy elephants of Borneo

Some scientists do not agree with the differentiation of the mainland race in different sub-species but classify all elephants on the mainland from India to Malaysia in sub-species *E. maximus indicus*.

The Srilankan sub-species is referred as *E.m.maximus* by some scientists. There are regional differences in the appearance of Asian elephants and significant physical difference in appearance is noted between the elephants from south and north region of India. Elephants from north and north-east region are observed to have short and stout body with relatively small head & short trunk. Elephants from the south have long trunk and huge head.



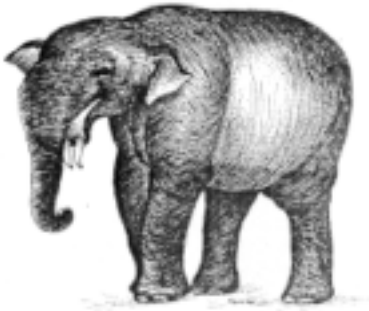
*Moeritherium*

**Deinotherium:** In Deinotherium, the tusks were found to be on the lower jaw.

**Platybilodon:** Platybilodon were very huge and weighed almost 8-10 tonnes.



*Platybilodon*



*Deinotherium*

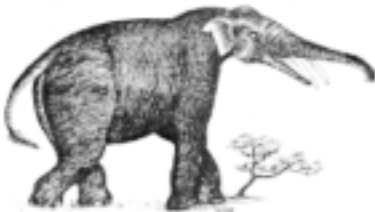
**Mastodon:** Huge sized elephants.



*Mastodon*

**Trilophodon:** Trilophodon had two pairs of tusks, one pair on the upper and lower jaw each.

**Mammoth:** The fossils of mammoths were found in Siberia. It is assumed that they died due to the cold. It is from mammoths that the present forms of elephants have evolved.



*Trilophodon*



*Mammoth*

## Differences between Asian and African Elephants

S.No.	Asian Elephants	African Elephants
1.	Comparatively smaller in size	Larger in size
2.	Shorter in Height	Taller in Height
3.	Twin domed fore head	Elongate, narrow face with flat fore head
4.	Highest point at the middle of the back	Highest point at the shoulder
5.	Comparatively smaller ears	Have larger ears
6.	Long and large trunk	Comparatively smaller trunk
7.	One finger like process at the tip of the trunk	Two finger like processes at the tip of the trunk
8.	Tusks seen only in males	Tusks seen in both the sex
9.	Commonly found to possess 18 nails	14 nails are common
10.	5 (or) 4 nails on each fore foot	4 nails on each fore foot
11.	4 (or) 5 nails on each hind foot	3 (or) 4 nails on each hind foot
12.	Back is arched convex	Depression on the back between fore and hind quarters
13.	Musth episode usually seen in males	Musth observed in both the sex. (But there is difference of opinion among scientists about this episode).
14.	Comparatively easier to domesticate	Difficult to domesticate
15.	Have smooth skin with yellowish brown (or) pinkish depigmented areas.	Skin is coarser and lacks depigmentation.

## Social organization of elephants in free ranging state

Elephants live in a matriarchal system and the leader of the herd is usually an older cow elephant. Within the social groups,

related females especially young, nulliparous females are engaged as allomothers or aunties, who may not only aid in rearing of calves but also benefit themselves from the experience of caring for the young of another female. Males are loosely attached to the herd for different periods of time (days to months) and they travel around solitarily in search of females in estrous. In summer, when there is scarcity of food and water, the large herd breaks up into smaller herds and when favorable conditions return, they reunite to form a large herd. In the wild, elephants forage for many hours daily and have been found to consume more than 100 different species of plants.

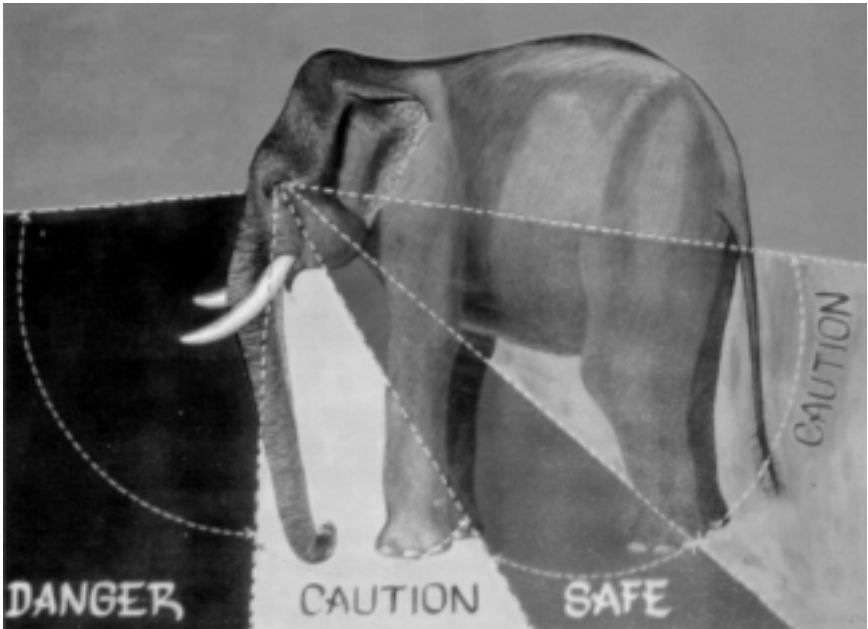
Elephants inhabit mixed deciduous, evergreen forests, dense tropical rain forests, scrub and grass lands, plain and hilly forests with perennial river, lake or other water sources. In the wild, they are migratory in nature traveling for long distances in search of food and water generally on regular pathways called elephant corridors. The conflict comes when these pathways are disturbed and encroached by human interference.

Female elephants in the wild are known to remain reproductive throughout the year and are engaged in calf rearing and maintenance of long term familial relationships with their female relatives. Male elephants have very different social needs. In the wild, the males leave or driven out of the family group as they approach sexual maturity and spend as much as 90% of their lives alone or in loose association with other bulls. Providing an appropriate social structure also contributes significantly to the well being of captive / semi captive elephants in a number of husbandry related areas. For females and calves, the herd interaction provides the best environmental enrichment possible. Calves provide tremendous stimulation to the herd, as a result all the elephants move around more, get more exercise, and put more activity on their foot, potentially decreasing foot problems. Health management of captive elephants will be very successful by understanding their social organization in the wild and provision of husbandry conditions in captivity simulating the natural free ranging state.

## SPECIAL FEATURES OF ASIAN ELEPHANT

### (Special features of different body systems and functions)

- E Head of the elephant is not so heavy as it looks, because the skull bones are filled with air sacs ( pneumatic bones ) for easy movement. Size of the neck is not proportionate to that of the head and so elephants have a short neck to balance their huge head. Generally adult Asian males may weigh around 3.5 to 5.5 tons and adult females weigh around 2.5 to 4.0 tons.
- E The eyes are relatively small in size and cannot see objects at long distance. The colour of the eye is like honey or dark brown normally. A third eyelid / nictitating membrane within the eye which protects the pupil is a feature in elephants and this makes application of medicine into the eye difficult. Hence medicines should be applied from the outer canthus of the eye. The eye sight is very poor and it relies very much on its sense of smell. Elephants can recognize people by their sense of smell even after years.



Courtesy : Elephant study centre, Kerala Agricultural University



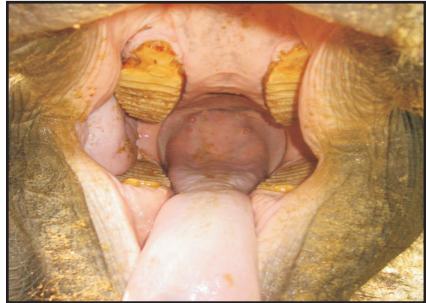
Gajarajan Kesavan (Statue)



Asian & African elephants \*



Social organization in the wild



Oral cavity of elephant \*\*



Teeth and Tusks



Scrub bathing

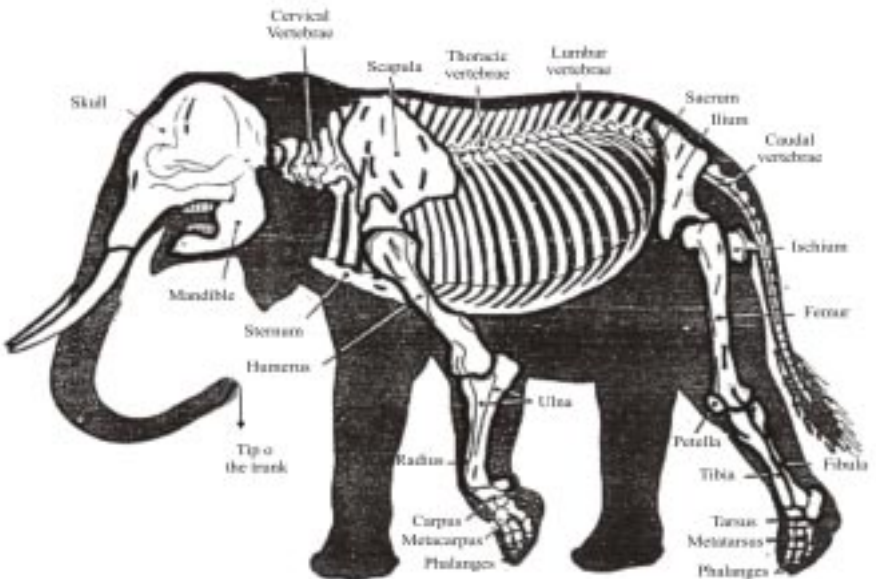


Elephant palm (*Caryota spp*)

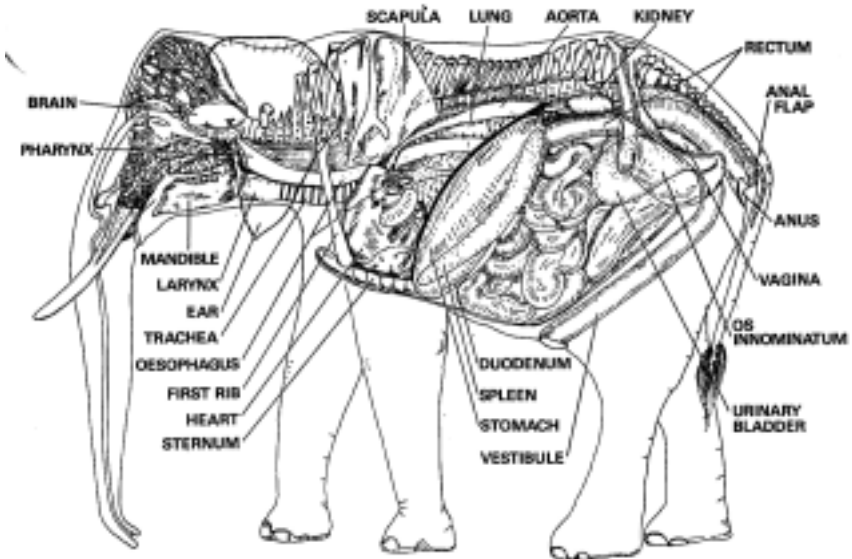


Concentrate food

- E Elephants do not have true eyelashes. The nictitating membrane contains a small but well developed harderian gland and is the main source of lubrication for the corneal surface. Elephants lack a naso-lacrimal duct running from the eyes to the nose, hence lacrimation with mild discharge of clear fluid from the eyes is normal and it is common to see tears on the face.
- E There are several functions to the ear including acoustics, balance, thermoregulation, information transfer, sound location and con-specific signaling. Since elephants are thought to have a poor thermoregulatory system, the pinna plays an important role in the heat dissipation by flapping the ears.
- E Elephants are the first terrestrial animals found to produce and hear infrasonic sounds and can communicate with other members of the group through infrasonic waves. Frequencies below the normal audible range are called infrasonic waves.



- E The region between the frontal projection and the base of the trunk produces vibrations and they can perceive thunder several miles away and will move towards that direction to find the rain. Hence the elephants are considered as one of the indicator species in the natural eco system.
- E Since elephants have few sweat glands they depend on their ears for thermo-regulation. Blood from various parts of the body is transported to the ear where it is cooled due to its fanning action and then flows back into various parts of the body, thus regulating the body temperature.
- E The upper ridge of the ear starts folding inwards from the age of 10 – 15 and folds about an inch around 25–30 years of age approximately with individual variation.
- E Trunk is an elongation of upper lip and nose fused together, composed of about 40,000 -1,00,000 muscle units (exact number is unknown) without bone and is used in multiple ways equivalent to a human hand.



- E The Asian elephant has one finger like process on the tip of its trunk which is very sensitive and by which it could pick up even a small peanut from the ground.
- E Six group of muscle units viz., the two radial, two longitudinal and two transverse / oblique layers of muscles present in the trunk allow the shortening, extension, bending, twisting movements accounting for the ability to hold and manipulate loads of about 300 kg. This muscular and tendinous ability combined with nervous control allows extraordinary strength and agility movements for the trunk to do simple tasks like sucking, spraying of water, spraying of dust and heavy works like transferring heavy loads, timber logging etc.,
- E An elephant drinks about 60 - 75 liters of water at one time and up to 150 - 200 liters in a day. The trunk of an adult elephant can hold 8 - 10 liters of water at a time. Normal elephants have moist nostrils with a small amount of clear fluid present in the tip of the trunk.
- E Though the elephant can breathe through both the mouth and trunk, 70 % of the air intake is through the trunk. The pharynx is a funnel-shaped tube that provides a passage way for the respiratory and gastrointestinal tracts.
- E Tusks are the beauty and also the bane of an elephant. There are tuskless males known as makhnas which are more robust than tuskers. The upper two incisors in elephant have undergone exaggerated evolutionary development to form tusks in males and tushes in females. Only 2/3 of their length is visible.
- E It is observed that a pair of temporary tusks or milk tusks of about 5 cm in length may appear at the age of eight months in some calves but not in all and sheds off within two years.
- E Tusks are the extension of upper incisor teeth and in males the permanent tusks start appearing at the age of 2 – 2 ½ years and grow approximately 3 – 4 inches per year throughout its life.

