

# HEALTHCARE MANAGEMENT OF CAPTIVE ASIAN ELEPHANTS



**KERALA  
AGRICULTURAL  
UNIVERSITY**

**HEALTHCARE MANAGEMENT**  
**OF**  
**CAPTIVE ASIAN ELEPHANTS**



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# HEALTHCARE MANAGEMENT OF CAPTIVE ASIAN ELEPHANTS

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## FOREWORD

The elephant has been part of the Indian culture and mythology from time immemorial. Elephants are worshipped and respected all over India. Indian mythology contains many stories about them. The earliest writings on elephants is considered to be in Arthashastra. Historically, King Akbar maintained thousands of elephants in his stables.

Elephants are possibly the most important animal in the animal kingdom. Their size, strength, anatomical peculiarities, intelligence, irresistible appeal and usefulness have made them lovable and at the same time terrific. They evoke strong emotions and opinions.

The first treatise on elephant healthcare was written 2000 years ago (Hastayurveda). Scientific studies on elephants started in 19<sup>th</sup> century. In the 20<sup>th</sup> century, G. H. Evans did some pioneering work on elephants.

Despite the fact that India has got largest number of wild and captive Asian elephants, systematic works on elephant healthcare are still lacking. This book seems to be a humble beginning to fill the void. Kerala Agricultural University has been associated with elephants for more than 50 years. Considering the contributions of the Faculty, a Centre for Studies on Elephants was established in the year 2000. This centre is proposed to be elevated to the status of a Centre of Excellence by Government of India. The Centre is actively involved in elephant research and related activities. The experiences of the Faculty and other professionals are narrated in this book. Elephant management is a dynamic process and is liable to change. As the time advances, it will be necessary to incorporate advancements and new information.

I congratulate Elephant Study Centre of Kerala Agricultural University for the efforts it has taken for publishing this book and hope that the book would be a useful guide for all elephant practitioners.



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*Date : 15-1-2009*

## **PREFACE**

Elephants have never failed to captivate human beings, be it as a mythical figure, in the battle front, in the wild or as a domesticated animal. Beliefs and notions about this pachyderm are as old as the fascinating stories that we have heard about this animal. India is home to 50 per cent of the Asian elephant population. Kerala is abode to more than 800 captive tuskers who are admired and revered.

The Faculty of Veterinary and Animal Sciences was in the forefront since its inception in mitigating sufferings of captive elephants and took a lead role in conducting research on captive elephant welfare and treatment. Chemical immobilization protocols for controlling elephants in musth were developed and standardized by eminent scientists of our Faculty. Elephant Study Centre under the faculty has been recognized by the Project Elephant as one of the two training centres at National Level for imparting scientific know-how to Veterinarians, Mahouts, Elephant Owners and Officers of Forest Department.

The book "Healthcare Management of Captive Asian Elephants" is an endeavour of the Elephant Study Centre of Kerala Agricultural University. The authors are adepts in their respective fields of elephant care management. The book gives stress on the importance of adopting modern treatment principles without neglecting the proven traditional methods. Exhaustive details on every realm of elephant care and management including housing, handling, diagnosis and treatment of diseases and musth management have been incorporated in this book. I whole heartedly congratulate the authors, editorial team and the Elephant Study Centre of Kerala Agricultural University for their meticulous effort. The book will unequivocally be an authoritative quote in any scientific literature on Asian elephants.

**(E. NANU)**

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## CONTENTS

<i>Sl.No.</i>	<i>Topic</i>	<i>Page</i>
1	The status of domesticated elephants in India	1
2	Evolution of elephants	7
3	Anatomy of elephant	12
4	Physiological features of Indian elephant	16
5	Significance of various external and internal organs of elephant	21
6	Elephant facts	23
7	The exploitation of Asian elephants	28
8	Elephant capture	33
9	Desirable and undesirable traits in an elephant	35
10	Purchasing elephants - Tricks of the trade	37
11	Sensitive points (Marmams)- Hastyayurveda concept	39
12	Prediction of body weight in Indian elephants	40
13	Management practices in Kerala	42
14	Transportation of elephants by rail	44
15	Reproduction in elephants	48
16	Care of elephant calves	55
17	Signs of health in elephants	58
18	Feeding of elephant	59
19	Feeding and management of captive Asian elephants	64
20	Elephants and work	69
21	Musth: Observations based on studies on 140 elephants in Kerala over 10 years	71

<i>Sl.No.</i>	<i>Topic</i>	<i>Page</i>
22	Use of antiandrogen in controlling musth in captive elephants	73
23	Elephant status, stress and musth	75
24	Captive elephant practice - tips to veterinarians	78
25	Administration of medicines in elephants- points to ponder	80
26	Handling and care of syringe projectors	82
27	Principles and practice of fixing dose of drugs for elephants	85
28	Review of the incidence, etiology and control of common diseases of Asian elephants with special reference to Kerala	92
29	Anaesthesia for surgical manipulations in the elephant	101
30	Management of surgical affections in captive elephants	104
31	Foot disorders and their care in elephants	111
32	Fluid therapy in elephants with special reference to intestinal impaction	114
33	Healthcare management of the elephants of North - East India	117
34	Tuberculosis in elephants- the hidden enemy	121
35	Necropsy protocol with special reference to elephants	127
36	Collection and preservation of clinical materials for laboratory examination and interpretation of haematological findings	130
37	Training the mahouts	134
38	Media and elephant welfare	136
39	Appendix - 1 Tips for laboratory investigations	139
	Appendix - 2 Kerala captive elephant (Management and Maintenance) rule - 2003	147
	Appendix - 3 Package of practices - 2001	157
	Appendix - 4 Guidelines for euthanasia in elephants	166
40	Bibliography	167

# THE STATUS OF DOMESTICATED ELEPHANTS IN INDIA

*S. S. Bist*

## Elephants in India

The Asian elephant (*Elephas maximus*) enjoys a special status in India which harbours over 28,000 wild elephants. This is over 50 per cent of the total population of this species in the world. Elephant represents the Indian ethos. It has been very closely associated with the religion, myths, history and cultural heritage of India for centuries. It has been rightly said that one cannot imagine India without the elephant (Anon., 1993).

Asian elephant is an endangered species throughout its range. It is threatened on account of pressures of poaching for ivory, loss of habitat and ever-increasing incidents of human-elephant conflict. Many legal steps have been taken in India since 1873 for the protection of elephants. In February 1992, Government of India launched Project Elephant – a major initiative for the conservation of elephants in the country. A number of measures have since been taken under the Project for strengthening the enforcement machinery; protection and improvement of habitats and corridors for elephants; reducing human-elephant conflict; creating awareness among the people; and addressing various other issues relating to elephant conservation. The success of the Project is evident from the fact that the elephant population in the country has increased from about 15,600 in 1980 to about 28,000 in 2001.

## Domesticated elephants

India has a fascinating history of domesticating wild elephants. Various methods of capturing and training of elephants were evolved over a period of time in different geographical regions of the country. A lot of literature was produced in the ancient and the medieval period on the management and treatment of the domesticated elephant. Kings and noblemen used to patronize elephants in the past. Elephants were domesticated in the early days mostly for the military purposes. In the modern era, however, elephants have been used in state pomp, as status symbol by princes and the landed gentry, the great *shikar* meets, elephant-capturing, logging operations, tourism, temple processions, circus shows and to a limited extent in agricultural works.

However, until the recent past, domesticated elephants have not received due attention from the conservationists. There has been a tendency to dismiss them as just another category of cattle. This is despite the fact that the Wildlife (Protection) Act, 1972 (WPA-1972), the principal legal instrument for protection of wild animals in the country, treats domesticated elephants on par with the wild ones. Project Elephant has, however, accepted the role of the domesticated elephants in the overall conservation of the species. One of the objectives of Project Elephant is 'to improve the welfare of elephants in domestic use, including veterinary care, training of *mahouts*,

humane treatment of elephants, etc.’ But until recently, Project Elephant has mostly been busy in activities relating to wild elephants and it has not done much for the welfare of the domesticated elephants.

#### **Number of domesticated elephants**

The relative neglect of the domesticated elephants is evident from the fact that no formal census of captive elephants has ever been attempted in India. The WPA-1972 stipulates that all the domesticated elephants, except those in the recognized zoos, should be declared to the Chief Wildlife Warden (CWLW) of the State who should register these elephants by issuing ownership certificates to the owners. But only about 1300-1400 domesticated elephants are registered with the CWLWs. Jackson (1985) estimated 2910-3110 domesticated elephants in India. Santiapillai and Jackson (1990) revised the estimate to 2260-2760. Lair (1997) observed that number of domesticated elephants in India should not be less than 4000. Project Elephant carried out a quick survey in December 2000 and estimated that there were 3400-3600 elephants in domestication in 24 States in the country (Bist *et al.*, 2001).

There is no evidence to suggest any significant increase or decrease in the population of the domesticated elephants in recent years. There is, however, some regional shift in their distribution. For example, there has been a great exodus of the domesticated elephants from Assam and Arunachal Pradesh to other parts of the country, particularly Kerala, as a result of the restriction on logging operations in the north-east India imposed by the Supreme Court in 1996.

#### **Legal status**

Elephant has been included in Schedule-I of the WPA-1972 since October 1977, which implies that it has the highest degree of legal protection. Hunting (which includes capturing) of elephants is normally banned. The CWLW may, however, proclaim a rogue elephant which has become dangerous to human life and permit its hunting. The CWLW may also, with the previous permission of the Central Government, permit capturing of elephants for scientific research, zoological parks or population management. Commercial trade in live elephants as well as any product, including ivory, derived from elephants is prohibited.

Definition of wild elephants under the WPA-1972 also includes the domesticated ones. No person can keep, possess or acquire an elephant without an ownership certificate issued by the CWLW or any other authorized officer. Only the persons possessing ownership certificates can transfer elephants by way of sale, gift or otherwise. A person, having an ownership certificate, is required to inform the concerned CWLW within 30 days if he transfers his elephant from one state to another. The domesticated elephant is excluded from the definition of livestock. However, the Act recognizes a domesticated elephant as a ‘vehicle’ to facilitate its confiscation if used for committing any offence. The zoos recognized by the Central Zoo Authority are exempted from possessing ownership certificates. Zoos are also required to follow standards and norms prescribed under the Recognition of Zoos Rules, 1992 for keeping elephants in captivity.

Offences relating to elephants under the WPA-1972 cannot be compounded. For

general offences concerning elephants, the offender can be punished with imprisonment from one year to six years and a fine not less than Rs.5000. For offences relating to illegal trade in elephants and ivory, term of imprisonment can be extended up to 7 years. Any elephant captured or kept in violation of the WPA-1972 is a government property and liable for confiscation.

Import and export of elephants is governed by the Import-Export Policy announced periodically by the Ministry of Commerce. Zoological parks, recognized scientific institutes, circus companies and private individuals can import elephants subject to recommendation of the CWLW and provisions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Export of elephants is prohibited. However, in special cases, noncommercial export of elephants for scientific, zoological or educational purposes is permitted subject to recommendation of the Ministry of Environment and Forests. Violation of the Import-Export Policy is treated as an offence under the Customs Act, 1962.