- E Most of the tusk is composed of a combination of hard, elastic calcium salts and dentin. The pulp is composed of blood vessels, nerves and lymphatics. A crack or a hole in the tusk that exposes the pulp canal may lead to infection. A small black spot at the end of a tusk may be an indication that an infection is present.
- E At a given time there are only four molars in use in the mouth of an elephant. There are such six sets of teeth during the whole life span of an elephant.
- E The gradual horizontal progression of each set of teeth to the grinding position is called as the molar progression - a phenomenon seen only in elephants. Each molar in the elephant is a combined massive structure of particular number of laminae that are cemented together which can be counted to understand the approximate age, although the mouth opening is not very wide and it may be difficult to count in the living elephant.
- E The teeth are replaced at various ages in an elephant's life time. The first set of teeth appears when the elephant is one month old. The second set appears by six months. These are replaced when the elephant reaches 2 ½ years of age. This is followed by further replacements at 6, 15 and 40 years of age. The age of an elephant can be approximately estimated by observing its teeth. The sixth set is the largest of all the sets and measures approximately 1 foot in length, 2 inches in breadth, weighs about four kilogram and has 24 ridges.
- E Molar teeth are worn down and shed in sections and they are replaced by the next tooth pushing forward from behind and not from the bottom unlike other animals. Therefore it is difficult to make a clear age estimation just by the molar teeth because we never know how many laminae of the current molar are already worn out and shed. Each new tooth is larger than the preceding one.

## DIFFERENT TYPE OF TUSKS IN ELEPHANTS

A. According to plane



unevenness - either tusk higher than the other



Totally opposite to each other

B. According to thickness



Thick and massive tusks



Thin tusk-like tusks

C. According to parallelness



Parallel



Divergent



Convergent

D. According to angle to the ground



Sufficiently recurved to enable carrying of a log



Short, thick, no recurving



Sloping towards ground, slight recurve



Straight towards the ground



Short, straight tusks of no particular distinction

- E Elephants have two openings on the upper palate / roof of their mouth called as Vomero-nasal openings which acts as scent glands.

Molar set	Number of laminae	Age of Appearance	Age of Replacement / worn out
1	4	4 months	2 - 2 ½ years
2	8	6 months	6 years
3	12	3 years	9 years
4	12 (broader)	6 years	25 years
5	16	20 years	50 - 60 years
6	24	40 years	Life long

- E The tongue is fleshy and non-protrusable because of its attachment to the floor of the mouth. The tongue has an inwardly projecting fold / depression in the middle that aids in directing food backwards into the mouth. The taste and gustatory sense is well developed in elephants with the presence of numerous taste buds in the circumvalate and fungiform papillae.
- E The pleural cavity / space although present in young ones, is absent in adults. Hence the lungs are directly attached to the chest wall and diaphragm. The visceral and parietal layer of pleura is occupied by a pleural sac of connective tissue. This is a three dimensional fibrous network with fluid filled pockets allowing movement and sliding of visceral pleura during breathing. Since there is no negative pleural pressure to aid inflation of lungs, respiratory movements are solely induced by the muscles of the chest and ribs. Hence dog sitting posture or sternal recumbency is a dangerous posture in elephants especially when they are tired since the absence of pleural space makes breathing a difficult process leading to suffocation. Even long periods of lying on one side could some times lead to this serious problem if position of the internal organs compromise breathing.

- E Although the typical mammalian heart is about 0.6 % of the animal's body weight, in elephants it is only about 0.5 % and the heart may weigh 12 - 21 kg.
- E The heart of the elephant has a bifid apex with only one coronary artery. RBC's of elephant are the largest of all mammals with a mean diameter of 9  $\mu\text{m}$  ( 8.8  $\mu\text{m}$  - 10.5  $\mu\text{m}$  ). The total blood volume of an elephant will be around 7 percent of its body weight (Ref : M.E. Fowler)
- E The vertebral column forms the central beam of the body and is made up of C 7, T 19 - 20, ( 20 - 21 in African elephants ) L 4, S 4, Cy 28 - 30 vertebrae and no anticlinal vertebrae in elephant. Hence the side ways bending of the animal is difficult and a fall on the sternum may be fatal for an elephant.
- E The skin is comprised of two layers: the external - nonvascular epidermis and the underlying dermis composed of collagen with nerves and blood vessels. Skin thickness varies considerably over the body from the ear to the hind quarters.
- E Elephants can adapt to a wide spectrum of habitats from deserts to forests and therefore are classified as mixed feeders in the wild. They can change their diet according to the season.
- E The elephant has a relatively small mouth compared to the size of the body and it cannot be opened widely. The salivary glands present in the mouth and the mucous glands in the short oesophagus help in the initial digestive process by lubricating the coarse vegetation of the elephant diet.
- E Elephant feeds on all three tiers of plant life i.e. lower ( grass ), middle ( bush ), and upper ( canopy ) tiers. Elephants have very clean feeding habits like horses. While grazing they pull out a bunch of grass and dust the mud and dirt against their legs before eating it.
- E Elephants are generalized feeders, feeding on bushes, tree branches, bark, palms, seedlings and a variety of grasses.

In captivity elephants are typically fed with green fodder, cultivated roughages and concentrates.

- E The elephant liver has 2 - 3 lobes. The right lobe is largest when two lobes are present. There is no gall bladder in the liver but biliary canals are present.
- E Elephants are hindgut fermenters. The stomach is simple with expansible folds where partial digestion of the ingested food takes place. 70% of the digestion occurs in the huge sacculated caecum and proximal colon. The caecum is the first important fermentation site in the digestive tract. The colon is regarded as the main digestive area of the elephant. The digested materials are absorbed through the relatively thin and highly vascularized mucosa of the caecum.
- E The presence of anal flap is a speciality in elephants and should be everted while attempting to insert the thermometer into the anus for taking temperature. Use non-contact infra-red thermometer for temperature assessment without stress to the animal. In Asian elephants, the normal body temperature is  $36.9^{\circ}\text{C}$ , ranges from  $36^{\circ}\text{C}$  –  $37^{\circ}\text{C}$  ( $96.0^{\circ}\text{F}$  to  $98.0^{\circ}\text{F}$ ). It is reported that the temperature in the fecal bolus may be  $0.7^{\circ}\text{C}$  higher than the body temperature due to bacterial action.
- E Elephants defecate 15 - 20 times a day. The number of fecal boli may vary from 5 – 8 at a time and each boli may weigh around 1 – 2 ½ kgs. Elephants are efficient seed dispersers and the seeds that pass out in elephant's dung are highly viable and germinate easily.
- E The elephant kidneys are lobulated and contain 8 (+2) lobes. Elephants urinate 10 – 15 times / day with a total quantity of 50 – 60 litres. The color of normal urine varies from clear to straw colored with calcium oxalate / calcium carbonate and amorphous phosphate crystals. Specific gravity ranges

from 1.004 – 1.033 and the urine is always nearly alkaline ( pH :- 6.8 – 8.0 ). The physiological constituents of urine includes urea, uric acid, creatinine, sulphates, phosphates and hippuric acid.

- E The skin of elephant has very few sweat glands and nerve corpuscles. They are unable to tolerate high temperature or direct sunlight. Spraying themselves with sand or mud, evaporation of moisture from trunk, radiation of heat from ears, standing in shade, eating a great quantity of green succulent fodder are some of the methods adopted to cool its body.
- E Elephant is one among few animals that use tools in their day to day activity. They hold twigs / branches of the trees by the trunk to scratch their body and to remove the block in the temporal opening during musth to facilitate free flow of musth fluid etc.,
- E Elephants have nails instead of hooves and most of the elephants have 18 nails, 5 nails in the each front foot and 4 in the hind foot. 20 nails are very rare ( 5 nails on each fore and hind foot ) which is considered as very auspicious according to Gajasastra. The foot pad has a thick fatty cushion which not only provides a good grip while walking but also improves the blood circulation throughout the body.
- E Elephants can stand for long periods like horses and passerine birds as they have checked ligaments on their foot. Healthy elephants in captivity usually may not lie down during the day. Like humans and horses, elephants are also prone to arthritis because of the vertical position of their limbs. The ulna is larger than radius and no long bone has the marrow cavity which instead is filled with cancellous bone or red marrow.

- E A leg chain / trailing chain is always used when the mahout is not sure about the temperament of the elephant. A double rope is used around the neck for the mahout to keep his feet in position and to give toe commands during riding. Usually ordinary cotton rope with 2 ½ - 3 cms in diameter is used for this purpose.
- E Most animals flex their hind limbs forward while lying down, but elephants flex them backwards. It is possible to measure the height of the elephant, by measuring the circumference of the front foot. Twice the circumference of the front foot gives the approximate height.
- E In the absence of a weigh bridge, the following formula can be used for estimation of body weight in elephants.
- E Weight ( kgs ) = 18.0 G (Heart girth in cms) – 3336  
( Ref :- Hile *et al.*, 1997 )

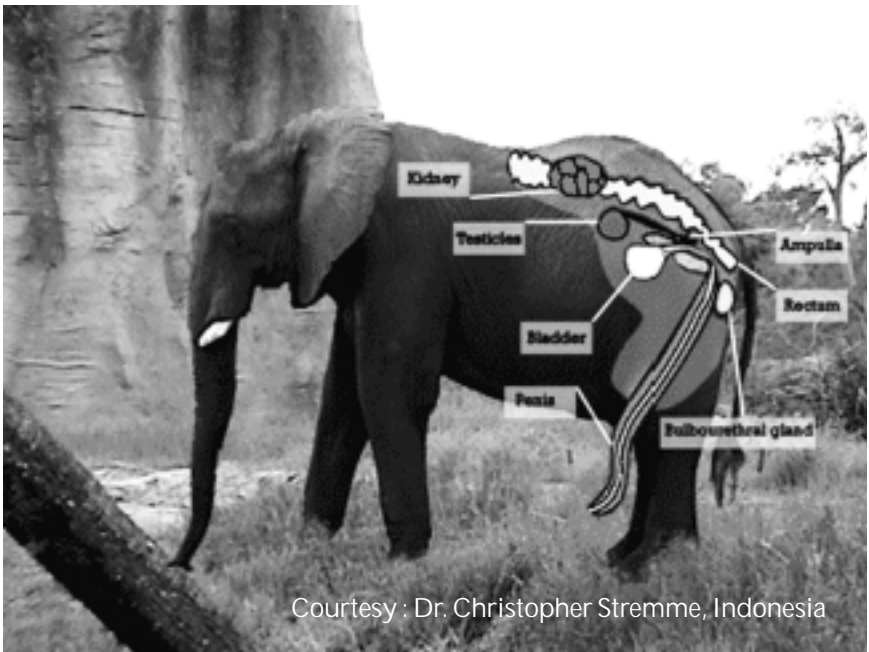
## **REPRODUCTION IN ELEPHANTS**

Elephants do not have a specific breeding season. Krishnamurthy (1992) suggested that a male:female ratio of 2:5-6 is ideal for captive life of elephants. In general, age at sexual maturity varies widely in both the sex depending on the plane of nutrition, physical activity and environment.

### **Male Elephants**

- E Age at sexual maturity : 14 - 15 years.
- E All the three accessory sex glands viz., Seminal vesicle, prostate and bulbo-urethral gland ( Cowper's gland ) are present.
- E Pampiniform plexus, cremaster muscles and inguinal canal are absent.
- E The length of the penis is about 4.5 feet, 15 inches in circumference and weighs about 20 - 25 kgs. The glans-penis is absent and the tip of the penis is more flat. It resembles and is flexible like the hood of the cobra. Testes are intra - abdominal.

- E There is no prepuce and the presence of large paired levator penis muscles are responsible for the flexibility of the penis during erection and copulation.
- E During musth testes enlarges very much in size (Functional hypertrophy ). Serum Testosterone levels increase to many folds during Musth ( 25 ng / ml ) when compared to the non-musth period ( 0.5 ng / ml ).
- E Male elephants have very different social needs. In the wild, the males leave / are driven out of the family group as they



Courtesy : Dr. Christopher Stremme, Indonesia

approach sexual maturity and spend as much as 95% of their life alone or in loose association with other bulls. Providing an appropriate social structure also contributes significantly to the well being of captive elephants in health and husbandry related issues.

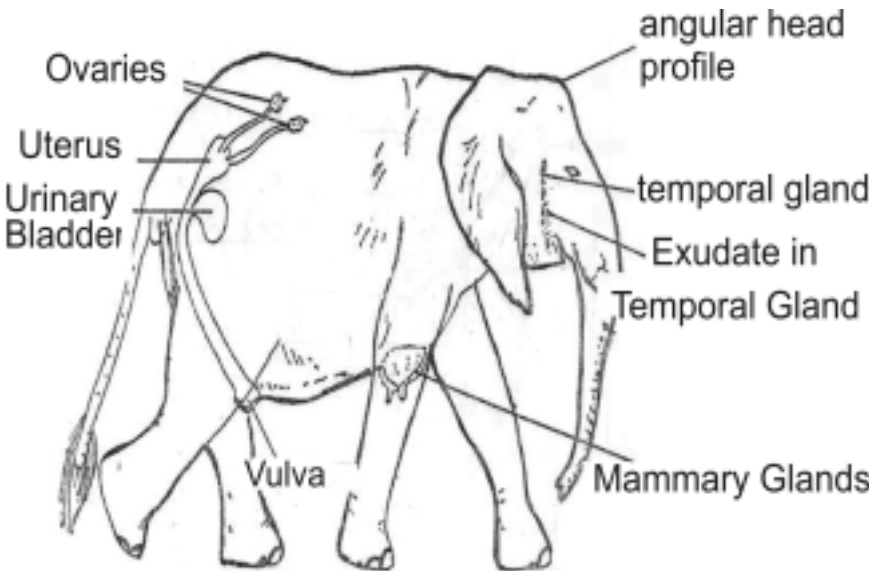
- E The mating process consists of prolonged courting, a short duration of penetration for about 1 – 2 minutes and a rest for about thirty minutes to one hour before next mating.