The domesticated elephants are also subject to the provisions of the Prevention of Cruelty to Animals Act, 1960 (PCA-1960) and the various rules framed thereunder, viz. the Prevention of Cruelty to Draught and Pack Animals Rules, 1965, the Performing Animals Rules, 1973 and the Prevention of Cruelty (Capturing of Animals) Rules, 1972. "Cruelty" has not been defined in the Act. However, certain acts of omissions and commissions described in the Act constitute cruelty punishable under the Act. Some of the activities recognized as cruelty include:

Subjecting an elephant to beating, over-riding, over-loading, torturing;

Willfully and unreasonably administering any injurious substance to an elephant;

Confining any elephant to a cage which does not permit it a reasonable opportunity of movement;

Conveying or carrying an elephant in such a manner as to subject it to unnecessary suffering;

Inciting any elephant to fight any other animal for the purpose of entertainment;

Depriving an elephant of sufficient food, water or shelter.

The rules under the PCA-1960 prohibit use of elephants for drawing any vehicle or carrying any load for more than nine hour a day; use of any spiked stick or sharp equipment for driving or riding an elephant; and capture of animals except by 'sack and loop' method, tranquillising guns or any other method which renders the animals insensible to pain before capture. The rules stipulate registration of trainers and exhibitors of performing elephants.

Despite a strong legal support, the general welfare of the domesticated elephants remains a problem due to poor enforcement of laws. As stated earlier, even after 25 years of inclusion of elephants in Schedule-I of the WPA-1972, registration of the domesticated elephants has not been completed. By excluding domesticated elephants from the definition of 'livestock', they have theoretically been placed outside the purview of the Livestock Departments. Provisions of the PCA-1960 are hardly ever invoked. Most of the legal restrictions on private ownership of elephants were not intended but consequential to inclusion of the Asian elephant in Schedule-I of the WPA-1972. Provisions of the WPA-1972, PCA-1960 and

various rules made under the said Acts were never framed keeping the elephant in mind and as such, they suffer from various types of inadequacies and flaws. Some of the restrictions like the requirement of ownership certificates for elephants could have been utilized with advantage for improving the condition of the domesticated elephants if only the CWLWs could enforce these provisions seriously.

### **Veterinary care**

Veterinary support is needed for treatment of sick and injured elephants, immunization of livestock on the forest fringes to protect elephants against infectious diseases, control of problematic elephants (e.g., elephants in musth) and also for postmortem and forensic support. Not all the domesticated elephants in India get veterinary support. Elephants owned by the zoos and the State Forest Departments have been lucky. All the major zoos in India have one or more full-time veterinarians. The major Protected Areas (PAs) also have full-time veterinary doctors. The PA authorities generally receive help from the State Veterinary Officers in arranging immunization of livestock – a legal requirement under the WPA-1972. In some PAs, NGOs also arrange veterinary support. A large number of the domesticated elephants, particularly under private possession, do not have access to modern veterinary care and the elephant keepers depend on *Kaviraj* (practitioners of traditional medicine), quacks or their own knowledge. Veterinary colleges, even in the major elephant states, seldom include elephant-healthcare in the syllabus of their regular teaching programmes. Most of the veterinary doctors called upon to treat a wild or a domesticated elephant, lack necessary knowledge, experience and laboratory support. There

have been instances when a problematic elephant had to be destroyed in the absence of tranquillising equipments. In a large number of cases of postmortem of elephants, the reports are either defective or inconclusive. In fact, expert elephant veterinarian is a rarity in the country.

### **Employment opportunities**

The survey by Project Elephant in December 2000 has revealed that 75 per cent of the domesticated elephants are owned by individuals, 6 per cent by temples, 2 per cent by zoos, 3 per cent by circuses and 14 per cent by the State Forest Departments. The survey has also revealed that 43 per cent of the elephants are primarily used for logging, 10 per cent for transportation, 6 per cent for tourism, 5 per cent for entertainment (e.g., circus and zoo), 12 per cent for ceremonial purposes, 2 per cent for agriculture (mostly in Arunachal Pradesh), 4 per cent for elephant capturing (as *kunkis*) and 7 per cent for begging. The remaining 11 per cent elephants (mostly calves, sub-adults and old ones) are not put to any work.

The tradition of keeping the domesticated elephants appears to be going out of fashion in India. The abolition of *zamindari* - the landed gentry, after independence, deprived domesticated elephants of their chief connoisseurs. Remedial measures taken by the Government to protect wild animals and their habitat have resulted in a ban on capturing and trading of elephants as well as restrictions on logging operations - an activity that used to generate maximum employment for elephants. Improved road networks and availability of faster means of transport have reduced the utility of elephants as draught animals. Even the circuses that used to employ elephants in significant numbers are

finding it difficult to sustain themselves either due to economic reasons or due to pressure from the animal-right activists. It is a costly proposition now to acquire and keep an elephant and the returns are very uncertain. There is not much incentive left for owning and possessing elephants. All these factors have led to a great decline in the employment opportunities for the domesticated elephants. Although there has not been any immediate decrease in the over-all numbers of the domesticated elephants, yet one can see the impact of the reducing employment opportunities in the form of the falling standards in the upkeep of the domesticated elephants and the general neglect of their *mahouts* in many parts of the country.

#### **Initiatives of Project Elephant**

As stated earlier, Project Elephant has only recently started paying serious attention to the management of the domesticated elephants in the country. The first step, as stated earlier, was in the form of a quick survey of the domesticated elephants in the country in December 2000. Project Elephant has undertaken a programme for registration of the domesticated elephants by using microchips for identifying the individual animals. It is proposed to prepare a database containing all the essential information about the domesticated elephants and their keepers during this exercise. This programme will subsequently be extended to other parts of the country. It is also proposed to provide free annual health check-up and immunization facilities to the registered elephants as an incentive to their owners. Attempts are also being made to bring all the domesticated elephants and *mahouts* under an insurance cover.

Project Elephant undertook skill-upgradation programmes for the *mahouts* of the State Forest Departments in Uttaranchal and Assam during 2001-02. It is proposed to continue such programmes in other States and extend these to cover the *mahouts* of the private elephants as well. Project Elephant also sponsored during 2001-02 some refresher courses on elephant-health care for the veterinarians in Orissa and Assam. It is now proposed to hold such refresher courses regularly in different regions of the country in collaboration with the reputed veterinary institutes. Project Elephant has also undertaken the publication of some useful literature relating to the domesticated elephants for the benefit of the elephant managers and the veterinarians. Project Elephant has also been conducting awareness programmes in collaboration with the State Forest Department and NGOs at the annual elephant-fair in Sonpur in Bihar for sensitizing the elephant-keepers regarding the humane treatment of their elephants. Project Elephant proposes to organize similar elephant-fairs in the north-eastern India which harbours the largest population of the domesticated elephants. The elephant owners and *mahouts* in the north-eastern region are also being motivated to form co-operatives and undertake ecotourism activities in the PAs. Project Elephant is also engaged in developing suitable norms and standards for the elephant-owners, which can be enforced through the WPA-1972 and the PCA-1960, for ensuring the welfare of the domesticated elephants. Attempts are also being made to persuade the State Forest Departments and other government agencies for increasing the employment opportunities for the domesticated elephants by deploying them for



patrolling duties, controlling depredation by wild animals and eco-tourism works.

### **Roadmap for future**

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. Domesticated elephants have been ignored both by the wildlife experts and the livestock experts. There is also an apprehension that much of the traditional knowledge and skill available in India would be lost unless demand and utilization of domesticated elephants is kept alive. It is important to understand that management of domesticated elephants is complementary to that of wild elephants. It will be ironical if the option of capturing and utilizing surplus or problematic wild elephants is given up simply because of some illogical provisions of law or because of criticism by the animal-right activists. It makes a better sense to take steps for stopping the abuse of the domesticated elephants rather than banning the domestication itself.

It is also possible to utilize modern technique and scientific knowledge to remove unnecessary cruelty from capturing, training and handling of elephants. Demand for the

domesticated elephants will have to be created and sustained by careful planning. The provisions of the WPA-1972 as well as the CITES need to be relaxed to facilitate internal trade and export of the domesticated elephants. It needs to be emphasised that, unlike the trade in ivory, trade in the domesticated elephants is not detrimental to the survival of the species. It is also possible to give suitable training to elephants to prepare them for new jobs and new avenues of employment. 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 large fleet of domesticated elephants.

Yet another point worth remembering is that the people in most parts of the country still have sympathy for elephants because of their cultural and religious values. These values must be nurtured and encouraged as an essential ingredient of the conservation strategy for elephants in the coming years. The domesticated elephants provide a convenient medium for preserving these values. It is desirable that the energy, experience and goodwill of thousands of elephant keepers in India is channelled towards conservation and welfare of elephants.

## EVOLUTION OF ELEPHANTS

*K. Chandrasekharan*

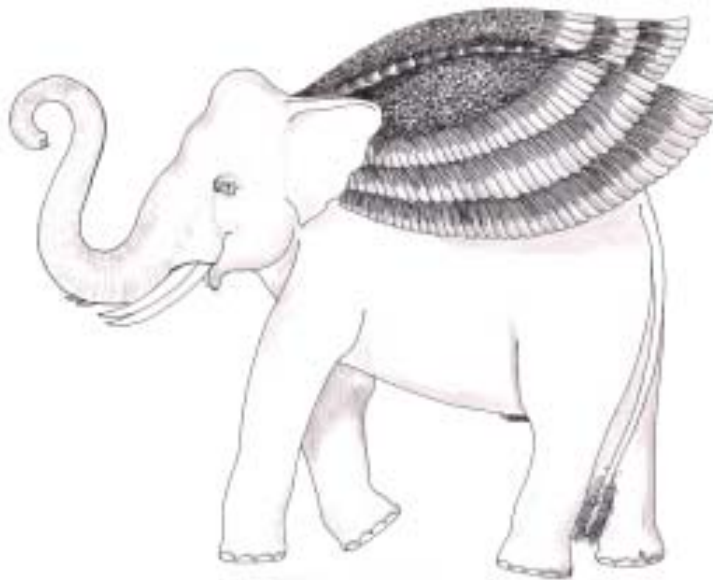
### 1. The mythological story of evolution

Charles Darwin is considered the Father of evolution and according to him all life forms evolved from water. Protozoa, the single celled forms were the first life form and everything else evolved from them.

Indian mythology has a different story to tell about the evolution of elephants. A long time ago, when the sun was non-existent, the saints or the maharshies in heaven pleaded with Lord Brahma, the Creator, to create a sun for them. Lord Brahma immediately scooped up some mud from the ground, rolled it into a ball and chanted some Vedic mantras. The ball then transformed into a divine sphere.