Mating will be repeated 4 – 6 times a day and it may last for 3 – 4 days. An ejaculate may have 50 – 100 ml of semen.

- E The average pH of semen is 7.05 and the elephant spermatozoa resembles equine spermatozoa in many respects.

## Female Elephants

- E Age at sexual maturity :  $15 \pm 2$  years generally (but nowadays some elephants reach sexual maturity as early as 8 years of age may be due to environmental and anthropogenic influences).
- E The duration of oestrous cycle is 13 – 16 weeks (longest of the mammals) with an 8 – 10 week luteal phase and 4 – 6 week non-luteal phase. Generally the estrous period lasts for 3 – 4 days.



Courtesy : Dr. Christopher Stremme, Indonesia

- E The uterus is " T " shaped (about 0.8 - 1 metre long with a short uterine body only 5 cm - 10 cm and the cervix is about

15 cm long and protrudes into the vagina with a rosebud like appearance and resembles that of equines. The ovaries are rounded, slightly lobulated and placed in a bursa and located near the kidneys.

- E The vagina measures about 60 cms and the wall is thin and highly flexible. The clitoris is very long and big measuring about 30 – 60 cms in length and 1.5 – 2.0 kgs in weight and help in directing the penis into the urogenital canal for copulation.
- E The average gestation period is about 20 - 22 months.
- E Vulval opening is present in between the hindlegs which is a speciality in elephants and the vestibule is long and vertical. The special anatomical position of vulva in female elephants makes the erected penis to form a cobra shaped hood to facilitate penetration.
- E Mammary glands are pectoral in position and the teats have multiple openings.
- E Female elephants are known to remain reproductive throughout most of their lives, this is their primary activity beyond eating and drinking. Hence the focus of captive elephant management for female elephants should be the opportunity for reproduction, calf rearing and maintenance of long term familial relationships.
- E Pregnancy can be diagnosed around 13 months of gestation by observing / feeling the kicking movements of the fetus ( Quickening ). Increased size of the mammary gland can be seen from 5 to 6 months onwards but varies with individual elephants. An increase in blood prolactin can be measured from 6 months onwards. By ultrasound ( if sufficient equipment is available ) pregnancy can be detected using trans-rectal ultrasound after 2 months and trans-cutaneous ultrasound after 12 months.

## MUSTH

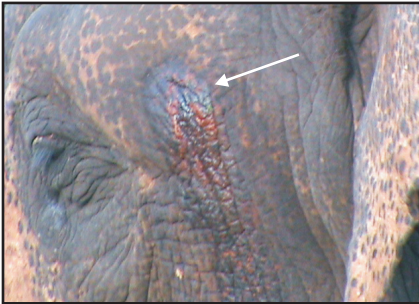
- E Musth is a normal physiological phenomena occurring annually in male Asian elephants.
- E Occurs more regularly in well nourished and healthy male elephants between the age group of 21 - 80 years.
- E Temporal glands are modified skin glands located on either side of head just beneath the skin, above the zygomatic arch, half way between the lateral canthus of eye and external opening of ear. Histologically it is a tubulo-alveolar gland and during musth it enlarges in size and produces foul smelling musth secretion.
- E Earlier in many American and European zoos, male Asian elephants on attaining sexual maturity used to be shot dead for the fear that they might develop musth. They even experimented with various surgical techniques including castration to prevent or to contain musth but with very little impact.
- E Moda (or) juvenile musth is observed in the age group of 15 - 20 years.
- E Duration of musth period ranges from 3 weeks to 3 months.
- E Initially during pre-musth, the temporal gland discharge will be viscous and dirty brown in colour with a strong odour. This viscous fluid may some times block the temporal opening or the opening may be too small to allow free flow of fluid. Since it will be very uncomfortable for the elephant, it may scratch the temporal opening with a twig or any other sharp object which may lead to injury or abscess some times.
- E During pre-musth there will be increase in body weight and body size especially the head, neck and trunk region and shining of the skin is also observed.



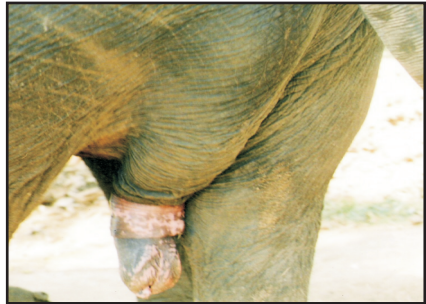
**Kumki elephant - Mudumalai**



**Musth - Aggression**



**Temporal secretion**



**Penile / Perineal enlargement**



KSS

**Musth - Act of masturbation**



**Krall - for training elephants**



**captive family**

## Stages of Musth

Stage	Signs	Period
I. Pre-musth	<ul style="list-style-type: none"> <li>• Frequent rubbing of temporal gland opening with the trunk or twigs.</li> <li>• Erection of penis with enlargement and attempts for masturbation.</li> <li>• Enlargement of temporal gland and oozing of fluid.</li> <li>• Swelling at the perineal region.</li> <li>• Tendency to gore and an intense feeling of vengeance towards mahouts.</li> <li>• Unruly behaviour and ears are spread out</li> <li>• Aggressiveness</li> </ul>	10 – 14 days
II. Musth (Violent musth )	<ul style="list-style-type: none"> <li>• Penetrating, more viscous, bitter smelling secretion from the temporal glands.</li> <li>• Red mark around the temporal region.</li> <li>• Permanent dribbling of urine from unerected penis.</li> <li>• Increased alertness.</li> <li>• Unusual vocalization.</li> <li>• Stiff and tense body.</li> <li>• Charging or destructive tendency.</li> <li>• Fully open eyes with rowing eye balls.</li> </ul>	30 – 40 days.
III. Post – Musth	<ul style="list-style-type: none"> <li>• Reduced secretions</li> <li>• Normal behaviour and urination</li> </ul>	Rest of the period

## MUSTH MANAGEMENT

- E The elephant must be strongly chained with one of its foreleg and opposite hindleg with a strong object. He should be left alone, should not be excited.
- E The tethering site must be slightly inclined to facilitate drainage of urine and fecal matter.

- E Provide ad libitum drinking water and shower with water, 2 - 3 times / day.
- E Showering water in the temporal region regularly will not only cool down its temperament but also help in removing the block in the temporal opening facilitating easy drainage.
- E Studies reported that a combination of Flutamide @ 500 mg, Haloperidol @ 100mg and Potassium iodide @ 20mg orally, once in a day for 3 days may be effective in controlling the aggressive behaviour. Scientists working with elephants emphasize that this should be used in elephants with prolonged musth period only and should not be used to stop the regular musth.
- E There are several traditional preparations used to control musth in different regions and though there is no recorded scientific proof on their effectiveness, mahouts use them as they believe to have active anti-androgenic properties. The ethno-veterinary therapy on musth management has to be explored for their effective use.
- E Some scientists reported that keeping a female elephant near by a musth male will reduce the aggression while another school of thought is that it may continue to stimulate his libido and instead, keeping two or three strong males around him serves a better purpose in making him docile much faster.
- E The elephant being an intelligent animal, the presence of any restraint tools like chains, ropes, hobbles etc., will psychologically make the animal to obey the commands and the feeling of freedom will make the animal to misbehave many times.
- E Scientists working with Asian elephants in western zoos in protected and free contact system believe that construction of separate musth enclosures / pens should be considered consisting of two compartments divided by a sliding door

operated from outside. This would ensure the elephant to be kept safe and able to be shifted between the two compartments of the musth enclosure. Modern zoo facilities in many countries provide such enclosures for protected contact management of their males.

## **PREGNANCY DIAGNOSIS IN ELEPHANTS**

The mahout is certainly the first to detect the mating and pregnancy. If he suspected mating to have taken place, he could look for the following signs.

- E Scars or marks of the male's feet, on the cow elephant's back.
- E Remnants of seminal fluid, along the inside of thighs and at the vulva.

### **Physical changes**

The first physical signs of pregnancy begin to manifest from the first month onwards.

- E Cows delivering for the first time, will show an enlargement of breast. This is not so obvious for those that have delivered before.
- E Gait becomes slower and hence quality of work also decreases.
- E A viscous fluid oozes out when the breasts are squeezed and breasts tilt laterally.
- E During the 13<sup>th</sup> month, it is possible to feel the foetus kicking inside the womb, from outside (Quickening). This can be checked when the elephant is being given scrub bath.
- E Cervical mucous is observed 12 – 14 hours before parturition.

### **Care during and after pregnancy**

- E The cow should not be allowed to work, after the 13<sup>th</sup> month, until the calf is born and is at 6 months of age.
- E Regular moderate exercise shall be continued during the entire pregnancy to ensure physical fitness, crucial for smooth delivery to prevent dystocia.

- E Overweight needs to be avoided as it can lead to dystocia.
- E The quantity of ration or concentrates is raised. A special diet consisting of vitamins, minerals, soaked green grams and coconuts are provided. Daily 6-10 coconuts are provided one month before delivery and 8-10 coconuts after delivery. Coconut milk contains several nutritious materials and enhances the quality of mother's milk.
- E The average birth weight of an elephant calf is 80 – 100 kgs. The mammary glands are pectoral and teats have many opening –Lactophores ( 8 – 10 No's ).

## **ORPHAN ELEPHANT CALF MANAGEMENT**

During the first three months of birth, the elephant calf is solely dependant on its mother's milk. Hence the management of orphaned elephant calves can be of two categories.

- 1) Those that have never received colostrum and
- 2) Those that have received colostrum atleast for some time

Generally it is a very challenging task to rear calves which have not received colostrum as they invariably develop enteritis and other digestive problems and the mortality rate will be high even with mild change in feeding, husbandry and management in spite of best attention.

The elephant calf should be reared separately and should never be left alone especially during night hours. The calf must be kept warm at night, especially in winter. Elephant calf is scared of the dark and a light must be kept on all night. Successful rearing and management of an orphaned elephant calf especially up to the age of 2 years is an art involving a good team work.

The elephant calf will start to drink milk within 30 minutes of its birth generally, but some may take its own time. However the new born calf should drink milk / colostrum within the first 24



Lactating mother



Suckling elephant calf



Feeding orphaned elephant calf



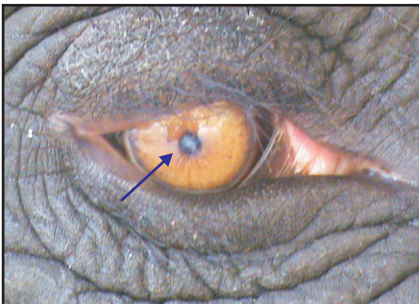
Debilitated captive calf



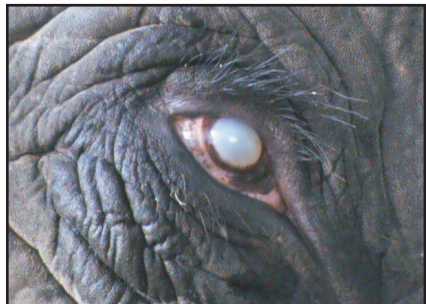
Healthy captive calves



Third eye lid



Mild Corneal opacity



Complete Corneal opacity

hours after birth. In natural condition, an elephant calf consumes about 2 to 10 litres of colostrum.

The elephant milk is thin, watery, white in colour and sweet. The composition often varies at different stages of lactation, especially the fat content varies from 0.635 to 9.0%, protein content from 1.9% to 3.0% and carbohydrates 4% to 8%. Hence the composition of artificial milk should be modified according to the digestible capacity of the calf at regular intervals for better management.

Fatty acid of elephant milk fat is comprised of capric and lauric acid (82%), while in cow's milk, palmitic and oleic acid are the predominating fatty acids. The lactose concentration in elephants milk is only about half of the humans but twice the energy content/litre (~ 1200kcal in elephants and only ~600kcal in humans/litre) which often causes diarrhea if human milk replacer is used without adjusting lactose and energy levels. The fat level is high during weaning time and the lactose level decreased with advancement of lactation. The milk is poor in vitamins A and D but rich in vitamin B. Elephant calves getting balanced adequate milk show a growth rate of 2 – 3 cms per month.

Young calf will drink milk equivalent to about 10-15% of its body weight per day. This is comparable to one litre of milk per 10 kg of live weight daily. This can be slowly reduced once the calf starts to digest solid foods with an age of about 5 months. The milk must always be fed at body temperature at 38 ° C.

The calf may reject the milk that is too warm or too cold that differs from what the animal is used to be. Sometimes the milk offered in low temperature may upset the calf. A hungry calf make frequent sound / call and if we keep our finger tip carefully on the tip of the mouth, the calf will attempt to suckle. When its stomach is full, the calf may tend to sleep with moderate to good snoring.

From birth to 3 months of age, the elephant calf must be fed every 2 hours with infant milk powder - Lactogen – II along with

500 gms of glucose / day, vitamin-A, B, D and calcium syrup and mineral supplements except during night hours. The quantity of milk powder used should be gradually increased from 500 gms to 1.5 kg over 3 months of age. From 3 to 6 months of age they are fed every 4 hours and in addition to milk powder, cereals in the form of fresh rice gruel or ragi gruel can also be provided.

Cooked brown rice - 0.5 kg, Glucose powder - 0.2 kg, dried skim milk powder of bovine origin - 100 gms and water - 8.5 litres comprising a total quantity of 10 litres. This can be fed for a day at different intervals. In addition to brown rice gruel and tender coconut can also be given. Big size feeding bottle with tube like nipple or a clean large enema can with tube can be used for feeding.

Goat's milk is one of the suitable milk replacer than cow's milk because of the presence of smaller sized fat globules and if not available cow's milk can be diluted twice and used temporarily before getting milk powder. Bovine skim milk powder or Soya milk powder can be mixed with milk replacer formula gradually by observing the acceptance of the calf.

The first vaccination of Anthrax for the elephant calf can be done at six months of age and revaccinated once in a year. From 6 months onwards they will begin nibbling grass and solid food, hence the milk powder quantity is gradually reduced and supplementary ration in the form of cooked rice should be added in the daily diet to ensure good growth rate.

### **SELECTION OF ELEPHANTS ( Desirable and Un-desirable traits )**

- E Dignified look with massive head, broad fore head and head held high. To have / make this many times mahouts poke ankus on top of their nails or poking in their chin especially during festivals which must be discouraged.
- E The two projections on either side of the head should be big, raised and evenly separated. They should not be close together.

- E The fore head bump should be raised, broad and projecting outwards.
- E The portion of the face between the eyes and tusk must be broad and long.
- E Eyes should be bright, honey or brown coloured, without any opacity or excessive flow of tears. Red eyes indicate aggressive behaviour / angriness.
- E The trunk should be fleshy, broad and long, touching / trailing on the ground with a long, strong and triangular tip which is considered as auspicious. Elephants from north and north east of India lack this quality and they have a comparatively short trunk.
- E The trunk should be broad at the base, blotched in front with pinkish spots.
- E The tusks are very important for a male elephant which makes it appealing and also forms one of the identification factor among males. The ideal quality is that the tusk should grow downwards from the base, diverging, rise up and then be evenly separated. The colour must be that of butter or sandal wood.
- E The temporal region where in the temporal glands are located should be bulging and if this region looks depressed due to loss of fat or flesh, it can be assumed that the elephant is tired or weak.
- E Some owners believe that if the upper palate of the mouth or upper surface of the tongue is black or has black spots, the character of the elephant is unreliable.
- E The body should be long and the abdomen should always look full / big.
- E Skin should be soft, elastic & wrinkled, black or greyish black in colour due to the presence of large amounts of melanin pigment. Albinism or the so called White elephants occur when there is lack of melanin pigment on their body.

- E Wild elephants have more hair on their body compared to captive elephants as they are shed during the regular scrub by the mahouts. If more than one hair arises from a root it is considered as an indicator of long life and a good sign. These occur usually below the eye or between the eye & the trunk or on the sides of their chin.
- E Usually the penis is red in colour due to high blood circulation, but if there is a black region on it, the elephant is considered as inauspicious.
- E The fore and hind foot should be placed straight and firm on the ground. The legs should resemble pillars evenly bearing the weight of the elephant.
- E Presence of 20 nails in the foot ( in total ) is considered as very auspicious and very rare. As per Hindu mythology, the Elephant of Indira – Airavat had 20 nails and the Elephant Govindan Kutty of Thiruvambadi devaswom, Kerala had 20 nails (Ref. :Dr. K.C. Panicker). Elephants with 16 nails are considered as inauspicious for individuals to own, but it can be kept in institutions like temples, mutt, camps etc., The nails must be clear and smooth without cracks and must appear pronounced like the shell of a tortoise.
- E Tail should be of good length, free of hardness with good tuft of hairs. Some people feel that the elephant with twisted tail is inauspicious.
- E The elephant makes a mild gurgling like sound from the throat on seeing its mahout / owner and it may excrete dung or urine to express its happiness. Instead if the elephant remains still without fanning its ears and rolls its eye balls at people, then we must be cautious.

## FEEDING MANAGEMENT

- E Elephant is a non-ruminant herbivore with a similar digestive physiology as that of equines and in the wild elephants spend 60 - 70% of their daily activity in feeding. In the wild, elephants forage for many hours daily and have been known to consume more than 100 different species of plants.
- E Elephants can adapt to a wide spectrum of habitat from desert to forest and therefore could survive in different ecological regions with mixed feeding habits in the wild and their capacity to digest food is poor, only 40% is digested and the rest (60%) is passed out as feces.
- E Elephants feed on all three layers of plants, grass, bushes and tree and the barks provide necessary essential fatty acids and minerals to them.

### Daily Ration for Young Elephant Calves

Feed Ingredients	Age Group		
	6 months to 1 year	1 year to 3 years	3 years to 6 years
Ragi	2 - 4 kgs	4 kgs	6 kgs
Horse gram	-	1 kg	1 kg
Salt	30 gms	50 gms	50 gms
Jaggery	100 gms	100 gms	100 gms
Green fodder	10 - 25 kgs	25 - 50 kgs	50 - 90 kgs

- E The development of excess weight on elephants maintained in captivity is a great problem and this should be corrected by regulating and modifying the diet and activity of the elephant.

### Daily ration for an elephant weighing 3000 kgs

#### Roughages

150 – 200 kgs / day; in the form of bamboo leaves, grasses, ficus twigs, palm leaves etc.,

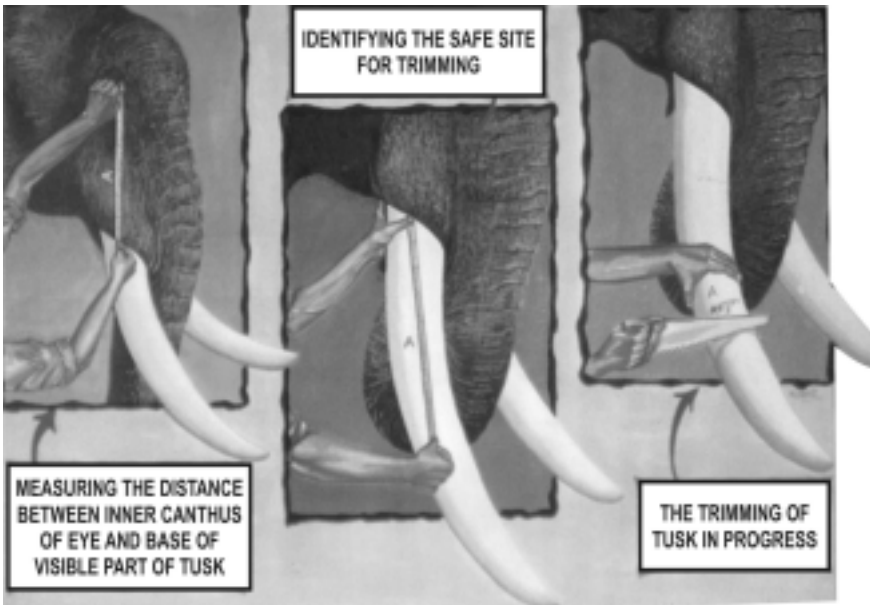
## Concentrates

Horse gram	-	4 kgs
Ragi	-	7 kgs
Rice	-	3 kgs
Salt	-	100 gms
Mineral mixture	-	100 gms
Jaggery	-	50 gms

- E Concentrate feeding should be done in 2 - 3 divided portions in a day to prevent acidosis.

## TIPS FOR TRIMMING / CUTTING OF TUSK IN ELEPHANTS

- E Tusks are modified incisor, the ever-growing structure of the elephant. The tip of tusks are usually trimmed, once in two years beyond a measured distance from its base which is equivalent to the distance between the inner canthus of eye and base of tusk of the respective side. Maximum of distal  $1/3^{\text{rd}}$  of the length of the tusk is seen outside.



Courtesy : Elephant study centre, Kerala Agricultural University

- E Before the operation, the owner of the tusker should apply for permission for trimming the tusk to the Chief wildlife warden of the state indicating the details and the Chief wildlife warden will issue permission to carry out the operation in the presence of Forest veterinary officer or any other competent officer.

## HOUSING MANAGEMENT OF ELEPHANTS

- E Elephants should be tethered on earthen substrate to the maximum possible in order to maintain their foot health and blood circulation throughout their body. They should not be allowed to stand on cemented / stoned / concrete flooring for a long time in the same place without adequate movement. This is one of the main problems in captivity which should be avoided.
- E In case of covered sheds, the height of the ceiling / roof should not be less than 4.80 metres. The elephant barn should be protected against cold and hot winds. The floor should not be wet and uneven.

Category	Minimum Floor Area (L x B)
Weaned Calf ( Height below 1.50 m )	5 m x 2.5 m
Sub-adult Elephant ( Height 1.50m to 2.25m )	7 m x 3.5 m
Cow Elephant with unweaned calf	9 m x 5 m
Adult Elephant (Height above 2.25m)	9 m x 5 m

- E Elephants should not be allowed to stand close to an electric post or compound wall since they may try to lean against or push them down.
- E The mahout should be advised while walking with the elephant to watch for concrete or cement slabs, septic tank lids or any other substrate which may collapse with the weight of the elephant and also glass pieces , sharp stones or metal objects which can create serious foot lesions and some times infections like tetanus challenging their life.

- E Elephants are very curious animals, use their sense of smell, touch and hearing to understand their surroundings which is called as cognitive learning. The mahout should allow the elephant to explore its environment and find its own understanding about various things happening around and should not discourage its curiosity.
- E For example, if an elephant is being taught to cross a bridge / to board into a vehicle, it will first sniff the bridge or the floor of the vehicle with its trunk and only if it is convinced of its safety it will cross the bridge / board into the vehicle. During this process the mahout must respect the elephant's fear with patience and gently guide the elephant to do the task. This will not only help the elephant to overcome the fear but also increases its trust towards the mahout.

### **TIPS FOR TRANSLOCATION OF ELEPHANTS**

- E For transportation of the elephants, necessary permission from the chief wildlife warden or any other officer authorized by the government in this behalf shall be obtained as provided under chapter V, section 48 - A of the Wildlife ( Protection ) Act – 1972.
- E A health certificate from a Registered veterinary practitioner to effect that the elephant is fit to travel by road or rail, as the case may be and is not showing any sign of infectious or contagious disease should be obtained in the form as given in the Annexure.
- E Elephant should be properly fed and given water before loading. Sufficient fodder should be carried and watering arrangement should be made.
- E Trucks with length less than 12 feet should not be used for carrying elephants except calves ( height below 1.50 m ).

- E One truck should not be used to carry more than two weaned calves ( height below 1.50 m ) or one cow elephant with one unweaned calf or one adult / sub-adult elephant ( height above 1.50 m ).
- E 12 hours rest should be allowed to elephants for every 12 hours of journey by trucks.
- E Cow elephants in advanced stage of pregnancy should not be transported by trucks.
- E While transporting elephants by rail or ordinary goods wagon should not transport more than three adult elephants or six calves on broad gauge, not more than two adult elephants or three calves on meter gauge, or not more than one adult elephant or two calves on narrow gauge.
- E Each truck wagon carrying elephant should have at least two mahouts and one attendant.
- E Sedatives should be used to control nervous or temperamental elephants if necessary, based on the advise of the Veterinary Doctor. ( Haloperidol / Xylazine).
- E Necessary precautions for avoiding jerks to the elephants during the journey should be made.
- E Animal should not be made to walk continuously for more than three hours.
- E Animal should not be made to walk more than 30 kms a day and any transportation for more than 50 kms should be carried out in a vehicle.
- E While transporting elephants by walk during nights, two prominent reflectors shall be placed at the front and hind portion of the elephant.

## COMMON DISEASES REPORTED IN ELEPHANTS

### Specific Diseases

<i>Bacterial</i>	<i>Viral</i>	<i>Parasitic</i>	<i>Non- infectious</i>
Anthrax	Pox	Round worms	Impaction
Tuberculosis	FMD	Amphistomes	Arthritis
Tetanus	Papilloma	Flukes	Constipation, Colic
Salmonella	Rabies	Cestodes	Sand consumption
HS	Herpes	Protozoa	Eye disorders and
Colibacillosis	Encephalo-	Trypanosomiasis	Ocular lesions
Leptospirosis	-myocarditis	Louse, Flies	Foot ailments
Black quarter		Cobboaldiasis	Rickets, Vit –A & E Deficiency, Wounds Injuries, Sunburn, Tusk injuries and Molar problems.

**E Endo-parasitic infection** :- Elephants heavily infested with gastro-intestinal helminths may be generally anaemic with frequent colic accompanied by foul smelling diarrhoea. In addition mud eating, oedematous swelling on the lower part of the neck, jowl, brisket and abdomen are indicative of fairly high infection with helminths especially flukes and amphistomes.

Deworming with rotational anthelmintics based on regular fecal examination should be carried out once in three to four months for all the captive elephants. For better results deworming should be carried out on the first day and repeated after 20 days.

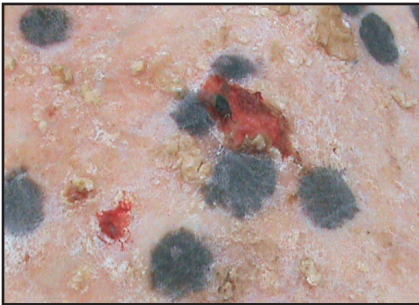
**E Cutaneous filariasis** is characterized by nodules ( 1 - 3 cm size ) on the sides, ventral part of the abdomen and outer sides of the hind foot. The nodule ruptures on the second day,



Ear veins - Blood sampling \*



Temporal abscess



Fungal infection of ear



Anal flap - special feature



Fascioliasis - Jowl edema



Severe hip wound



Elbow abscess



Abscess - pointing

oozing blood at about 10 seconds interval for 30 minutes and it stops spontaneously. Microscopic examination of the exudate reveals microfilaria and it has been reported that Anthiomalin @ 50 ml per 2000 kg body weight, S/C at weekly intervals for 8 weeks was found safe and effective.

- E **Wounds** :- Elephants have several callouses on different parts of their body acquired from daily works, laying down, from chains / ropes etc., and there may not be any problem as long as it is not prone to any injury / infection. If injured it must be attended immediately since these areas are constantly under pressure which delays healing.
- E Colibacillosis and salmonellosis are considered to be the major cause of mortality in calves due to poor hygienic conditions.