This was swallowed by Aditi, a Devadasi. After 1000 years of gestation, Aditi delivered the sphere and as it came out, it immediately split into two halves and the sun escaped from inside. Thus the sun is also called Aditya in Sanskrit as he was the son of Aditi. The rishis were still not satisfied and once again Brahma was requested to create an animal that they could enjoy watching and play with. He picked up the two halves of the shell in both of his hands and chanted Vedic mantras once again. From the half on his right hand he created Airavatam, the bull elephant and from the other half created Abrahmu, the female counterpart.

Both Airavatam and Abrahmu were white



*Fig. 1. Airavatam*

skinned, had four tusks each and a pair of wings. It is believed that the present generation of elephants was their descendants. Only one historic document on elephants, the 'Gaja Sastram' discusses this aspect coupled with illustrations.

Soon the potential of elephants were recognized by all Gods in heaven and they decided to employ elephants as guards to the entrances of Heaven. Hence seven more pairs of elephants were created to guard the heaven's entrances. They were called the Ashtadikpalaka's or the eight divine guards. Their names were

<i>Male</i>	<i>Female</i>
Airavatham	Abrahmu
Pundareekan	Kapila
Pushpadantan	Thamarakkarni
Vamanan	Angana
Supradeekan	Anupama
Anjanan	Anjanavati
Sarvabhowman	Subradanti
Kumudan	Pingala

The elephants with their wings were free to fly about anywhere they wanted to in heaven. They became naughty and mischievous in nature and began disturbing the rishis in meditation. The outraged rishis cursed the elephants which deprived them of their wings and one pair of tusks. Rishi Durvasav, notorious for his temper, cursed them once again that they all descend to the earth and live the rest of their life down there. The elephants began to actually enjoy their life down in the earth living in lush and bountiful forests but they were all susceptible to diseases and wounds which they could not take care of by their own. Just before leaving heaven for earth, they had requested Lord

Indra to create some one who could take care of them and Lord Indra had promised them the same.

Lord Brahma created a beautiful 'Apsaras' or celestial beauty called Gunavati. Gunavati was extremely proud of her assets and irritated the Gods especially Indra. Indra cursed her that she be transformed into a cow-elephant and descent to earth, but also said that she would be redeemed of her curse if she consumed the semen of Samagayana maharishi and gave birth to a young boy, to be named 'Palakapya'.

Gunavati, the cow-elephant came down to earth and settled into a life near Samagayana maharishi's ashram. One day by chance, she was able to consume the maharishi's semen and after a gestation period of 1000 years she gave birth to Palakapya, a young boy after which she returned to heaven.

Palakapya was brought up by the elephants and he became their guardian and healer tending to their wounds and ailments. The elephants by then had multiplied in numbers and began to venture close to human settlements. King Romapada of a nearby kingdom of Champa found the menace from the elephants intolerable and ordered his men to capture them. Only after a while did Palakapya know what had transpired and he immediately went to meet the king. He told the king that he was the guardian of the elephants and assured that his protegee would cause no further harm to his subjects in the future and that they be released. The King was impressed with Palakapya and he released the elephants.

Palakapya returned to the forests and once again took up his life with the elephants. He is the author of the famous



*Fig. 2. Palakapyan with elephants*

“Hastyayurvedam” or the “Palakapyan”. Hastyayurvedam is a book which is about elephant diseases and medications. It is believed that Palakapya wrote this book based on his personal experience and knowledge on the elephants. Hastyayurveda is written in Sanskrit and is not easily understood by layman. No one has been satisfactorily able to translate the book and it is indeed a challenging task as one needs to be a master in Sanskrit as well as in medicine. “Matanga leela” is another historical piece of work on elephants based on the former text. Vallathol Narayana Menon has translated this into Malayalam and an English version of the same also exists. Recently Vaidyamatom Cheriya Narayanan Namboothiri translated Hastyayurvedam into Malayalam and the same has been published by Mathrubhoomi books.

## **2. The scientific aspects of evolution**

Elephants are said to have evolved into their present form after several million years. They belong to the family Proboscidae, which are animals that have a proboscis or trunk-like extension of the upper lip. Presently there are only three animals that have a proboscis and they are the elephant, dugong and hyrax belonging to the hare family. Previously there were 350 species belonging to this family.

**Moeritherium:** The first form of elephant is named “Moeritherium” as the fossils of these creatures were found near Lake Moeris in Egypt. The Moeritherium resembles a pig. It is from this Moeritherium that other forms of elephants evolved.



*Fig. 3. Moeritherium*

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



*Fig. 4. Deinotherium*

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



*Fig. 5. Trilophodon*

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



*Fig. 6. Platybilodon*

**Mastodon:** Huge sized elephants.



*Fig. 7. Mastodon*

**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.



*Fig. 8. Mammoth*

**Characteristics of African elephants when compared with Asian elephants:**

They are taller and heavier

The tusks are heavier

The trunk has transverse ridges

The trunk has two finger tips

The ears are bigger

There is a marked dip in the back.

The foot has 14 nails (4 each on forefoot and 3 each on hind foot)

Ridges found on the table surface of teeth are semi-lunar shaped

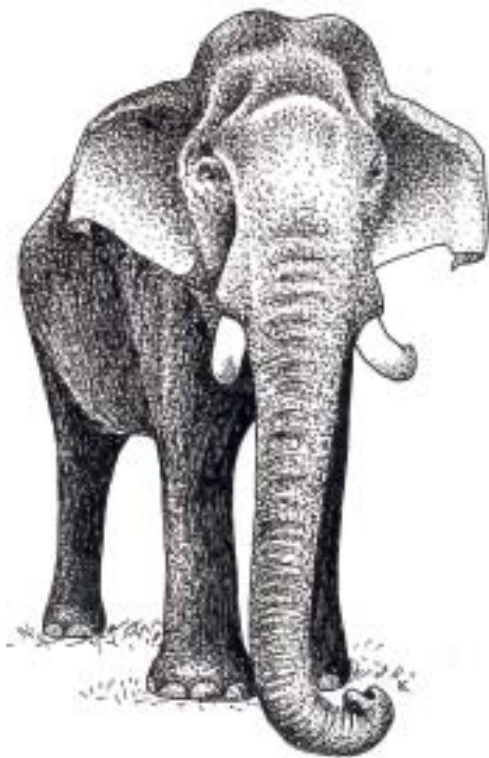
Temporal gland secretion occurs in both male and female.

Both males and females have tusks

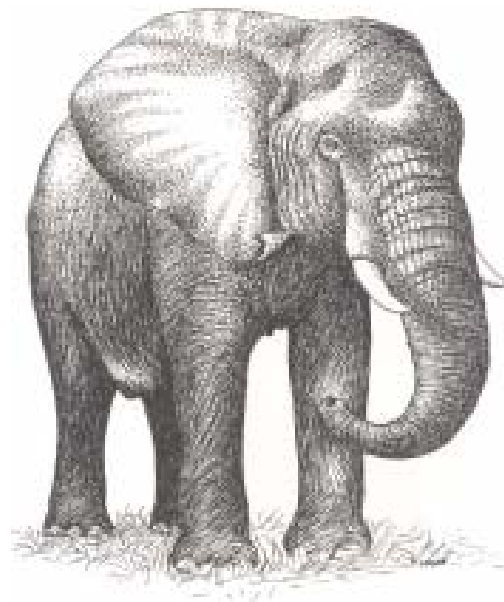
An opinion exists that they are difficult to be trained compared to Asian elephants.

An attempt was once made at the London zoo to cross Asian and African elephants and a calf named Moti was born. But this calf died very soon.

There are differences in appearance of Asian elephants regionally and in different Asian countries. For example, a lot of difference in appearance is noted between elephants from South India and that of Bihar. Bihari elephants are tall but their head is small. Also the trunk is short and barely touches the ground. Elephants from the South have long trunks and huge heads.



*Fig. 9. Asian elephant*



*Fig. 10. African elephant*

## ANATOMY OF ELEPHANT

*Jose John Chungath*

Veterinarians have a special role to play in resolving diseases of wildlife/livestock. The existence of an organism in the universe requires energy that is derived from the food taken in. Thus anatomy and physiology form the base for other subjects. Based on food habits animals are further classified into

1. **Carnivores** - that hunt their prey and so have tuberculo-sectorial teeth and have a glandular stomach to digest it.
2. **Non-ruminant herbivores** - that feed on vegetation and so have 'lophodont' type of teeth to cut and grind the roughage and have anaerobic chambers of intestine to digest it.
3. **Ruminants** - that feed on vegetation hasty to eat and have 'selodont' type of teeth to cut the vegetation. They have large chamber of stomach that are meant for anaerobic digestion.
4. **Omnivores** - that feed on mixture of plant and animal matter and so have 'bunodont' type of teeth. They have their digestive system with comparatively less capacious stomach, but long intestine.

Thus the types of teeth help us to identify the skull of different wild animals. The digestive system of wild animals are adapted to their food habits. Some of the non-ruminants as elephant and zebra have no gall-bladder which is primarily the storage place of lipolytic enzymes.

### *Elephant – Anatomy*

This largest terrestrial mammal has the most distinctive and fascinating feature (the longest nose) in animal kingdom. 'Trunk' the elongated upper lip is composed of about 6000 circular and longitudinal muscles and is used in multiple ways equivalent to a human hand. The elephant's sense of smell is greatly developed and the raised up trunk can test the breeze for scents that may reveal territorial sense, nature of food, identifying the herd, calf etc. The finger like process at the tip of the trunk combined with a little suction action enables the elephant to pick up objects as small as a pin. The sensory nerve endings here can transmit impulses as to the shape, texture, temperature, etc. Trunk is the shower of an elephant for its bath and to drink. A single bout in the trunk of an adult elephant carries 8-10 litres of water.

The ear vary greatly in size between the African and Asians sub-species. Elephant has excellent hearing power but it is believed to have poor eye sight.

### **Skeletal peculiarities**

#### **a. Skull and sexing**

The skull is massive and formed by all the skull bones seen in other animals. The sinuses are highly compartmentalized and hence not easily drained while infected but reduces the weight. The skull measurements

enable us to identify the sex of an elephant which is a specific factor in elephant compared to other animals. The ratio of forehead length, head length and occiput length are the main parameters that enable us to sex it.

**b. Dentition and ageing**

The dental formula of an elephant may be written as

$$2 \left( I \frac{1}{0} (\text{tusk}), C \frac{0}{0}, PM \frac{0}{0}, M \frac{1}{1} \right).$$

At a given time there are only four molars in use in the mouth of an elephant. These four molars in use in the mouth of an elephant form a set of molars. There are such six sets of teeth during the whole life span of an elephant. The gradual progression of each set of teeth to the grinding position is the molar progression – the phenomenon seen only in elephant. The process of teeth shedding or in other words temporary and permanent sets of teeth is not there in elephant. Each molar in elephant is a combined massive structure of particular number of laminae that are

cemented together. We can easily count the laminae to know which set of molar is in use by which we can infer the age of elephant.

Molar set	Number of laminae	Appearance/ grinding age	Replacement/ worn out age
1	4	4 months	2-2½ 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

**c. Tusk – the beauty and cost of an elephant**

The upper two incisors in elephant have undergone exaggerated evolutionary development to form tusk in males and tushes in females. Only 2/3<sup>rd</sup> of their length is visible. There are tuskless males known as *makhnas* which are more robust than a tusker. Their trunks are very broad at base. It is reported that a pair of temporary tusks appear at the

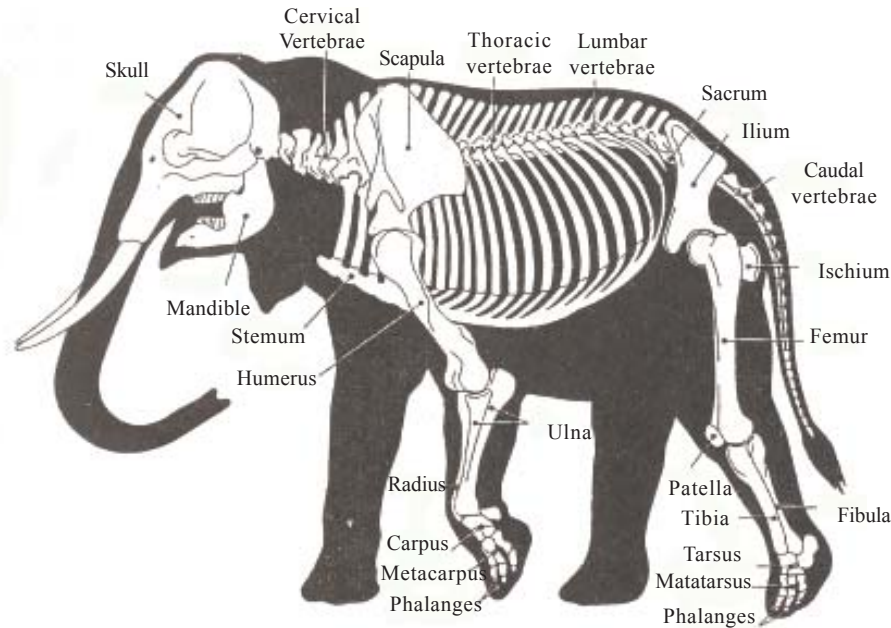


Fig 1. Skeleton of elephant



age of eight months and sheds off by two years. In African sub-species both bulls and cows have tusks. The bulk of the tusk is made of dentine and not so brittle as enamel and is creamy in colour.

**d. Vertebral column** – It forms the central beam of the body and is made of C7, T19-20, L4, S4, Cy 28-30 vertebrae and no anticlinal vertebrae in elephant. Hence the side ways bending of the animal is little difficult but the locking spines help to carry the huge weight of the body.

The rib cage is massive and almost reaches upto pelvic bones. The sternum and the pelvic symphysis is not horizontal but arranged dorso-caudally. Hence the animal never prefer to rest on sternal recumbancy as in other animals. In other words a fall on sternum is fatal for an elephant. The inclined pelvic symphysis brings the genital sinus of a cow elephant between its thighs.

**e. Limbs**–The appendicular skeleton of an elephant is articulated in such a way that side ways and backward movements are very much restricted. The joints are in straight lines and work as concrete columns to bear the huge weight of body and helps the animal sleep on standing. Ulna is larger than radius



Fig 2. Foot of elephant

and no long bone has the marrow cavity which instead is filled with cancellous bone or red marrow.

### The viscera

The heart of the elephant is with a bifid apex and has only one coronary artery. The lungs are very capacious in size and resemble that of a horse.

The elephants have simple stomach and the digestive system is similar to that of horse. The small and large intestines are 65-75 feet and 35-45 feet long, the large intestine arranged as in horse and the flexures are the sites of constipation and colic in elephants. The caecum presents three taeniae-caecii and three rows of sacculations in its wall. The liver does not have gall bladder. Usually the roughage requirement of an elephant is 250-300 kg per day and 200-250 litres of water.

The notable feature of an elephant's male reproductive system is the absence of Pampiniform plexuses, cremaster-muscle and inguinal canal. The testis is intra- abdominal, just behind the kidneys and globular in shape. Mammary glands are pectoral in position and the teats have multiple openings.

The skin of elephant has very few sweat glands and nerve corpuscles. They are unable to tolerate high temperature or direct sunlight. Spraying itself 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 methods adopted to cool its body.

Temporal glands are modified skin glands located on either side of head just beneath the skin, above the zygomatic arch at a point about half way between the lateral canthus of eye and external opening of ear. Its duct opens in temporal fossa close to lateral canthus of eye. Histologically it is a tubulo-alveolar gland and during musth there is profuse foul smelling discharge.

### Comparison between African and Asian elephant

	<i>African</i>	<i>Asian</i>
1.	Larger in size (6000 kg)	Smaller (5000 kg)
2.	Taller (12-13 ft)	Not so taller (10-11 ft)
3.	Highest point at shoulder	Highest point behind the shoulder at middle of back
4.	Ears are larger	Not so larger
5.	Short trunk with circular rings of skin	Long, trunk touching on ground and comparatively smooth
6.	Two finger like processes at tip of trunk	One finger like process at tip of trunk
7.	Tusk in both bull and cow	Tusk in tusker only
8.	Long but slender tusks	Short but stout tusks
9.	Marked dip in the back between fore and hind quarters	Back is unbroken convex
10.	Flat forehead	Twin domed forehead
11.	Skin coarse and lacks depigmentation	Skin less coarse and has depigmented areas as age advances.
12.	Temporal gland secretes in bull and cow	Temporal gland secretes only in bull
13.	Four nails on forefoot and three on hind foot	Usually five nails on forefoot and four on hind foot
14.	Molar laminae semi- lunar in shape	Molar laminae elliptical in shape

## PHYSIOLOGICAL FEATURES OF INDIAN ELEPHANT

*K.P. Sreekumar*

Kerala has reasonable population of Indian elephants and this has encouraged our institution to make many scientific contributions to the study on this largest terrestrial mammal. This animal is extensively used for temple ceremonies, processions, timber industry and also in capturing, taming and training new elephants. Thus, elephant is a common client to many veterinarians and scientists of this state. A brief report on the blood, milk and urine studies carried out in our laboratory and some data collected from literature form the subject matter for the article. This could be used as a referral data by elephant lovers, practitioners and scientists.

Depending upon the size and age of an elephant, a normal heart weighs between 12 and 28 kg, which consists about 0.5 per cent of the body weight. The slope of the heart is unique, bifid apex, i.e., ventricles are separated at the apex region. The venacavae are also peculiar with its paired nature, instead of the usual fused single vein. The enormous size of the arteries are supported by tough elastic fibres/ muscle which gets calcified in older elephants. About 10 per cent of the body weight constitutes body fluids and an elephant contains about 115 L of blood. Heart rate is more while sitting or lying (32/minute) compared to standing (28/minute). The skin is very thick and hence superficial veins are observed only on the exterior and interior of the ears, anterior surface of the proximal portion of forelimbs and on the medial aspect of the distal portion of rear limbs.

Erythrocyte has on an average of  $93 \mu\text{m}^2$  surface area and  $9.3 \mu\text{m}$  thickness. The usual

shape is biconcave disc and has a diameter of 8.8 to  $10.5 \mu\text{m}$ . Platelet count averages about  $637 \times 10^3/\text{mm}^3$ .

Recently it is postulated that the previously classified bilobed or less commonly a trilobed nucleated cell with clumped chromatin is not a variation of lymphocyte but a monocyte which can bring out monocyte as the predominant leucocyte in elephant.

The relationship between ESR values and its time of determination is only during the first 15 minutes. Fifty percentage of the sedimentation is attained at 15 minutes. Hence ESR determined at 15 minutes can be used as a clinical tool in diagnostic aid (Tables 1 to 6).

The low serum icterus index is suggestive of the non-contribution of carotenoid fragments present in the bulk of the diet of elephants, viz., leaves of *Caryota urens* and the efficient excretion of bilirubin by liver.

The brain even though occupies only a small part of the skull weighs about 3-5 kg. In proportion to the size of the body, it is smaller to human brain, even though brain size is not directly related to intelligence. Only 35 per cent brain growth is attained at birth and the major development of brain occurs as the baby grows up. This pattern is similar to human brain growth. The cerebrospinal fluid is clear and colourless with no leucocytes and about  $18/\text{mm}^3$  erythrocytes. The total protein is 7.8 mg/dl and glucose 150 mg/dl. The sodium, potassium and chloride level are 133 mEq/L, 3.2 mEq/L and 105 mEq/L respectively in the CSF.

Table 1. Haematological values of Indian 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 (fl)	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

Table 2. Certain haematological norms in Indian elephants

Constituents	Baby elephant	Tuskers	Adult non-lactating non-pregnant females
Specific gravity			
<i>a. Whole blood</i>	1.050	1.054	1.054
<i>b. Plasma</i>	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 coagulation time – capillary tube method (min.)	5.39	6.71	5.30
Serum icterus index (units)	2.29	2.24	2.25

Table 3. NPN constituents in the blood of Indian elephants

Constituent (mg/100 ml)	Baby elephant	Tuskers	Adult non-pregnant non-lactating	Pregnant	Lactating
Total NPN	32.60	32.66	35.25	31.50	38.15
Urea N	12.99	12.04	15.20	13.16	11.47
Uric acid	2.49	2.46	2.33	1.97	1.73
Creatinine	1.77	1.93	1.88	1.94	1.91
Free amino N	7.82	7.38	7.77	5.71	6.90

Table 4. Normal plasma protein level of Indian elephants

Constituent	Baby elephant	Tuskers	Adult non-pregnant non-lactating	Pregnant	Lactating
Total protein (g%)	8.25	8.49	9.25	7.99	9.28
Albumin (g%)	2.20	2.36	2.10	2.08	2.06
Globulin (g%)	5.41	5.56	6.50	5.32	6.68
A/G ratio	0.45	0.46	0.34	0.42	0.33
Fibrinogen (g%)	0.64	0.57	0.65	0.58	0.54

Table 5. Chemical constituents in the blood of Indian elephants

Constituent	Baby elephant	Tuskers	Adult non-pregnant non-lactating	Pregnant	Lactating
Total cholesterol (mg%)	116.68	111.38	93.66	130.83	115.13
Inorganic phosphate (mg%)	5.54	4.47	4.07	4.40	4.27
Glucose (mg%)	67.47	59.54	52.86	62.50	64.00
Chloride (mg%)	473.60	488.00	496.90	510.00	433.00
Sodium (mmol/l)	125.36	118.24	126.99	—	—
Potassium (mmol/l)	4.97	4.77	4.85	—	—
Calcium (mg%)	12.20	11.80	12.50	11.10	11.10
Magnesium (mg%)	2.41	2.06	2.33	2.68	2.49
Copper ( $\mu$ mol/l)	23.84	28.74	33.69	—	—
Iron ( $\mu$ mol/l)	34.78	44.48	43.26	—	—
Zinc ( $\mu$ mol/l)	31.13	33.73	42.61	—	—
Iron : Copper ratio	1.50	1.14	1.33	—	—

Table 6. Serum enzyme activities in Indian elephant

Constituent	Baby elephant	Tuskers	Adult non pregnant non-lactating
AST (SGOT) (U/L)	10.2	15.7	18.5
ALT (SGPT) (U/L)	5.6	4.8	5.0
LDH (U/L)	366.7	468.8	398.8
CK (U/L)	30.3	51.2	43.8
AKP (Bodansky units/100ml)	—	—	1.25
ACP (Bodansky units/100ml)	—	—	0.35
Amylase (Somogyi units/100ml)	—	—	381.09

Urine is clear or turbid with straw to amber in colour. The turbidity is due to calcium oxalate or calcium carbonate and amorphous phosphate crystals. The pH is alkaline ranging from 8 to 9 with a specific gravity of 1.019. An elephant urinates 8 to 12 times per day with a volume ranging from 25 to 53 L per day. The total solids is 4.46 mg/100 ml and ash 1.23 mg/100 ml. Urea, creatinine and uric acid are 1025 mg per cent, 93 mg per cent and 36 mg per cent respectively. Though the total sulphates are 56.7 mg per cent, chlorides are about 460 mg per cent and inorganic phosphates 35.5 mg per cent.