### **Signs of Colic / Abdominal pain**

- E Excitement & restlessness, dullness especially in later stages.
- E Reduced water intake and loss of appetite.
- E Tendency to eat mud, chewing bark from trees.
- E Drowsy appearance and motionless for a long time with feel of pain by keeping the head down.
- E Pushing against some object like a pillar or wall
- E Frequent changing of limbs in an abnormal way with the feel of pain.
- E Biting the tip of the trunk for a long time.
- E Stomach rumbles, probably due to improper digestion and gas formation.
- E Absence of mucoid coating on the dung which appears rough and dry. Size of the dung is smaller than usual. It continues to get smaller as the condition becomes advanced / chronic.
- E Swellings may be seen on the feet, brisket and the dependent areas of the body.
- E The trunk is twisted often, as if to expel mucous or gas, accompanied by cough.

- E Grinding of teeth & reduced feed intake / in-appetence without pyrexia.
- E Diarrhoea with or without blood in severe worm problem.
- E Frequently sitting & rising ; turning from side to side and moving the legs apart.
- E Frequent attempts to defecate with straining but often unsuccessful.
- E Kicks at the belly frequently and frequent trumpeting.

### **Predisposing factors for Colic**

- E Eating of large amounts of sand material.
- E Drinking large amounts of cold water especially by the fatigued and exhausted elephants, immediately after a long travel / heavy work.
- E Elephant exposed to severe cold and wet seasons.
- E Unaccustomed type of feed / poor quality fodder / roughages
- E Over eating of feed at a time.
- E Endo-parasitism ( Fascioliasis, Cestodiasis, Helminthiasis ).

### **Traditional remedies** (based on the reports of senior mahouts)

- E On observing initial signs of colic, mahout must coax the elephant to drink more water with fried crystalline salt to prevent dehydration (150 gm of fried crystalline salt dissolved in 20 litres of lukewarm water for an adult elephant is given).
- E Lemon grass oil (*Cymbopagan flexuosus*) is a natural medicine, sought by elephants themselves in the wild, as well as in captivity. A loaf of bread soaked in 30 ml of lemon grass oil, can be fed to the elephant.
- E A herbal mixture consists of two handful of ginger, small green chillies, crystalline salt (50 gms), garlic and fried mustard seeds used by mahouts with good success rate . They are ground into a paste and placed inside the elephant's ration or

concentrate feed. This paste induces the elephant to drink water and further facilitating dung expulsion. Sand / mud consumed during early stages is also expelled along with the dung.

- E Asafoetida relieves discomfort caused by accumulation of gases, in the stomach. 75 to 100 gms can be fed along with concentrates i.e. rice, only during the early stages of colic. It should not be administered during chronic stage as it absorbs water from the body.

### **Management of Colic due to impaction**

- E Analgesics and anti-spasmodics ( Meloxicam / Novalgin ; 60 – 100ml, I/m ).
- E Antihistaminics ( 70 – 100 ml. I/m ).
- E Drugs acting on smooth muscles like ; Calcium pantothenate; 50 - 70 ml, Perinorm ; 50 – 60 ml, Calcium borogluconate ; 450 – 900 ml, I/v ).
- E Usage of motility modifiers ( eg. Cisapride or Metaclopramide @ 2mg/Kg body wt, P.O.).
- E Usage of H2 receptor antagonists like Ranitidine at rate of 2 mg/Kg body wt.
- E Usage of liquid paraffin ( 5 to 8 litres, P.O.).
- E Usage of fecal softeners like lactulose.
- E Fluid therapy ( Ringers lactate, Hypertonic dextrose, electrolytes and dextrose saline etc.- 10 - 20 litres, I.V per day. In case of pyrexia, isotonic saline or 5% DNS may be given, instead of hypertonic dextrose solution ).
- E Anthelmintic therapy – according to the case based on fecal examination.
- E Antibiotic depending on the severity of the case ( Fluoroquinolones like Enrofloxacin at rate of 5 mg/Kg body wt., I.M or I.V )

- E Usage of steroids especially in conditions like shock and Parenteral B complex injections.
- E Exercise (Avoid severe exercise esp. in case of highly debilitated elephants or anemic elephants) and hot fomentation over the abdomen and hind quarters.
- E Enema administration ( using a hose pipe with adequate diameter )
- E Racking of dung from the rectum manually or by physical means carefully without any injury to the rectal passage.

### **Management of Diarrhoea**

- E Identification of primary cause and treatment.
- E Provision of fluids and electrolytes
- E In mild to moderate cases : Ringers lactate solution may be chosen along with dextrose solution to prevent dehydration.
- E Provision of B complex vitamins and calcium injection by parenterally
- E Administration of suitable antibiotics ( Enrofloxacin / Sulpha drugs ), along with Metronidazole by I/V route.
- E Appropriate oral anthelmintics like Albendazole/ Fenbendazole / Pyrantal pamoate at rate of 3 - 5 mg per Kg body weight.

### **Eye problems**

Ocular disorders like conjunctivitis, keratitis, corneal ulcer, corneal opacity, opacity of lens etc., are common ailments in captive elephants and are generally caused by trauma or injury. Line of treatment consists of cleaning and application of antibiotic & anti-inflammatory eye drops / sprays ( Ciprofloxacin / Gentamycin with Betnesol ) based on culture and ABST of conjunctival swab. Preparations of alternative systems of medicine like *Cinnarea maritima euphrasia* drops were also proved effective in some cases. Sub-conjunctival injection of Placentrex (5 – 10 injections on alternative days) may be effective in chronic cases.



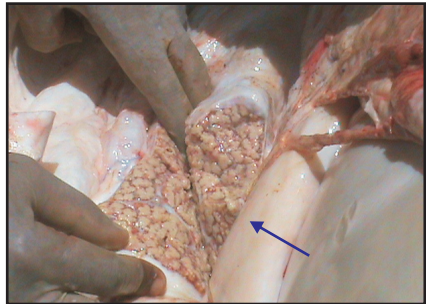
Age related debility



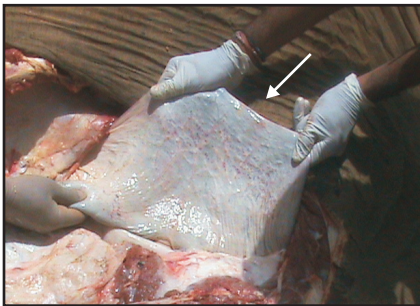
Elephant Carcass in the wild



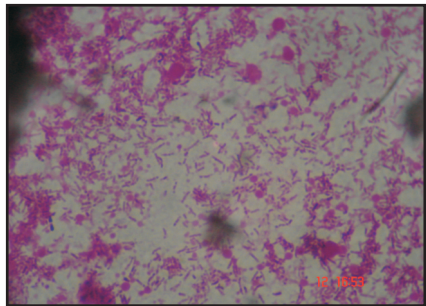
Purulent discharge from the trunk



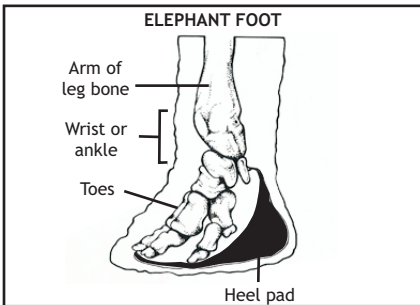
Tuberculosis - Lungs



Tuberculosis - Spleen



Acid -fast bacilli



Split nail

## **FOOT AILMENTS**

### **Physiology of the foot.**

- E The foot of an elephant is a master piece of evolutionary development to support and balance the huge weight of the largest terrestrial mammal. Both captive and free ranging elephants when standing and not otherwise engaged in some activity, move back and forth, alternating putting weight on one leg then the other. This is called swaying and some people equate this only as stereotypic behavior. It is a natural behavior and in the process of swaying back and forth the elephant is facilitating the circulation of blood from the distal extremities back to the heart. Blood flows peripherally easily, but return flow must overcome the gravitational stagnation of blood in the long limbs. This is brought about by compressing the digital cushion in the foot, which acts as a peripheral pump to force blood up the leg. As the elephant alternatives its weight, it is facilitating circulation in the feet, throughout the body and legs. Though this is not normal behaviour of an elephant, in captivity with restricted movements, it is necessary because in the process of swaying back and forth the elephant is facilitating the circulation of blood from the distal extremities to the heart.
- E The foot has an integumentary covering consisting of skin, toenails and a cornified but flexible sole. The hind foot is smaller than the fore foot and is oval in shape. Elephants are semi-digitigrade in the front feet and semi-plantigrade in the hind foot. The front feet bear the majority of the body weight.
- E The joints are in straight line and serve as concrete columns to bear the huge weight of their body and helps the elephant to sleep on standing. The ulna is larger than radius and no long bone of the foot has a marrow cavity, which instead is filled with cancellous bone or red marrow.

- E The feet should be inspected and cleaned daily. The bottom of the foot should be brushed with a stiff bristled brush and checked for foreign bodies imbedded in any of the cracks or grooves of the slipper or below the toenail.
- E The elephant must be tethered on natural earthen substrate ( sand flooring ) to the maximum possible in order to prevent foot ailments.
- E The internal foot problems can be observed by making the elephant to walk for a distance, lie down and sit up. During this process if the elephant makes more than two or three swings on its legs and also groans while trying to sit up, it is an indicator of disability and pain.
- E The common foot ailments encountered in captive Asian elephants includes foot-rot, podo-dermatitis, different types of wounds and abscesses in the foot pad, nail, cuticle, split / crack nail condition, nail damage overgrown / deformed nails, excess cuticular growth over and inbetween the nails, excess foot pad growth ( Hyperkeratosis ), abrasion of sole, uneven wear and tear of foot sole, arthritis, ankylosis of joint, degenerative joint disease etc., Tetanus is a potential sequel to abscessation.
- E Generally the main predisposing factors for foot ailments include; absence of regular foot care, constant exposure / standing on unhygienic environment and unsanitary tethering conditions, lack of exercise, lack of minerals in the diet, lack of awareness among mahouts & elephant keepers, negligence of lesions at the early stage, incomplete treatment and unscientific approach.
- E Toenail cracks (horizontal and vertical cracks) are common in elephants and require constant attention from the care takers. As a preventive measure, corners of the nail should be rasped using the nail rasper and rounded to remove excess nail as and when required. In the existing cases, if the crack has not reached the cuticle, a horizontal groove at the top of the crack may discourage further cracking.



**Deformed nails**



**Excess cuticular growth**



**Spiked chain**



**Foot pad - Hyperkeratosis**



**Abrasion of sole**



**Severe nail & cuticle abscess**



**Nail & foot pad abscess**



**Foot rot**

- E Arthritis is one of the common ailment observed in all age group of elephants in captive condition. The elbow, carpal, stifle and tarsal joints are usually affected. If not attended in the early stage, it will lead to ankylosis of that joint / region in course of time. The common signs observed are; swelling involving the joint with odema of the limb distal to the joint, tenderness and pain over that area, lameness, fever, anorexia & septicaemia in case of purulent arthritis. In chronic cases stiffness of joint / limb is observed, leading to ankylosis and at this stage pain and lameness may not be evident.
- E The line of treatment for arthritis may be; external application of counter irritants / absorbents – Iodine ointment / Icthamol glycerine, anti-inflammatory drugs – orally / parenterally for a short course, Diuretics ( Furosamide ) – orally / parenterally in case of oedema, antibiotics in case of septic arthritis based on culture & ABST and rest from work. There are several ethno-veterinary preparations used in different regions for the foot ailments including arthritis and their scientific efficacy in elephants has to be explored.

### **FOOT CARE AND MANAGEMENT PRACTICES**

- E Cleaning and dressing the foot lesions with Potassium permanganate and hydrogen peroxide solution, removal of necrotic tissues should be carried out regularly before medication.
- E Potassium permanganate ( 1 : 1000 solution ) foot bath followed by formalin ( 1 - 2 % solution ) or Gentian violet foot bath ( 1 % solution ) should be provided daily in case of foot rot and pododermatitis before medication.
- E In order to facilitate formalin based foot bath ( in case of elephants resisting to stand or to keep their foot into the tub / vessel filled with formalin ) use 1 kg of nicely powdered husk or saw dust placed in a gunny bag and soak it in hot / luke warm water according to the weather and pour about 50 ml of formaldehyde and now, this can be applied under foot

pad by tying around the leg, in order to facilitate the hardening of foot pad structures.

- E For external wounds and abscesses, application of pure, raw honey over the lesion twice a day was observed to be very effective in removing the pus and necrotic tissue debris in the early stage of the lesion. This also promotes formation of granulation tissue earlier and facilitates healing.
- E For conditions like foot rot and podo-dermatitis with mixed bacterial and fungal infection, initial cleaning of the complete foot pad with 1 % copper sulphate / gentian violet solution and application of Castlanis's paint is observed to provide an early cure according to the elephant practitioners in Kerala.
- E Preparation of Castlani's paint :- Dissolve 8 gm of Resorcinol in 4 gms of liquid Phenol. To this add 8 ml of methylated spirit and 4 ml of Acetone and leave it for one hour. Then add 0.8 gm of boric acid, 0.4 gm of Basic fuchsin and make up the volume to 100 ml with distilled water. This should be applied as a topical paint over the foot lesions such as foot rot and podo-dermatitis etc.,
- E Application of antibiotic medication based on the microbiological examination and antibiotic susceptibility tests of the foot ailments should be carried out at regular intervals till the infection cures completely.
- E For elephants suffering from severe chronic foot ailments, a sandal type protective cover with proper aeration and drainage may be applied for a short period after treatment to prevent external contamination of the wound / medication and to improve the healing process with less stress to the elephant.
- E The treatment approach for the foot ailments should be carried out with systematic microbiological examination and anti-biogram at regular intervals for early effective healing with least stress to the elephant.



**Foot-rot with abscess**



**Cuticular abscess**



**Nail abscess**



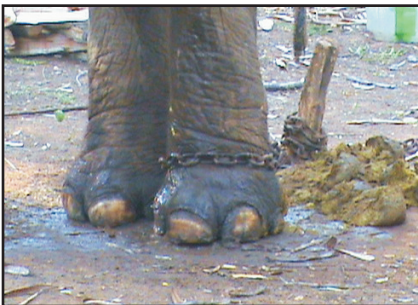
**Chronic necrotic wound in-between nails**



**Chronic foot pad abscess**



**Severe foot-rot & cuticular abscess**



**Unhygienic tethering site**



**Microbiological sampling**

- E In elephants with proper cleaning and dressing of wounds, the granulation tissue forms faster, but the external closure of epidermis and skin takes longer time generally.

In such chronic cases, use of ethno-veterinary combination of medicines / herbal pastes like freshly prepared neem, tulsi, turmeric and *Aloe vera* in equal quantities along with Zinc oxide and sulphanilamide powder was found to be very effective by the author.

- E Regular rasping of the nails using the nail rasper and brushing of over-grown foot sole ( > 2 . 5 cm thick ) should be done as and when required. At the same time over-zealous trimming of sole should be avoided as it will expose the foot for traumatic and penetrating injuries.
- E Tethering site should not have water logging environment, without dampness and should be kept dry with provision for adequate drainage.
- E The captive elephants must be tethered on earthen / natural substrate with adequate shade to avoid foot & nail problems.
- E Leg chains should be covered with cushioned rubber / leather hose to prevent chain scratch marks and other related inflammation.
- E Scrub bath with brushing throughout the body including the feet should be carried out daily.
- E Dikameli oil ( a plant resin substance belonging to *Gardenia sp.* mixed and boiled with neem oil – working as a good antiseptic emollient ) should be applied over the foot, cuticular area and in-between the nails daily after bath to prevent foot ailments and to improve the foot health.

**E Mixture of Dikameli oil:-**

( Ref:- Dr. S. Gopalan, Z P Jr.; Vol-11(4); 17 )

Dikameli :- 28 gms

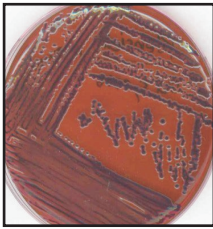
Camphour :- 28 gms

Garlic :- 28 gms

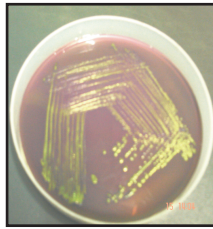
Neem oil :- 680 ml.

This should be applied over the nails and foot daily after bath for better foot health.

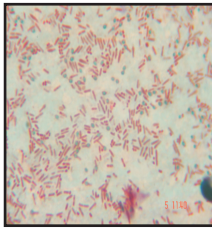
- E Use of ethno-veterinary medicine and their successful combinations have to be explored for early and effective cure for various ailments in elephants.
- E Captive elephants must be given adequate exercise daily.
- E Mineral mixture ( enriched with Vit-B ) should be included in the diet @ 100 gms / day to improve the general health and foot care.
- E Tetanus toxoide ( @ 3 – 6 ml ) may be administered whenever the *Clostridium sp.* of microorganisms are encountered in the foot lesions and can also be given prophylactically.
- E The captive elephants especially in temples should not be made to stand on a solid stoned / cemented substrate continuously for a long time since this is the main predisposing cause for most of the minor foot ailments at the initial stage and if neglected leading to major foot ailments in the course of time.
- E Trimming of the excess cuticular growth over and in-between the nails should be practiced regularly to avoid infection.
- E General hygiene and sanitation of the tethering site and enclosure is a must for proper foot care of captive elephants.



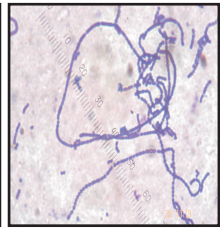
*Klebsiella* spp



*E. coli*



Spore forming  
*Bacillus*



*Streptococci* spp



Formalin foot bath



Chain scratch wound



Leg chain cover



Foot care during bathing



Trimming the nails



Rasping the nails

## **Signs of health in elephants**

- E Frequent movements of extremities ie., ears, foot, tail. The lower flap of the ear should be warm to touch.
- E Normal feeding and drinking of water and free passage of dung and urine in normal colour and consistency.
- E Attentive to its surroundings.
- E Absence of abnormal posture or appearance.
- E The mucous membrane at the oral cavity and tip of the trunk should be rosy pink in colour which indicates sufficient quantity of blood in circulation.
- E Moist nature of the tip of the trunk without any abnormal discharge.
- E Good nutritional condition (ribs should not be visible), Clear gear, no limping etc.
- E Free from swelling and injuries over the body surface.
- E Clear eyes with normal amount of tear drops.
- E The body temperature can be checked at the brisket region and if that region feels cool to touch, it indicates ill health.
- E The pulse can be taken below the chin or at the ventral part of the tail which can be felt by the fingers where an artery crosses the bone is pressed. The large arteries on the ear can also be used.
- E The skin of the elephant is an important indicator of the water balance in its body. If the skin feels resilient or elastic to touch, when pinched it can be assumed that the elephant is receiving adequate water and if the skin feels dry and non resilient, it should be understood that it needs enough water.
- E Ectoparasites like lice can be seen at ear folds, inner aspects of limbs and tail switch and can be treated with ecto-parasiticides used in livestock practice.



**Multiple ankylosis - DJD**



**Sandal type protective cover for chronic foot lesion**



**Ethno-Veterinary therapy**



**Dikameli resin**



**Application of Dikameli oil**



**Stoned flooring - Un ideal / un natural Substrate for elephants**



**Natural substrate**



**Healthy elephant foot**

## **Signs of illness in elephants**

- E Reduced movements of tail, ears, trunk & legs
- E Less alert and dryness on the tip of the trunk.
- E Partial closure of eyes and the lower part of the ear may be cold to touch.
- E Changes in the frequency of urination
- E Changes in feeding / watering behavior
- E Development of edema on dependent parts.

## **Tips for VETS on Clinical examination of Captive elephants**

Elephant being an unpredictable and massive animal, it is always advisable to take extra care while approaching and handling since within seconds it can cause serious damages.

Elephant should be approached only in the presence of mahout. Collect the detailed history including the character and behavioral pattern of the elephant from the mahout before starting clinical examination. Before any physical / clinical examination, observe the elephant from a distance and then conduct a close examination starting at the left side of the head.

Avoid approaching an elephant which is not properly restrained. Approach the animal from the front side with the mahout and make the animal aware that you are approaching by calling its name or making some soft sound.

While examining the anterior region of the animal, make sure that the mahout is present at the forequarters of the elephant. When the elephant is in standing position or in recumbency, care should be taken not to be within the reach of its trunk especially while crossing the animal through the front side.

While approaching the hind quarters, make sure that the tail is properly secured as the elephant can beat dangerously with its tail. While approaching the elephant, do not expose surgical instruments and injections because previous painful experience with the instruments may evoke some sort of resistance or non-co-operation

from the animal. Verbal commands may be accompanied by touching a specific area of the body. It may be helpful if the veterinarian is familiar with some of the commands used by trainer. However the veterinarian should not make the mistake of trying to issue commands.

The normal healthy skin is soft and wrinkled, uniformly warm to touch, free from warts / edema and greyish black to black in color. The skin over the nails should be moist from sweat. This can be tested by applying dust, which should stick. Observe the eyes for abnormal ocular discharges, corneal / conjunctival lesions or cataract and the color of oral and conjunctival mucosa for anemia, icterus or cyanosis.

### **Principles and practice of fixing dose of drugs for elephants**

Elephant being a non- ruminant ungulate, is comparable to the horse and pig in computing the dose of the drugs. Being a simple stomached animal, microbial degradation of anti-histaminics, glycosides and other similar active medicinal principles are very unlikely. This is an advantage in elephants for oral medication compared to the cattle.

Since force feeding by mouth is impossible, a lot of patience is required in the administration of oral medication. As the gastrointestinal system of elephant is being close to that of the horse, usually horse dosages can be used for elephants if there is no exact elephant specific dosage available.

During sedation / anaesthesia with intramuscular route, if the animal shows any sign of recovery  $1/3^{\text{rd}}$  of the initial dose may be given (e.g; Xylazine) to extend the period. During xylazine sedation protrusion of the penis indicates the beginning of the action of the drug and the animal should not be handled till the sedation becomes deep. The animal can go into heavy sedation to deep narcosis with xylazine in a standing posture itself. So in case recumbency is desired, it is better to make the animal to lie down and then give xylazine. Otherwise it will prove some times difficult or even dangerous to attempt to make an animal to lie down which is under deep sedation.

## Common medicines / drugs used in elephants

Indications	Medicines / Drugs used
Restraint / Chemical Immobilization (Ref : Prof. M.E.Fowler & Prof K.K. Sharma)	<ul style="list-style-type: none"> <li>➤ Xylazine 300 mg – 500 mg I/M, Total dose @ 0.1 mg / kg body weight ( Incremental dose of 50 – 100 mg may be given depending on the condition)</li> <li>➤ Xylazine and Ketamine ( 0.125 mg / kg + 0.1 mg / kg) I/M, in combination ).</li> <li>➤ Etorphine Hcl; - 1 mg / 450 kg BW, I /M ( Immobilon )</li> </ul>
Antibiotics : Ampicillin	➤ 10–15gm / animal ; I/v or I/m
Amikacin	<ul style="list-style-type: none"> <li>➤ 3.5 mg / kg - I/v</li> <li>➤ 6 – 8 mg / kg – I/m</li> </ul>
Amoxycillin	➤ 11 mg / kg – I/m
Enrofloxacin	<ul style="list-style-type: none"> <li>➤ 1 mg / kg– oral</li> <li>➤ 1.5– 2.5 mg / kg – I/m</li> </ul>
Gentamycin	<ul style="list-style-type: none"> <li>➤ 4 mg / kg – I/v ( diluted with 10 % saline )</li> <li>➤ 4 mg / kg – I/m</li> </ul>
Cephalosporins	➤ 1 mg / kg – I/m
Polybion ( B complex )	➤ 50 ml / animal, I/v
Calcium pantothenate Calcium borogluconate	<ul style="list-style-type: none"> <li>➤ 50 – 70 ml / animal. I/v</li> <li>➤ 450 - 900 ml / animal. I/v</li> </ul>
Dexamethazone	➤ 1 – 3 gram / ton
Furosamide	➤ 300– 500 mg / animal, I/m
Metachlopromide	➤ 250– 400 mg / animal, I/v
Control of musth in pre - musth state	Flutamide 5000 mg per animal, Oral.
Control of aggressive behaviour during pre-musth and last phase of violent musth	Combination of Flutamide at rate of 5000 mg to 7500 mg, Haloperidol 100 mg and Potassium iodide- once daily for a continuous period of 3 days, Orally.
Postponement of musth temporarily	Flutamide 2500 mg / elephant, Oral.
Postponement of musth for longer time ( > many months )	Flutamide 7500 mg / elephant, Oral. ( should not be done except inevitable )

Shock	Dexamethasone 1-3 gm / ton, Fluid therapy; I/V Antibiotics and supportive therapy
Transport related sedation	Xylazine 80 – 100 mg, I/M and/or Haloperidol 40 – 100 mg, P.O.
Control of Vomition	Metaclopramide ; 2mg / Kg BW, P.O.
Suspected Ulceration	Anti-ulcerative drugs (eg. Ranitidine 2 mg / kg Body weight)
Haemorrhagic septicemia	Enrofloxacin @ 2 mg / kg body weight, I/M or sulphadimidine 200 – 250 gm orally, daily and I/V injection of sulphadimidine sodium (33% solution) 500 ml for three consecutive days.
Corneal opacity	Rule out the cause. Wash eye with normal saline or boric lotion. Medication based on culture and ABST. Sub-conjunctival injection of 2 ml Placentrex or Prednisolone . Antibiotic eye ointments - 5 times / day e.g. Ofloxacin / Chloramphenicol / Gentamycin eye ointment.
Tissue swelling / Raw wound with swelling	Rule out the cause. Ichthamol glycerine / Iodine ointment application (for ripening).
Lithium Antimony Thiomalate ( Anthiomaline)	50 ml / 2000 kg B.Wt, Deep I/m. Total of Six injections at weekly intervals.
Tetanus (with locked jaw: partial or full)	Therapy Diazepam – 250– 300 mg I/V (or) 400 - 500 mg Xylazine, I/M. Anti tetanus serum (ATS) – 4 – 6 lakhs units, I/V , twice a day for 7 to 10 days Crystalline Penicillin; 20,000 - 30,000 IU/kg BW i.m. Fluid therapy – I/V or Rectal. <u>Prophylaxis</u> Tetanus toxoid ; - 3 – 6 ml, I/M
Trypanosomosis	Berenil ( 3- 8 mg / kg body weight, I/M) - given for three consecutive days. Triquin – S by S/C in different sites. Anticide methyl sulphate; 2- 4 mg / kg as 10% solution by S/C.

Louse / tick / fly infestation	Ivermectin, Doramectin. External application 1% Sumithion / Butox solution as a wash
Itching at toes with ulceration of toes due to Stephanofilariae (black patches in between the foot space and just above nails) – STEPHANOFILARIASIS	8% metrifonate ointment on vaseline base along with Himax ointment
Bleeding from the nodules in skin – during day time only especially in the morning - INDOFILARIASIS	Lithium antimony thiomalate (Anthiomalin) @50 ml / 2 ton S/C at weekly intervals for 8 weeks. Tail fold is the ideal site for S/C injection. Area at the neck anterior to scapula may also be used.
Cestode Infection	Praziquantel ; 2.5 - 5 mg / kg body weight P.O
Helminthic Infection	Pyrantel pemoate ; 5 mg / kg body weight P.O Albendazole ; 2.5 - 5 mg / kg P.O. Fenbendazole ; 2.5 - 5 mg / kg P.O.
Gastric maggots due to cobboldia in elephants (colic, dullness, anorexia) loose motion.	Tetramisole ; 4 mg / kg P.O – has very low safety margin.
Fascioliasis	Rafoxanide - 5 mg / kg P.O. Oxyclozanide (Distodin) – 5-7 mg / kg P.O. Hexochlorophene – 10 mg / kg bw, P.O.
Amphistomiasis	Oxyclosanide– 7.5 - 10 mg / kg bw, oral
Vaccination	Anthrax, HS, Rabies, FMD – in general
Anthrax	Penicillin 10,000 – 30,000 IU / kg body I/M
Elephant Herpes virus infection	Famciclovir Tab: 8 – 15 mg / kg, oral, three days.
Tuberculosis	Isoniazid @ 5 mg / kg and Rifampicin @ 10 mg / kg B.Wt, Orally; daily for one year.