Milk is thin, watery white and sweet. The fat level is high during weaning time and the lactose level decreased with advancement of lactation (Table 7).

The milk is poor in vitamins A and D but rich in B vitamins. In non-pregnant or non-nursing females, the breasts are shrunken and the nipples shrivelled. During pregnancy the glands swell and the nipples become prominent. Normally 10-12 lactiferous ducts are seen in a gland.

Table 7. Milk of elephant

Specific gravity	1.023 - 1.038
Total solids (%)	16.40 - 28.55
Total ash (%)	0.57 - 0.80
Fat (%)	5.80 - 19.00
Total Protein (%)	4.40 - 5.40
Casein (%)	1.40 - 2.50
Lactose (%)	3.40 - 5.40
Calcium (mg %)	84.60 - 178.00
Phosphate (mg %)	186.00 - 309.00
Vitamin C (mg %)	0.25 - 0.40
Chloride (mg %)	42.00 - 64.00
pH	8 - 9

Though the elephant breath both through the mouth and trunk, 70 per cent of the air intake is via trunk. The pleural cavity although present in young ones, is absent in adults. Hence the lungs are directly attached to the chest wall and diaphragm. 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.

This anatomical peculiarity makes breathing a difficult process if the elephant's chest and diaphragm movements are restricted. This matter should be taken care during tranquillising elephants, where there is always a possibility of the animal falling down on its brisket and the viscera pressing on the diaphragm leading to breathing difficulty and death. Even long periods of lying on a side could lead to this serious problem.

The digestion is helped by a simple stomach and it is similar to the digestion in horse. There is a distensible pharyngeal pouch that terminates in a sphincter from which it can control the propulsion of fluid and food into the oesophagus. The stomach is on the left side, cylindrical in shape and glandular in nature. It is usually a storage organ with less activity in the digestion of food. The microbial digestion of cellulose takes place in the huge sacculated caeco-colon. Fermentation is also evident in the duodenum and colon, which are rich in protozoa. The digestion products are absorbed through intestinal wall. The rest

of the gut is mainly concerned with consolidation of the faeces and reabsorption of water. The average length of small intestine is 2.1 m; large intestine 12.8 m and caecum 0.6 to 1.5 m. Though bile duct is large and sacculated, gall bladder is absent. Young calves show coprophagia. Normally an elephant defecates 12-15 times per day at the rate of 5-8 boli at a time. Elephants digest about 44 per cent of what they consume. The shape of the faecal bolus reflects the dimension of the rectum and the seeds, vegetation and the nutrient rich bolus is a source of nutrient for dung beetles, birds and insects. Defecation occurs throughout the day except during 4 – 5 hours in the night when the animal sleeps. Tamed animals pass large quantities of loose faeces prior to circus act, trucking or other anticipated events. Each faecal bolus averages about 1 to 2 kg in weight, 100 to 150 mm in diameter and 70 to 180 mm in length. The faecal bolus is usually green to brown in colour and is held intact with a mucus seal.

## SIGNIFICANCE OF VARIOUS EXTERNAL AND INTERNAL ORGANS OF ELEPHANT

*K. Chandrasekharan*

**Trunk:** The trunk is the most attractive feature in an elephant and makes it look different from other herbivores. Trunk is an extension of the upper lip. The shape and length of the trunk varies in various elephants. Some elephants have a very long trunk that touches the ground, where as others have very short trunks. The free end of the trunk is triangular and has a finger like tip. This organ enables the elephant to pick up the smallest of objects from the ground. The trunk is made of two types of muscles. It is by the action of these muscles that the elephant is able to extend or retract its trunk. The trunk has two openings on its free end. The opening within the trunk forms the nasal passage. The nasal passage runs into the centre of the forehead bump, followed by the gullet and finally branches into the lungs.

The elephant breathes and also sucks water, through the trunk. The trunk is also used for other things such as spraying the body with water, uprooting grass, pulling down branches, tearing the palm branches apart etc. The elephant has a highly developed sense of smell. Using the trunk, they can smell objects and people. Bulls use the trunk to check if a cow is in heat. They hold twigs or branches to scratch their body.

**Tusks:** Tusks are modified incisors of the upper jaw. They arise from the front portion of the skull. 1/3<sup>rd</sup> of the tusk is embedded in

the skull and the rest is visible from outside. Two-third of the tusk is hollow and consists of pulp. Tusks continue to grow throughout the elephant's life. In captivity, the tusks are trimmed once in every two years. Elephants with long divergent tusks are considered attractive in Kerala. Tusks acquire various shapes. They are also called "white gold", because of the demand for ivory. Ivory continues to be a priced commodity, for which several elephants have been killed. It is therefore rightly said that the tusk is the elephant's enemy. The tusk is used as a defense weapon during fights between elephants. They are also used to push trees down, lift objects etc. The Asian cow elephant and *Makhnas* possess tushes instead of tusks. African bulls and cows possess tusks.

**Ears:** Broad and fan shaped ears make an elephant attractive. An elephant that fans its ears constantly is considered healthy. The ears help to regulate the body temperature of the elephant. The skin on the ear is very thin and the veins can be seen very clearly. Intravenous injections are administered through the veins on the ears. The sides of the ears begin folding inwards as the elephant becomes older. It is possible to make a rough estimate of the elephant's age by looking at the folds. The ear folds about an inch in 30 years, meaning if an elephant has a fold measuring an inch, its age can be predicated as 30 years.



**Eyes:** The eyes are relatively small in size. The elephant cannot see objects at long distance. The colour of the eyes is normally honey or dark brown. A third eyelid within the eye protects the pupil. This makes it difficult to apply ointments on the eye. Hence medicines must be applied from the outer canthus of the eye.

**Teeth:** The elephant possesses only molars and there are four of them at a time. The upper surface of the teeth is made up of several ridges. The teeth are replaced constantly. New teeth arise from behind the mouth and push forwards while growing and the older teeth fall off. The teeth are replaced five times in an elephant's life time. Thus there are a total of 24 teeth during the life span. Occasionally one may observe a single worn out tooth or a pair, on one side of the jaw. If a pair is seen then one of them is the remnant of the old tooth and the other is the rudiment of the new tooth. 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 2½ years of age. This is followed by further replacements at 6, 15 and 40 years of age. The age of an elephant can be estimated by observing its teeth. The sixth set is the largest of all the sets and it measures 1 foot in length, 2 inches in breadth and approximately weighs four kilo grams and have 24 ridges.

**Fore and hind limbs:** The limbs are strong and pillar like in appearance. In *Malayalam*, the forelimbs are called *nada* and hind limbs, *amaram*. The joints between the bones are

vertical which make it difficult for elephants to jump forwards. The limbs bear digits and nails. The digits are not visible as they are embedded within the skin. The nails are visible. Most elephants have 18 nails, five on each foreleg and four on each hind leg. The number of nails varies in number and some possess 16 or 17 nails. Those with 16 nails are considered inauspicious. It is rare to see elephants with 20 nails, which is considered as a very auspicious sign.

**Tongue:** The tongue is fleshy and cannot be protruded outwards. While feeding a depression or hook is formed at the middle of the tongue where the food material is placed and folded backwards into the mouth for swallowing.

**Digestive system:** Stomach is single chambered. The intestine is approximately 170 feet long and digestion takes place in the large intestine.

**Liver:** Liver is large but gall bladder is absent.

**Heart:** Has two apices. The rate of heartbeat is 28 times per minute, but it is greater while lying down. Heart beat is recorded from the arteries behind the ears.

**Testes:** They are located internally, on either side of the vertebral column.

**Temporal glands:** They are located in the temporal region of the skull. They lead to a temporal opening which is located between the eye and the ear. During musth, the temporal gland becomes enlarged and secretes a fluid, which flows out through the temporal opening.

## ELEPHANT FACTS

*Jacob V. Cheeran*

Elephants have always been fascinating to human beings because of their various peculiarities. Listed below are some interesting facts about elephants.

1. Elephants belong to the order proboscidae. In India, elephants are found in South India, North-eastern India, Himalayan valleys and Orissa.
2. Asian elephants are of five strains and they are Indian, Burmese, Ceylonese, Sumatran and Malaysian.
3. An Asian cow elephant weighs 2.5-3.5 tones and a bull weighs 3.5-5 tones.
4. Bull elephants without tusks are called 'makhnas'.
5. Size of the neck is not proportionate to that of the head and so elephants have short necks to balance their huge head.
6. The elephant is one among a few animals that use tools in their day-to-day lives. A few examples of such animals are discussed. A species of vulture uses a stone to break ostrich eggs. Some others found in the Californian seas use a stone to break open clamshells. A woodpecker sometimes uses a stick to stir insects hiding in a hole. Monkeys use a blade of grass to draw out ants from a hole. An elephant uses a twig to scratch itself and can learn to manipulate a variety of objects, to carry out a variety of activities.
7. Elephants have nails rather than hooves. Most of the elephants have 18 nails, 5 in each of the front legs and 4 in each of the hind legs and very rarely 20 nails (5 nails each, on the hind and fore legs). The footpad has a thick fat cushion to provide a good grip while walking over marshy and slushy grounds, as well as on rocks.
8. It is possible to measure the height of an elephant, by measuring the circumference of the front foot. Twice the circumference gives the approximate height.
9. The upper ridge of the ear starts folding inwards, from the age of 10 and folds about an inch, in 20 years. An elephant with a 1" fold on its ear, is considered to be 30-35 years of age, approximately. There are however, many exceptions to this rule.
10. In the absence of a weigh bridge, the following formulae can be applied, to weigh an elephant:  

$$W = 12.8 (g + ng) - 4281$$

$$W = \text{Weight in kg}; g = \text{girth (chest circumference just behind the forelimb, in cms)}; ng = \text{neck girth (in cms)}$$

$$W = \frac{1}{300} \times g^2 \times 1.25$$

$$W = \text{Weight in pounds}; I = \text{length (Anterior tip of the shoulder to point of hip, in inches)}; g = \text{girth (in inches)}$$
11. Elephants love spending lots of time in the water and can swim long distances. They also love wallowing in the marsh.