Antituberculous agents are divided into first and second line agents. First line agents include isoniazid, rifampin, pyrazinamide, ethambutol, and streptomycin. Second line agents include those with less activity and/or greater side effects.

Second line agents include capreomycin, ethionamide, cycloserine, and thiacetazone. The fluoroquinolones (FQ; moxifloxacin, ciprofloxacin, levofloxacin, and enrofloxacin) while not considered as 1<sup>st</sup> line agents have significant bactericidal activity against *M. tuberculosis*.

Anti TB drugs must be directly administered. Placing drugs over food does not produce reliable blood levels and this is not an acceptable method of treatment. Drugs vary in palatability and acceptance so some experimentation may be required to determine a workable regimen for each individual elephant.

Isoniazid and PZA can be given either orally or rectally. Rifampin and ethambutol should only be administered orally (effective blood levels of rifampin cannot be achieved with rectal administration and ethambutol is quickly expelled when given rectally). Below are suggested starting doses, but actual doses may need to be adjusted in order to achieve adequate blood levels and / or reduce effects of toxicity. ( Ref. : Dr. Susan K. Mikota, USA )

Drug	Dosage (mg/kg)	Route	Formulation	Target conc (µg/ml)
Isoniazid	5	Oral or rectal	premixed suspension	3 - 5
	4	Oral	powder	3 - 5
Rifampin	10	Oral only	powder	8 - 24
Pyrazinamide	30	Oral or rectal	powder	20 - 60
Ethambutol	30	Oral only	powder	2 - 5

### Administration of medicines and Sampling techniques in elephants

When approaching an elephant for administration of drug / medicines, it is most important to communicate to the mahout regarding the administration procedures, potential precautions and restraint needs. Feeding tasty foods like sugarcane / jaggery to the elephant during the clinical examination is indicated to increase the elephant's acceptance of the procedure. It is always advisable to administer drugs in presence of the mahout after properly restraining the elephant without much excitement.

## **Oral medication**

The common food stuffs like cooked plain rice balls, cooked rice with jaggery, plain jaggery, pineapple, banana, apple, loaves of bread are used to administer tablets / bolus / medicines in the form of powder etc.,.

## **Intra-venous route.**

The auricular vein in the ear, cephalic vein on the medial aspect of the foreleg and saphenous vein on the medial aspect of the hindleg are the primary blood collection sites for elephants. Generally the auricular veins on the ear pinna are selected for intravenous administration of fluids and medicines. It is always preferred to restrain the animal in lateral recumbency for intravenous administration of medicines. In some non-co-operative animals, intravenous administration can be tried in standing position also with the help of the mahout.

The ear pinna has to be washed with plenty of water to remove dirt sticking on the surface. After cleaning the ear pinna, mop it dry with a towel or cotton and touch with antiseptics like Tr. Iodine or 60 percent ethyl alcohol. Identify prominent veins on the ear pinna and select one. Care should be taken to avoid arteries on the ear pinna ( the walls of arteries are thicker with pulsation) and injections into the arteries of the ear can cause hematomas because of high blood pressure. Long term administration of drugs through arteries may lead to necrosis and sloughing of ear muscles.

Disposable needle ( 14 - 16 G ) can be introduced into the vein and I. V canula / catheter ( 14 - 16 G ) is preferred for administration of large volume of drugs / fluids. Ensure with care that the medicine is properly going into the vein and not entering the peripheral subcutaneous or intra-arterial areas which may lead to inflammation, necrosis and possible sloughing of ear parts since ear being an important organ which adds to the beauty of elephant.

Saphenous vein on the inner aspect of the hind limb can also be utilized for intravenous medication. The elephant lacks an external saphenous vein, but an internal saphenous vein is present

on the medial aspect of the pelvic limb and serves as a potential site for blood collection. Although the vein can be visualized through the skin, it is quite deep and the needle must be inserted perpendicular to the leg.

### **Intramuscular route**

The thick muscles of hind quarters, hindlegs, forelegs and shoulder region are the ideal sites for intramuscular injection (triceps muscles of lateral foreleg, rectus femoris muscles of hind leg, hip and upper hindleg muscles). Since the skin of the elephant is very thick (> 2.5 cms), the needle selected for intramuscular injection should be 2 – 3 inches long; 18 G to ensure deep deposition of the drug. Short needle may result in subcutaneous passage of the drug. Since elephants easily develop cellulitis extra care should be taken to sterilize the area before injection and to massage the area after injection. It is preferable to administer intramuscular injection in recumbent position and attention should be paid to see that the limbs are kept stretched straight during the administration. The amount of drug injected in a single site should not exceed 15 - 20 ml to reduce the risk of muscle destruction and inflammation at the injected site.

### **Subcutaneous route:**

The loose fold of skin on both sides of the base of tail (caudal fold) is the preferred site. The smooth and flexible part of the neck behind the ear is also used.

### **Subconjunctival route:**

The sub-conjunctival route of administration of drug is generally practiced in conditions like corneal opacity (eg:- Placentrex administration). Since the prominent third eye lid prevents easy access to the subconjunctival area in elephants, the subconjunctival injection is given by inserting a fine needle from the outer aspect of the upper eyelid parallel to the palpebral fissure ensuring that the needle does not penetrate through the eyelid. This should be done only on recumbency with proper restraint and cooperation of the mahout & elephant.

### Biological information of Asian elephants

Order	<i>Proboscidea</i>
Zoological name	<i>Elephas maximus</i>
Shoulder height	2.4–2.9 mt tall at shoulder ( Male ) 2.1–2.4 mt tall at shoulder ( Female )
Body Weight	Male :- 3500–6000 kgs Female :- 2500–4500 kgs
No. of chromosomes	56
Birth weight of elephant Calf	80–100 kg
Weaning period	2 years
Bull elephant without tusk	Makhna
Longevity	50–80 years
Maturity in female elephants	12-14 years
Defecation	15–20 times / day Weight of each bolus 1– 2½ kg; 4–6 boluses in each defecation.
Urination	10–15 times / day; Total amount of 50 – 60 liters is voided.
Social structure	Matriarchal groups (Leader of group is usually an older cow elephant)
Drinking habits	200–250 litres of water / day. About 50 – 60 litres at a time and 3 to 4 times per day; a trunk can retain 6 – 7 liters or even as much as 10 liters.
Walking speed	4 km / hr
Running speed	25 / km / hr f or short distance (or) 30 – 40 km/hr. (even with hobbles they can hop but can not jump / gallop / run like Horse / cattle )
Temperature	36–37° C ( 97.5° F– 99.0° F )
Respiration rate	15 breaths / mt in excitement, 4–6 in rest.
Heart rate	25–30 beats / mt in an unexcited standing elephant
Eye sight	Very poor
Smell and hearing	Efficient

**Elephant's Vertebral Formula :**

C : 7    T : 19 - 20    L : 4    S : 4    CY : 30

**Elephant's Dental Formula : ( Total :- 26 No's)**

1 - 1	0 - 0	3 - 3	3 - 3
I —————	C —————	P —————	M —————
0 - 0	0 - 0	3 - 3	3 - 3

**Estimation of body weight**

The live body weight of an elephant can be estimated using the following formulae.

Weight ( kgs ) = 18.0 G (Heart girth in cms) – 3336  
( Ref :- Hile *et al.*, 1997 )

**Estimation of height**

H = 21.04 + 1.77 CF

Where; H – Height in cm, CF – Circumference of front foot in cms

- E **Vaccination** :- Captive elephants should be vaccinated against Anthrax annually. According to the regional endemic status vaccinations against Foot & Mouth disease, Haemorrhagic septicemia may be carried out as per the advice of the Veterinarian.
- E Anthrax spore vaccine :- Preventive vaccination using spore vaccine, s/c at the base of the tail can be done.  
Dose : Elephants irrespective of age ; Initial dose; 1 ml, Booster after one month :- 3 ml.
- E Tetanus : Tetanus toxoid :- 3 – 6 ml / animal, I/M, Prophylactic (followed in India). The recent report describes that elephants do respond to tetanus vaccination with 1ml dose (Ref : William A. Lindsay - Vet. Imm & Imm. Pathology ; 2009).
- E Deworming : should be done once in every 3 – 4 months by using rotational anthelmintics based on regular fecal examination.
- E Maintenance of Registers :- Registers like Vaccination Register, Treatment Register, Feeding Register and Movement Register should be maintained for all the captive elephants.

## MAHOUTS AND ELEPHANTS

Earlier the relationship between humans and elephants was a lifelong one and bonded with affection and trust and the domesticated elephant would normally respond only to commands from its personal mahout. In the past, the job of mahout was a family tradition and the profession was passed on from father to son. The children of mahouts also had intimate knowledge of the elephant which was looked after by their father.

The traditional transfer of knowledge is almost lost now and there are very few older mahouts who knows the traditional husbandry and captive management of elephants at the regional level in Asian range countries . These mahouts have to be identified, supported and their practical knowledge has to be transfered to the present day mahouts and elephant keepers for the betterment of captive elephants. Unfortunately, now a days, mahouts are employed on a temporary basis and often change their employer many times because of commercial monetary reasons. As a result, when a new mahout is employed, he has to use brute force to make his new elephant to obey him. This commercial exploitation of captive elephants makes the mahouts and elephant keepers to become very greedy neglecting its health, pain and feelings.

Moreover in places where large number of captive elephants are maintained, out of competition ( during functions and ceremonies ) mahouts force elephants to keep their head high by poking them on their lower chin with spears or poking on the elephant's nails. Out of sheer pain the elephant would hold up its head. Hence the intimate bonding between the mahout and elephant is most essential need of the hour for successful captive elephant management.

Ultimately the present day captive elephants are in great need of an affectionate, humane handlers for them to be friendly and co-exist with the human race with peace for a long time.

## **Ten commandments for a good elephant management**

1. Elephant welfare is the first priority.
2. Each elephant is different and needs different type of handling best suited to the individual animal.
3. Elephant's welfare should not be compromised with the owners / authorities interest.
4. Try to learn about your elephant at every occasion.
5. Take every opportunity to fine tune your skills on elephant management.
6. Never take any unnecessary risk or negligence about the safety of yourself and people around the elephant since a fraction of second is enough for the elephant to cause disastrous results.
7. Educate mahout ( and authorities ) that he should be firm on his commands but should never be cruel. Positive re-inforcement will help.
8. At the same time emphasize that the mahout should always establish his dominance over the elephant by love, affection, trust & intimacy and not by fear.
9. Educate the mahouts that earning respect from the elephant as well as command over it, is a continuous process and cannot be attained just like that.
10. Learn about other elephants, share your experiences with others and continue to up grade knowledge in your profession.

## **Future of Captive Asian Elephants Problems and Perspectives**

Despite a long and glorious tradition of domesticated elephants to boast about, there have not been any systematic and conscious efforts in India for sustaining this tradition. Many scientists working with the captive elephants across the world feel that the domesticated elephants have been ignored both by wildlife experts and the livestock experts.

The mahoutship is a specialized job with skills, physical work, understanding the basic biology and behaviour of the animal, creativity, passion and affection towards the elephant which needs to be nurtured by providing training, due recognition and responsibilities, so that the traditional skills combined with scientific background will be passed on to the next generation of young mahouts. In fact, a ( un published ) survey with more than 300 mahouts, conducted by the author in south India during 2008 – 2010 revealed that more than 70 % of the present day mahouts do not wish their son to become a mahout for several reasons.

The unethical commercial exploitation of captive elephants by the present day mahouts / elephant keepers whose morality and responsibility are very much compromised for monetary benefits, making the captive elephants to undergo several challenges and health hazards. Lack of activity and regular exercise is one of the major predisposing factor for the captive elephants maintained by the religious centres creating several health problems including foot ailments. Hence new methods and creative enrichment techniques for providing adequate activities for the captive elephants should be formulated and implemented with open mind keeping the health and welfare of the captive elephant as the main objective.

At the same time since more than 70 % of the captive elephants in India are owned by private parties. Health and husbandry check up & monitoring including screening for tuberculosis and other infectious diseases with proper training to the mahouts and owners / elephant keepers should be carried out regularly. This should be sincerely reviewed atleast once in a year by a committee / team of specialized subject matter scientists from the field, forest department and academic institution and the erring elephant keeper's license should be cancelled with fine and the elephant should be rescued & rehabilitated.

Scientists working on elephant conservation at the field level feels that sincere steps should be taken for stopping the abuse of the domesticated elephants rather than banning the domestication itself. Engagement of captive elephants in eco-tourism will be helpful since elephants are the convenient, pollution free and cost effective mode of transport for viewing wildlife in National parks, sanctuaries and other ecologically fragile areas where use of vehicles and construction of road network may not be desirable.

It is not only to keep the tradition alive but also to maintain the survivability of the species since the captive gene pool will definitely help in restoring the depleting wild population. This is possible because the captive elephants have not been bred selectively to inculcate any specific domestic character and hence even in domestic condition they are wild animals only.

At the same time there is an acute need for a large work force of trained mahouts and veterinarians to take proper care of the captive elephants. The domesticated elephant provide a convenient medium for preserving these experience and goodwill of thousands of elephant keepers which should be channeled towards their conservation and welfare.

The people in most parts of the range countries of Asian elephants still have social, sentimental, emotional and intimate attachment with the elephants because of their cultural and religious value. These values must be nurtured and encouraged as an essential ingredient of the conservation strategy for Asian elephants - The living symbol of LORD GANESHA.



## Composition of milk of elephant and other animals

S.No	CONSTITUENTS	ELEPHANT	CATTLE	BUFFALO	HORSE	GOAT	HUMAN
1	Water (%)	82.3	87.5	82.4	89.2	87.3	87.6
2	Specific gravity	1.023 – 1.038	1.026 - 1.035	1.038 - 1.042	1.030 - 1.038	1.030 - 1.036	1.030 - 1.034
3	Total Solids (%)	16.4 – 28.55	12.9 - 14.5	18 - 22.5	9.5 - 11.2	12.6 - 13.2	11.5 - 13.5
4	Total Ash (%)	0.57 – 0.80	0.45 - 0.65	0.7 - 0.95	0.3 - 0.4	0.6 - 0.82	0.15 - 0.25
5	Fat (%)	5.8 – 19.0	3 - 3.85	6.5 - 8.75	0.6 - 0.82	3.2 - 3.95	2 - 3.65
6	Total protein (%)	4.4 – 5.4	3.4 - 4	5.3 - 6.15	2.1 - 2.6	3.6 - 6.2	1 - 1.65
7	Casein (%)	1.4 – 2.5	3 - 3.4	4.5 - 5.2	1.5 - 1.7	3.2 - 5.5	0.4 - 0.9
8	Lactose (%)	3.4 – 5.4	4.5 - 5.2	5 - 5.4	6 - 8.5	4 - 5.3	5.8 - 6.5
9	Calcium (mg %)	84.6 – 178.0	16 - 20	33.5 - 35	30 - 35	23.5 - 25	38
10	Phosphate (mg %)	186.0 – 309.0	23 - 34	33.5 - 34	31.8 - 34	27	29 - 32
11	Chloride (mg %)	42.0 – 64.0	10 - 13	9 - 10	7.5 - 10	15.5 - 16.5	34 - 72

### Haematological values of Asian elephants

Constituent	Baby elephant	Tuskers	Adult non-lactating , non pregnant females	Pregnant females	Lactating females
RBC Count ( Million / Cu.mm )	2.42	2.47	2.40	1.84	2.65
Haemoglobin ( g% )	11.12	10.24	10.72	9.98	11.10
VPRC ( % )	34.70	34.80	34.80	29.80	33.50
MCV ( fi )	144.80	142.00	146.90	168.60	126.50
MCH ( pg )	46.67	46.93	44.49	56.93	41.90
MCHC ( g % )	32.13	29.69	31.06	33.77	33.14
ESR ( mm / hr )	61.30	63.40	61.30	67.40	64.50
WBC / $\mu$ l	11900	8780	9810	12400	8900
Neutrophils ( % )	32.10	34.20	32.30	44.10	35.00
Eosinophils ( % )	3.80	6.20	6.60	1.90	4.00
Basophils ( % )	0.60	0.70	0.90	0.50	1.00
Lymphocytes ( % )	59.00	52.80	56.20	50.60	54.00
Monocytes ( % )	4.50	6.07	3.90	2.90	6.00
Specific gravity – Whole blood	1.050	1.054	1.054	---	---
Specific gravity – Plasma	1.020	1.027	1.028	---	---
Relative viscosity	6.37	6.10	6.36	---	---
Absolute viscosity ( centipoises )	5.70	5.54	5.68	---	---
Whole blood coagu . time – capillary tube method ( min )	5.39	6.71	5.30	---	---
Serum icterus index ( Units )	2.29	2.24	2.25	----	----

(Ref : K.P. Sreekumar, Kerala)

**Serum Biochemistry values of adult elephants**

Blood urea nitrogen (mg %)	9.63
Serum creatinine (mg %)	1.96
Total Bilirubin (mg %)	0.74
Direct bilirubin (mg %)	0.08
Indirect bilirubin (mg %)	0.66
Serum Glucose (mg %)	67.56
Total Protein (g %)	7.46
Albumin (g %)	2.27
Globulin (g %)	5.19
A / G ratio	0.45
Serum Cholesterol (mg %)	64.58
Total NPN (mg %)	35.45
Uric Acid (mg %)	2.73
Free ammonia (mg %)	7.51
Plasma Fibrinogen (g %)	0.65
Blood Chloride (mg %)	496.00
Blood Magnesium (mg %)	2.33
SGOT(U / L)	18.50
SGPT(U / L)	5.0
Alkaline Phosphates( Bodansky units / 100 ml )	1.25
Acid Phosphates( Bodansky units / 100 ml )	0.35
Amylase ( Somogyi units / 100 ml )	381.09
Serum Pottasium (m mol / L)	5.54
Serum Sodium (m mol / L)	115.90
CPK (IU / L)	99.48
LDH (IU / L)	405.60
AST (IU / L)	20.40
ALT (IU / L)	7.52

( Ref : K.P. Sreekumar, Kerala, A. Senthilkumar, Tamil Nadu )

### Incidence of endo-parasitism in Asian elephants

Name of the parasite	Location
Round Worms	
<i>Murshidia indica</i>	Intestine
<i>Murshidia murshidia</i>	Intestine
<i>Murshidia falcifera</i>	Intestine
<i>Quilonea travancra</i>	Intestine
<i>Quilonea rennie</i>	Intestine
<i>Amira pileata</i>	Intestine
<i>Decrucia additictia</i>	Intestine
<i>Choniangium epistomum</i>	Intestine
<i>Equinurbia sipunculiformis</i>	Intestine
<i>Grammocephalus varedatus</i>	Liver
<i>Parabronema indicum</i>	Stomach
<i>Parabronema smithi</i>	Stomach
<i>Indofilaria pattabhiramani</i>	Cutaneous nodules
<i>Indofilaria elephantis</i>	Probably portal vessel
Amphistomes	
<i>Pseudodiscus collinst</i>	Stomach & Intestine
<i>Pseudodiscus hawkesi</i>	Stomach & Intestine
<i>Gastrodiscussecundus</i>	Stomach & Intestine
<i>Pfenderius papillacus</i>	Stomach & Intestine
Blood Fluke	
<i>Bivitellobilharzia nairi</i>	Portal vessels
Tape worm	
<i>Anoplocephala mamibriata</i>	Intestine
Protozoa	
<i>Trypanosoma evansi</i>	Blood

Ectoparasites	
Louse	
<i>Haematomyzus elephantis</i>	Skin
Ticks	
<i>Boophilus annulatus</i>	Skin
<i>Haemophysalis spinigera</i>	Skin
<i>Rhipicephalus haemophysaloides</i>	Skin
<i>Ornithodoros savignyi</i>	Skin
Fly	
<i>Cobboldia elephantis</i> maggots	Stomach

(Ref : K.C. Panicker, Kerala)

### Microbiology of foot lesions and other wounds in elephants

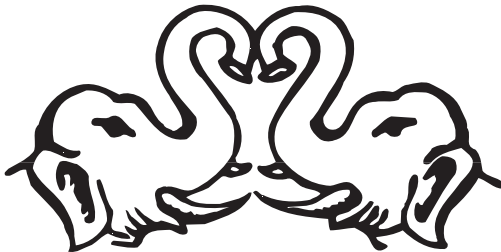
Type of lesions	Organisms encountered
Necrotic wound in foot	<i>Staphylococcus spp, Bacillus spp, Klebsiella spp, Streptococci spp, Clostridium spp and Bacteriods spp.</i>
Cuticular abscess	<i>Staphylococcus spp, Klebsiella spp and Streptococci spp,</i>
Nail lesions	<i>Staphylococcus spp, Bacillus spp, Klebsiella spp, Streptococci spp, E.coli, Proteus spp, Pseudomonas spp, Salmonella spp, Clostridium spp, Peptostreptococci spp and Candida spp.</i>
Foot rot condition and Pododermatitis	<i>E. coli, Staphylococcus spp, Streptococcus spp, Bacillus spp, Clostridium spp, Peptostreptococci spp, Penicillium spp, Candida spp and Aspergillus spp.</i>
Pad and Sole abscess	<i>Proteus spp, Salmonella spp, Bacillus spp, Streptococci spp, Peptostreptococci spp and Candida spp.</i>
Elbow abscess	<i>Staphylococcus spp, Streptococci spp, Klebsiella spp, Pseudomonas spp, Clostridium spp, Peptostreptococci spp and Bacteriods spp.</i>
Shoulder abscess	<i>Klebsiella spp, Streptococci spp and Proteus spp.</i>
Hip wound	<i>Streptococci spp, Klebsiella spp, Pseudomonas spp, Staphylococcus spp and Peptostreptococci spp.</i>
Lesions from hind quarters	<i>Streptococci spp, Staphylococcus spp, Pseudomonas spp and Candida spp.</i>

## Antibiotic susceptibility of aerobic organisms isolated from the foot ailments of captive elephants

S. No	Name of the Organism	Sensitive	Meditatively sensitive	Resistant
1	Staphylococcus	Gentamycin, Neomycin, Enrofloxacin, Chloramphenicol	Co-trimoxazole, Amoxicillin	Ampicillin-A, Amphotericin – B, Penicillin
2	Streptococcus	Gentamycin, Enrofloxacin, Chloramphenicol, Co-trimoxazole	Amoxicillin, Neomycin	Ampicillin-A, Amphotericin – B, Penicillin
3	Bacillus	Gentamycin, Enrofloxacin, Chloramphenicol, Ciprofloxacin	Neomycin, Co-trimoxazole	Ampicillin-A, Amphotericin – B, Penicillin
4	Pseudomonas	Enrofloxacin, Gentamycin, Neomycin,	Chloramphenicol	Co-trimoxazole, Amoxicillin, Ampicillin-A, Amphotericin – B, Penicillin
5	Klebsiella	Enrofloxacin, Chloramphenicol Gentamycin,	Neomycin, Co-trimoxazole.	Amoxicillin, Ampicillin-A, Amphotericin – B, Penicillin
6	Proteus	Enrofloxacin, Ciprofloxacin Chloramphenicol,	Neomycin, Erythromycin, Gentamycin	Ampicillin-A, Amphotericin – B, Penicillin
7	Salmonella	Chloramphenicol, Amoxicillin, Neomycin, Cotrimoxazole	Gentamycin	Ampicillin-A, Amphotericin – B, Penicillin
8	E.coli	Enrofloxacin, Ciprofloxacin, Chloramphenicol, Gentamycin.	Neomycin, Erythromycin.	Ampicillin-A, Amphotericin – B, Co-trimoxazole, Amoxicillin, Penicillin

## Antibiotic susceptibility of anaerobic and other organisms isolated from the foot ailments of captive elephants

S. No	Name of the Organism	Sensitive	Meditatively sensitive	Resistant
1	<i>Clostridium spp</i>	Chloramphenicol, Amoxicillin, Gentamycin, Enrofloxacin, Ciprofloxacin	Erythromycin, Ampicillin-A, Neomycin, Cotrimoxazole	Penicillin, Ampicillin-B, Metronidazole.
2	<i>Peptostreptococci spp</i>	Ciprofloxacin, Enrofloxacin, Gentamycin, Cotrimoxazole, Neomycin.	Penicillin, Amoxicillin, Ampicillin-A, Erythromycin, Chloramphenicol	Ampicillin-B, Metronidazole.
3	<i>Bacteriodes spp</i>	Ciprofloxacin, Chloramphenicol, Enrofloxacin, Gentamycin.	Co- trimoxazole, Neomycin, Erythromycin, Amoxicillin.	Penicillin, Ampicillin-A, Ampicillin-B, Metronidazole
4	<i>Aspergillus spp</i>	Gentamycin, Ciprofloxacin, Enrofloxacin.	Chloramphenicol, Amphotericin - B, Amoxicillin.	Penicillin, Ampicillin-A, Neomycin.
5	<i>Penicillium spp</i>	Penicillin, Amoxicillin.	Gentamycin, Ciprofloxacin.	Ampicillin-A, Neomycin, Chloramphenicol.
6	<i>Candida spp</i>	Enrofloxacin, Gentamycin, Chloramphenicol.	Neomycin, Amoxicillin.	Ampicillin-A, Erythromycin.



## APPENDIX I

### Certificate of fitness

( To be completed and signed by a Registered. Veterinary Practitioner.)

Date and time of examination :

Number of elephant/s :

Name of elephant/s :

Age / Sex :

I hereby certify that

1. at the request of (consignor) \_\_\_\_\_ I have this day examined the above mentioned elephants in their traveling cages / vehicle not more than 12 hours before their departure.
2. each elephant appears to be in a fit condition to travel from \_\_\_\_\_ to \_\_\_\_\_ by road / rail and is not showing any signs of infectious or contagious diseases.
3. no cow elephant appears to be under advanced stage of pregnancy.
4. the elephant/s are adequately fed and watered for the purpose of the journey.
5. the elephant/s have been vaccinated .
  - a) Type of vaccine/s
  - b) Date of vaccination/s

Place :-

Date :-

Signature  
Address, Qualification and  
Designation with Seal

**APPENDIX II****Certificate of Undertaking for Tranquilization of Elephant**

( Certificate to be obtained from Mahout / Elephant keeper  
before Chemical Immobilization )

I \_\_\_\_\_  
undertake that the elephant named \_\_\_\_\_  
aged \_\_\_\_\_ years is in my possession and it is  
uncontrollable. I have been properly appraised of the risks involved  
in darting the elephant with chemical immobilization technique  
and I am prepared to bear the damage and loss including possible  
death of the animal, if any arising out of it.

*Signature*  
Name and  
Address

**Witness :-**

1.

2.

Place :-

Date :-

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10. Bandipur Tiger Reserve, Karnataka
11. Mudumalai Tiger Reserve, Tamil Nadu
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