12. Elephants travel extensively, walking long distances in the wild, in search of food, shade, minerals and water. Since they have an enormous food requirement they have to travel constantly to look for fodder sources. They do not stay confined to a single place for a long time, which avoids habitat destruction.
13. They walk at a slow pace of 4 km/hr. Elephant walk has been made into a music (in the film *Hatari*), which is popular all over the world.
14. Elephant feeds on all three tiers of plant life i.e., lower (grass), middle (bush), and upper (canopy) tiers.
15. Elephants have very clean feeding habits. While grazing, they pull out a bunch of grass and dust mud and dirt against their legs before eating it.
16. Elephants drink 200-250 litres of water a day i.e., 50-60 litres at a time 3-4 times a day. A trunkful can retain 6-7 litres or even as much as 10 litres.
17. Elephants can run short distances quite quickly (25 km/hr or 30-40 kms/hr.) according to reports from Mudumalai Elephant Camp, in Tamil Nadu. Even with hobbles they can hop very fast, but cannot gallop like horses or run like cattle.
18. Elephants can perceive sound frequencies inaudible to the human ear. Frequencies below the normal audible range are called infrasonic waves and those above the normal audible range are called ultrasonic waves. Examples of infrasonic waves are thunder, earthquakes etc. Elephants sometimes communicate with each other through infrasonic waves. This was discovered by Catherine Payne in Africa. The region between the frontal projection and the base of the trunk produces vibrations. A simple experiment to demonstrate this fact can be done, by submerging (half way, to the middle of the head) the elephant in water, facing the current and tickling the frontal area. The vibrations produced can be seen as ripples, in the water. In African Savannah, elephants can perceive thunder several miles away and will move towards that direction to find the rain. Elephants have several kinds of communications between them. They are provided with large ears so that they can receive as many of these frequencies, as possible.
19. An elephant's eye sight being very poor, it relies very much on its sense of smell. Elephants can recognize people by their sense of smell, even after several years.
20. In Kerala, there is a notion that, elephants fan their ears because they appreciate the rhythm of the '*Panchavadyam*', a musical symphony. Although it makes a nice story, this is not true. Elephants fan their ears, to cool their body. Sweating, in other species such as man helps maintain suitable body temperature. Since elephants have few sweat glands, they depend on their ears to regulate their body temperature. The ear is an important organ in removing heat. The blood from the various parts of the body is transported to the ear where they are cooled due to its fanning motion. This cooled blood then flows back into the various parts of the body, thus bringing down the body temperature. It is observed that there is a difference of 1°C in the temperature of arterial and venous blood of the ear.

21. The normal body temperature of the elephant is 96.6°F
22. The skull has several sinuses and so the head is not as heavy as it may appear.
23. The elephant has only two pairs of teeth, at a time and they get replaced 5 times during its lifetime. The number of ridges on the teeth increases with age. In most animals the teeth erupt from the bottom, but in elephants, they grow and push from the back to the front.
24. The tusk is an out growth or extension of the upper incisor or teeth. In males, it starts in two or two and a half years and grows 3-4 inches every year. Tooth in Sanskrit is called *Dantam*, and thus the elephant is also called *Danti*. The elephant uses its tusks in a variety of ways. Humans may be right or left-handed. Elephants also exhibit, a similar dexterity, for a particular tusk. The tusks continue growing, even after being cut. Extreme care should be taken not to damage the pulp while trimming or shaping the tusk.
25. The Asian cow elephants have tushes, but African cows have tusks.
26. The tongue has restricted movement and cannot be protruded out. The food can be hooked if placed on the tongue and pushed back into the mouth.
27. An elephant's trunk is formed by the fusion of the upper lip and the nose. It is made of thousands of muscles.
28. There is no naso-lacrimal duct, running from the eye to the nose and so water runs out of the eyes constantly.
29. A few sweat glands are present on the skin, found at the base of the nails. Since the sweat glands are deficient, the elephant sucks secretions from the mouth and sprays it on the body, with its trunk, to lower the body temperature.
30. The skin is very thick and hence is called a pachyderm. The skin has several folds and wrinkles, which help to remove heat. Though the skin is thick, the elephant will experience pain when injured.
31. Males and females have a temporal gland, which produces secretions or temporal discharge. Temporal gland activity in bulls is characterized by behavioural changes, particularly aggression, libido and disobedience to commands. Some cow elephants occasionally exhibit temporal gland activity, but do not show any pronounced behavioural changes.
32. Elephants cannot jump up because their legs are not shaped correctly for absorbing the shock of a jump. They may leap horizontally however, as their knee cap is placed very low, which helps them stand on or bend their knees like humans.
33. The heart of an elephant does not have a pointed apex, like other mammals. The ends are shaped differently and have a bifid apex.
34. As in marine mammals, the testes of a male elephant are placed abdominally (close to kidneys). During *musth*, the testes enlarge in size (functional hypertrophy).
35. In a cow elephant, the vulval opening is between the hind legs. Clitoris is large and may be 15-30 cms long, but they mate like all other quadrupeds or four legged animals.
36. Elephants have two openings on the roof of their mouth called vomero-nasal

- openings, which act as scent glands. Mating consists of prolonged courting, short duration of penetration, several times a day. The special position of the vulva makes the penis (when erected), into a cobra shaped hood, to facilitate penetration. An ejaculate may have 50-100 ml of semen.
37. The gestation period is 21 months.
  38. Calf at birth weighs 80-100 kg and 90-100 cms in height.
  39. Mammary glands are found between the forelegs. They secrete milk through several pores. Usually they suckle offspring for 4-5 years, but in captivity, the calves are weaned after 2 years.
  40. Although herbivorous, the cholesterol level in African elephants is high.
  41. There is no gall bladder in the elephant.
  42. Dog sitting posture or 'sternal recumbency' posture is a relatively safe and comfortable position in other animals. In elephants this is dangerous, especially when they are tired. The pleural cavity around the lungs is absent in elephants, and they may die of suffocation if made to sit in the dog sitting posture for long periods under sedation, or for any other purpose. Respiration rate is 10 PM (per minute) while standing and 5 PM during recumbency.
  43. Like humans, elephants are also prone to arthritis, because of the vertical position of their limbs.
  44. The total number of bones in the elephant's body is 282 and the total number of vertebrae is 61. The bones are not very thick and so the likelihood of a fracture is greater.
  45. Elephants can stand for long periods. Horses and passerine birds have check ligaments, which help them to stand, while sleeping straight up. Similarly, elephants are also provided with such feet that can be splayed, thus enabling them to stand for long periods. There was an elephant in Thrippunithara, Kerala that stood up for 18 months, when it was sick. Healthy elephants in captivity usually do not lie down during the day.
  46. Most animals flex their hind limbs forwards while lying down, but elephants flex them backwards.
  47. Captive elephants in Kerala are given a restorative treatment during the monsoon, which is a practice for human beings too, in Kerala.
  48. Elephants are efficient seed dispersers. Seeds that pass out in the elephant's dung are highly viable and germinate easily.
  49. They defecate 15-20 times a day. The number of boli being 5-8 and weighing 1-2½ kg. Elephants uninate 10-15 times a day and a total quantity of 50-60 litres is expelled. Inadequate water intake produces crystalluria.
  50. Elephants can unerringly locate and dig out water from the subsoil or riverbeds, during the dry periods.
  51. Elephants have a remarkable memory of events and people and are also believed to be emotional. While in *musth*, captive male elephants deliberately try to attack their mahouts.

52. Elephants are gregarious by nature. In the wild when a baby elephant is born, it is trained and disciplined by every adult in the group. Captive born calves, on the other hand, turn out to be truants, as they are excessively pampered by humans. They turn out to be problematic adults, if not trained properly after weaning.
53. Elephants have matriarchal groups and the leader of a herd is usually a cow elephant. Males are loosely attached to the herd. In summer, when there is scarcity of food and water, the herds break up into smaller herds and when favourable conditions return, they reunite to form a large herd with a larger number of individuals. Elephants in the wild spend a minimum of 60-70 percent of their activity in feeding. In summer the herd spends 2-4 hours a day for resting, to prevent heat stroke.
54. Elephant herds when threatened, have an interesting defense strategy. At first they all stand in a line defending. Then they round up the young ones and sub-adults into the centre and form a circle around them.
55. Elephants can never be completely domesticated. They always have a desire to return to the wild, unlike some other domesticated species, such as dogs and cats, which come back home.
56. Elephants are a valuable commodity and need to be handled with care and respect. In *Arthashastra*, an ancient Indian text, the author Chanakya described the value of elephants as equivalent to gold. Chanakya says that, a man deserves capital punishment, if charged of killing an elephant.

## THE EXPLOITATION OF ASIAN ELEPHANTS

*Jacob V. Cheeran and Trevor B. Poole*

Asian elephants have a unique status as the only domesticated animal whose population depends on the recruitment of individuals caught from the wild. Elephants are used in their native countries such as India, Malaysia, Sri Lanka and Thailand for forestry work, religious festivals and in timber yards and are also housed in temples and logging camps. They are trained in many countries to perform in zoos and circuses. Their capture often, but not invariably, involves cruelty and rough treatment. Elephants are highly intelligent and in the confined conditions of captivity, boredom is a common problem. Elephants are usually underworked in zoos but, at the other extreme, overwork in other situations can cause exhaustion, particularly in combination with inadequate opportunities for feeding.

Wild Asian elephants conflict with humans where the size of their reserve is inadequate and they have taken to crop raiding. Attempts to translocate the elephants are of limited value as, frequently, the animals will return from over 100 km away. In some areas which are heavily populated by humans, wild elephants have little chance of long-term survival, particularly where their translocation or the creation of habitat corridors is impracticable. In such situations, it should be possible to develop a policy of humane domestication of the wild elephants to meet the requirements of local people. There is also a poaching problem in reserves to acquire ivory, which diminishes the male elephant population.

There are a few, if any, self-sustaining captive elephant groups, thus elephant populations are declining both in the wild and in captivity. There are real welfare problems for both wild and domesticated elephants. To maintain populations of Asian elephants, it is essential that they should be bred more efficiently in captivity.

### **Wild Elephants**

Much attention is drawn in western countries to the endangered status of the African elephant, while the plight of the Asian species (*Elephas maximus*) tends to have been ignored. However, the population of the Asian elephant is more endangered and is estimated to be between 25,000 and 40,000 in the wild. Asian elephant habitat is fragmented and the animal is in competition with people whenever it strays into human settlements. The small size of undisturbed habitats and the high degree of mobility of these animals often leads to crop raiding.

Farmers try to frighten off the elephants by shouting and waving their arms and using firecrackers. In some cases the animals are attacked with firearms, or burned with lighted torches soaked in vegetable oils. These actions make the animals aggressive so that they are provoked to attack humans and sometimes kill them. Farmers can lose their livelihood through the actions of a single wild elephant, so the animal is very unpopular in some regions. Even where electric fences are used to protect crops, some male

elephants learn that ivory is an insulator and break the wires with their tusks. Sukumar (1989) and Jayewardene (1994) give excellent accounts of the conflict between elephants and people and carefully consider possible ways of improving the situation.

In many instances, the real problem lies in the fact that reserves are too small to sustain a viable population of elephants; so that they invade agricultural land either to reach other groups or to raid crops. One technique to allow gene flow between small groups is by providing corridors between such areas. Alternatively, in India and Sri Lanka, elephants have sometimes been translocated to larger areas where they can contact other herds. Such animals may be moved as far as 100 km from their original site. However, translocation of elephants requires great expertise and a high level of organization. In some instances, one or more animals have returned to the original site (Sukumar, 1989, Jayewardene, 1994).

Asian elephants are also exploited by ivory poachers. This only affects the males but leads to a sex ratio of males to females which average one adult male to five adult females in India, but in some areas it may be as low as one male to 24 females (Sukumar, 1989). The effect of poaching is not as serious as it would be for a monogamous species, but the low male:female sex ratio in some areas does give cause for concern. In Sri Lanka, elephants are strictly protected and only one in 20 male elephants are tusked so that there is less incentive for ivory poaching and the adult sex ratio has been estimated to be of the order of one male to two females (McKay, 1973; Kurt, 1974).

### **Captive elephants**

The Asian elephant has a unique status as the only domesticated animal which is

taken directly from the wild. It has been caught and domesticated for at least 3000 years in India, Malaysia, Sri Lanka and Thailand and has formed an integral part of the culture and religion of these countries. Sukumar (1989) believes that up to 50,000 elephants may have been captured for domestication over the past 100 years and that, at present, in India alone, there are between 2500 and 3000 elephants in captivity. Nowadays, domesticated elephants are mainly used for forestry (logging), in religious festivals, in timber yards and kept in zoos and circuses.

### **Capture**

Even today, in spite of the endangered status of the Asian elephant, the great majority of captive elephants are taken from the wild. In some cases these animals may be calves abandoned by their mothers; they are thus saved from an early death. Typically, however, working elephants are caught from the wild between the ages of 15 and 20 years when they are sufficiently large to be used for heavy work. Traditional methods of capture, taming and training may involve some cruelty. Details of elephant training are given by Fernando (1988) and Jayawardene (1994) who emphasize the importance of positive reinforcement and the building of a good relationship between the animal and its handler. Both capture and training can be made less stressful by taking more time and being patient and utilizing tranquilliser drugs such as diazepam also has a taming effect.

### **Role of personal bond**

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 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. Unfortunately, nowadays, mahouts are employed on a temporary basis and often change their employer. As a result, when a new mahout is employed, he has to use brute force to make his new elephant obey him. Sometimes the level of violence is such that the elephant suffers permanent injuries which in some cases have proved fatal. This treatment can be avoided if the period allowed for the new mahout to take control is lengthened and employers are educated to appreciate the need for adequate time to be allowed for the take-over period. Hart (1994) has provided an excellent assessment of mahout-elephant relationships in Nepal.

### **Housing and husbandry**

In nearly all instances captive elephants are chained when not working usually in open houses, and some temple elephants may spend nearly all their lives on a tether. Elephants require a varied diet but are often fed on only one type of fodder; also the quantity fed is often quite inadequate. Gokula (1994) studied a sample of temple elephants in southern India and found that many of them relied entirely on begging for their food and receive only a quarter of the amount which they eat in the wild. In addition, the food is often unsuitable. Generally zoo elephants and those on logging camps where there is natural vegetation have a much better diet. Veterinary care in temples is usually inadequate or absent and reliance is often placed solely on traditional medicines. Elephants need proper veterinary care; they

are also susceptible to parasitic infestations and so need periodical deworming with a broad-spectrum anthelmintic.

### **Activities in captivity**

The best traditions for daily activity for elephants are found in those source countries where generations of mahouts have cared for these animals. Elephants are easily bored, so working is beneficial for them and they can carry on piling logs in a timber yard, for example, without supervision, even expanding the base of the pile when necessary. They also enjoy participating in religious processions and contact with people. However, they can be overworked, as is common in timber logging, when the animal is not supervised by the owner. Captive elephants in some areas are also overworked during the temple festival season when they are used continuously in ceremonial parades, all day and night. The day time procession progresses inch by inch on a hot, bituminized road in the full heat of the sun, which can prove very tiring for the shade-loving elephant; the lack of food and water also makes the animals temperamental. At festivals in the Indian state of Kerala, the mahout is commonly plied with intoxicating liquor by the local people and this often leads to him maltreating the elephant and losing control over it. This may result in the killing of the mahout or the animal running amok in the crowd, creating panic. The first author and his veterinary colleagues in Kerala have been called out to control these situations nearly 500 times in the last 25 years, requiring the use of tranquillizer darting on approximately 400 of these occasions.

### **Special welfare problems with elephants**

The exploitation of captive elephants can create welfare problems for the animal, the

most common of which is prolonged chaining. Tethered elephants become bored and develop behavioural problems (Schmid, 1995). Where there is no enclosed housing for the animal, chaining overnight may be acceptable, provided that the tether is not too short and plenty of food is available. In India, chaining elephants in zoos is illegal, but many still do so. There is no doubt that elephants should be willing to be chained for short periods of an hour or two to allow such procedures as veterinary examinations. It is unsatisfactory, however, to tether them for periods longer than a few hours. On the other hand, confining them to small stalls, as in some zoos and circuses, is probably no less restrictive than a reasonably long tether.

Older male elephants (over 25 years) can present a serious problem because they are liable to come into annual musth. Musth does not occur in all males – some show it occasionally and others regularly – but it invariably causes the animal to become aggressive, intractable and difficult. Traditionally, male elephants have been tethered with heavy chains throughout musth, which usually lasts from one to three months. This is clearly inhumane and the animals may show serious stereotypy during this period. Musth creates a significant management problem and this is probably the reason for meagre number of male elephants in circuses and zoos. Attempts are being made in Kerala to solve the problem of musth by using anti-androgens and long-acting depot-sedatives. However, the lack of availability and the high cost of such drugs place constraints on their extensive use. Factors which do seem to minimize the severity of musth seem to be a good relation with the mahout, being kept in a social group with females (Poole *et al.*, in press) and having plenty of space to move around.

Another problem for the future of captive elephants is their poor record of breeding, which has resulted in the lack of a self-sustaining captive population (Frost, 1986; Haufellner *et al.*, 1993). In general, the best breeding records are from elephants in forest camps in source countries where they are kept in groups and females can either mate with a captive bull or a wild bull in the forest. However, wild bulls have been known to entice such cows when in heat, and take them into the forest for courting and mating. While this in itself does not create problems, there was an instance where in a wild-bull challenged and killed a captive elephant. The record of breeding in zoos and circuses has been very poor probably because they keep very few bulls, often house the sexes separately and seldom have groups as large as six number which Roocroft and Zoll (1994) regard as the minimum size of social group for elephants. UFAW recently carried out research on breeding elephants in Sri Lanka (Taylor, 1995) and it is hoped that such work will eventually lead to improvements in breeding success.

### Conclusions

The exploitation of Asian elephants creates both conservation and welfare problems. There can be little disagreement that it would be a tragedy if the Asian elephant was driven to extinction. Wild elephants face two major problems: poaching and conflict with farmers. Attempts are being made to address these problems in the countries where Asian elephants are indigenous (Sukumar, 1989; Jayewardene, 1994) but it is difficult to resolve conflicts between wild elephants and humans in areas where there are small islands of habitat surrounded by human habitation. In some areas which are heavily populated by humans, wild elephants have little chance of long-term survival,

particularly where the translocation of the animals or the forming of habitat corridors is impracticable. In such situations, it should be possible to develop a policy of humane domestication of the wild elephants to meet the requirements of local people, through lumbering and so on. This would not only ensure that elephants and local people work together and are not in conflict, but will also save 'pocketed' herds which have no future.

To encourage reproduction in captivity, elephants should not be kept in barren enclosures lacking vegetation, or confined to indoor housing for long periods. An elephant needs opportunities to graze and wallow, or a regular daily routine of work. Staffing must be adequate to ensure that familiar, trusted keepers are employed to care for elephants, and staff should have received training to ensure that they are competent in both handling and training them. Management must be certain that the relations between the elephant and its handler are good and that both the motivation and ability of the staff member are adequate for the task.

Elephants are highly intelligent and, in domestication, should work with a well trained and trusted human companion. This situation will not only utilize the animal's great strength but also its skills and versatility. In some areas, elephants can be used instead of vehicles to carry tourists on safari into areas of natural habitat. Such a programme of elephant domestication should only be adopted if the highest standards of welfare can be applied. This will require an extension of the training programme for mahouts already initiated by the Elephant Welfare Association of Trichur in southern India. Every elephant should be provided with its own mahout or keeper, but also have the opportunity to mix freely with other elephants of both sexes in a familiar group to facilitate captive breeding. There should be strict

welfare guidelines for the keeping and husbandry of elephants and these should be enforceable. If such a programme was adopted this would benefit both people and elephants and help to secure a future for this highly endangered species.

### **Recommendations**

We would like to make the following suggestions for ameliorating the problems facing the existing populations of Asian elephants.

1. Efficient management of the few large reserves of natural habitat with effective anti-poacher strategies and an incentive to local people to conserve and maintain elephants in their immediate vicinity.

2. In pocketed areas of habitat, where translocation or the use of corridors is not practicable, elephants should be either:

- (a) domesticated for work to help local people; or

- (b) assigned to zoos which are able to provide good management for a breeding group of elephants, basic training by a specific keeper assigned to the animal permanently and adequate mental stimulation through either daily access to a large area of natural vegetation or full domestication with a daily work schedule.

3. Strict guidelines for the humane treatment and training of captive elephants should be framed and keepers and mahouts trained to act accordingly.

### **Caution**

The recommendations and suggestions made in this article, are all known to be practicable, but readers must appreciate that elephants should be handled with great care and sensitivity because they can be dangerous. The authors offer their advice in good faith but cannot accept any liability for problems or accidents arising from its application.

## ELEPHANT CAPTURE

*Jacob V. Cheeran*

Elephant capture is a very interesting and adventurous task. Several methods are employed for this.

### **Pit method**

Initially, elephant tracks or routes that a group or groups of elephants walk on are identified. Holes are dug along these paths. After digging, the extraneous mud is not allowed to pile up or be seen anywhere near or around the holes because the elephants may become suspicious. The hole is lined with sticks, twigs and dried leaves to soften the fall of the elephant into the pit. There must be no sharp sticks or twigs around. The hole is then covered with bamboo sticks, which are placed in a criss-cross manner across the opening of the hole. This is then once again covered with dry sticks, twigs and leaves and made to blend with nearby vegetation and terrain.

Several such holes are dug and they are located in a 'V' shaped manner. When elephant herds run amuck they scatter into a V shaped pattern hence the holes are also logically placed in this manner so that at least 4-5 elephants can be captured at one attempt. If the elephants in the pit are too big or too small or pregnant they are released back in to the wild.

After the elephant falls into the pit, a noose is prepared according to the size and circumference of the elephant's feet. A noose is also thrown around the neck. The sides of

the hole are levelled for the elephant to come out. Two other trained elephants or koonkies assist in getting the elephant out of the pit. Usually three koonkies are used. The elephant is, in this manner with the aid of the koonkies, taken to the elephant camp or the place where they are to be trained. Once they reach the destination they are given water to drink.

The training begins almost immediately. The elephant is trained to accept food from the hands and to obey commands. After a few days the elephants are brought out of the krall and taken for walks and baths. An elephant is trained by repeating an action several times.

### **Kheddah**

The elephants were captured by the kheddah method in Mysore along the banks of Kabini river. This was introduced in Mysore by Sanderson from the North East. This method was used to capture several elephants.

A huge pit is dug at the end of a fenced path along the elephant trails. The fence on either sides of the path is laid out in a funnel shape. The path broadens out initially and gradually tapers into a narrow region at the end of which is the kheddah. The path broadens here again and is surrounded by a deep trench which is stockade. People lie in wait for the elephants at the beginning of the narrow path and as the elephants approach

they are chased into the path where they are trapped inside the kheddah.

A strong door which opens inwards is located at the end of the path and as soon as the elephants enter, the door is snapped shut. The elephants try to attack the fenced portion but they are discouraged from the outside with long pointed sharp sticks and spear. Finally a mahout enters the enclosure on koonkie and nooses the elephant.

#### **Mela shikar**

This is a very exciting and adventurous way of capturing elephants. The mahout mounts on the koonkie elephants, ventures into the midst of a group of elephants and

tries to noose the elephants. Usually small elephants are chosen. The mahout who is on the top of the elephant must be an expert rider.

#### **Decoy**

Receptive female elephants are used as a decoy to tempt bulls. The cow elephants are chained at the edge of the forest and any male that is tempted to approach her is captured easily.

#### **Darts and tranquilizers**

This is the latest trend in capturing elephants. Here, one is able to choose one's target and pursue only that. It is a much more humane method of capturing elephants.



*Fig.1. Capturing by darting*

## DESIRABLE AND UNDESIRABLE TRAITS IN AN ELEPHANT

*K. Chandrasekharan*

It is said that nothing is more fascinating to gaze at than the waves and the elephant. Elephants are very fascinating creatures and they have a charisma or quality that attracts and endears them to adults and children alike.

Elephants were maintained in Kerala in olden days as a status symbol. Only very rich and respectable Hindu families used to keep elephants, and these were used during temple festivals and other auspicious events. Soon other communities also began using elephants for their religious events and now elephants are an important part of any religious occasion among all castes in Kerala. These days there are not as many private owners as there used to be in the past. There are institutions that own elephants which use them for labour and religious purposes.

An elephant is considered handsome when it meets certain physical requirements. A dignified look and also the head held high. The head should be raised and the back low. Elephants from Bihar lack this quality and their trunks are short. Hence out of competition people these days force elephants to keep their head high by poking them on their lower chin with spears or poking the elephant's nails. Out of sheer pain the elephant would hold up its head. Also if elephants lack a long trunk the mahouts force it to hold its head in such a way that the trunk reaches the ground. This is very painful and uncomfortable and the elephant would have to stand in this manner for several hours.

The fore and the hind feet should be placed straight and firm on the ground. The legs must resemble pillars.

The two projections on upper portion of the head (*Thalakunni*) should be big, raised and evenly separated. They must not be close together.

The forehead bump (*Vayukumbham*) must be raised, broad and projecting forwards.

The portion on the face between the eyes and the tusk (*Cheela*) must be compact. This portion must be long and broad. In cow-elephants this region is less pronounced than in males.

The eyes must be clear. They must have the colour of honey and should be moist always. The pupils must be dilated. Many elephants from Bihar usually have corneal opacity and is caused by deficiency of Vitamin-A in their diet. This condition can be cured with proper care. Red eyes in elephants indicate an aggressive and angry temperament. This is also seen during musth. Eyes can turn red also if they have been hurt. One must be careful about elephants that stare on persons.

The ears must be like fans. They should constantly move and strike with a loud flapping sound in the front, at the forehead. The ears must never be small. Bihari elephants have holes on their ears on the upper regions. These are man-made and a rope is passed through them by which the mahout leads the elephant around. The mahouts also apply the ankus around these holes to lead the elephant.

The tusks are very important and that disfigure or make an elephant appealing. They may be formed in several ways such as converging in the front, or diverging, or

curved upwards, etc. The ideal quality is that the tusks should grow downwards, diverging, rise up and then be evenly separated. The colour must be that of butter or sandalwood. The tusks have regenerative capacity.

The trunk is a modification of the upper lip. It should be fleshy, broad and long, trailing on the ground.

The tip of the trunk (the *Thunikkai*), must be long, triangular and strong. Any damage to the trunk, especially the *thunikkai* may disfigure the elephant. It is with this that it can pick up the smallest of objects from the ground. The African elephants have two *thunikkai* or tips to their trunk.

The temporal region (the *Kannakuzhi*), must be swollen and full. It is here that the temporal glands related to musth are located. If this region looks depressed due to loss of fat or flesh then it can be assumed that the elephant is tired or weak.

The elephant's back must slope downwards. The bones of the back must be pronounced, the area where one sits (the *Irikkasthanam*) must be broad and fleshy, and otherwise it will not be a comfortable ride. The seat of the mahout is usually found above the forelegs or above the scapular bone. The Asian elephant is different from the African in that the *Irikkasthanam* is arched up like a bow in the former where as it is not so in the latter.

The body must be long and the abdomen must always be full and big.

The tail must be long and end broadly into a fleshy region (the *Vaal kudam*). There should be ample hair on the tail. The tail must be long enough to touch the ankle but not too long to trail on the ground and should be devoid of twists or turns.

Usually an elephant has 18 nails, five each on the forelegs and four each on the hind legs. Rarely some have 20 nails, which is considered very auspicious. Mythology says that Airavat, the elephant of Lord Indra had

20 nails. Besides Airavat, some real elephants in the past had possessed 20 nails. Elephant that possesses 16 nails are considered inauspicious for individuals to own, but institutions like temples etc. could keep them. The nails must be clear and smooth without cracks and must appear pronounced like the shell of a tortoise. Elephants used for labour and physical activity have broken nails.

The skin must be jet black (like black teak or a granite). In Malayalam elephants are called "*Kariveeran*" meaning the 'one who is black'. The elephant has a large amount of melanin pigment in its body which imparts the black colour. If there is not enough melanin, certain parts of the body become discoloured and this is called "*Madagiri*". This should not be mistaken for a disease. It is merely a condition. Albinism or so called white elephants occur when there is a lack of melanin pigments in their body.

The skin must also be elastic. Elephants may lose water from their body and get dehydrated. The skin during such conditions becomes shriveled and dry. This is not a good sign.

Wild elephants have more hair on their body compared to captive elephants as the latter shed it when they are scrubbed regularly. If more than one hair arises from a root it is considered an indicator of long life and is a good sign. These occur usually below the eye or between the eye and the trunk, or on the sides of their chin.

If the upper palate of the mouth or the upper surface of the tongue is black, the elephant's character is considered unreliable.

Usually the penis is red in colour due to blood circulation but if there is a black region on it, then it is inauspicious.

The elephant makes a gurgling sound, which emanates from the throat on seeing its favourite mahout or owner. Similarly it may excrete dung or urine to express its happiness. But if the elephant remains still without fanning its ears and rolls its eyeballs at people, then one must be wary of it.

## PURCHASING ELEPHANTS – TRICKS OF THE TRADE

*V. Krishnamurthy*

‘Sonepur Mela’ was famous for elephant trade. Most elephants appearing at Sonepur, were ridden with physical defects or illness. These elephants would normally fetch low prices, so the owner or broker tries to hide these defects from prospective buyers. The elephant trade is a very tricky business and one can be easily deceived, by clever traders. Discussed below are a few tips for buying a good elephant and making a reasonable bargain.

### **I. Health and body condition:**

1. **Vision:** In order to ensure that an elephant has proper vision, it must be approached from both sides (left and right). Elephants that are blind or with poor vision, are usually more sensitive to their surroundings. An elephant that is blind on its left eye will be very conscious of movements happening on the left side. It may react violently if approached from the left side. Eyes must be clear without patches. They should be dark brown or honey coloured.
2. **General appearance:** A healthy elephant constantly fans its ears, swishes its tail and trunk and shifts its weight from one foot to another. On the contrary, if an elephant remains motionless, it is an indication of some physical disorder.
3. **Fodder and water consumption:** Healthy elephants feed continuously throughout the day. Lack of appetite is an indication of internal disorder.

4. **Composition of excreta:** Dung and urine should be clear. The dung should be of right consistency and expelled at regular intervals.
5. **Mobility of limbs:** Elephants must be checked for lameness. They must be made to walk forward, backward, take right and left turns to check mobility of legs. They should also be made to lie down and sit up. If the elephant makes more than two or three swings of its legs and also groans while trying to sit up, it is an indicator of disability and pain. Forelimbs may appear curved inwards, due to abuse by mahouts.
6. **Tusks:** Tusks may be infected. False tusks are fixed during the trade, in order to deceive the buyer. Tusk can be inspected for pus or infection by inserting a finger into the region around the tusk. Infected tusks also produce an odour.

### **II. Temperament**

7. The temperament is an important factor irrespective of the nature of work it is suited for. The buyer must observe the elephant, from a distance, in the presence and absence of its mahout. He could also consult experienced people for a second opinion. There is also a practise of drugging elephants with a violent temperament. Thus the elephant may appear docile during inspection.



**III. Other factors**

8. The elephant must also allow its mahout to mount via the front and hind legs. Some elephants may not allow people to ride on its back. The elephant must also follow the foot commands of the rider. Elephants displaying stereotypic movements on chains, such as weaving of head, rocking back and forth, swinging one feet around, etc., must be avoided. If these actions continue even on being unchained, the elephant should be avoided.
9. An elephant with 17 nails is considered inauspicious. Traders sometimes place an artificial nail made of sea shell to cheat the buyer.
10. Dark pigmentation on the tongue and the palate are considered inauspicious.
11. Neck must be short. Such animals are called pig – necked, in local parlance.
12. Animal must not be tall and lanky. Limbs must not be long.
13. Animal must appear strong and fleshy with feet placed firmly on ground.
14. Knee must be broad
15. The callouses from work or lying down must not be prominent.
16. Spinal ridge must not be visible.
17. Tail must be broad, long and fleshy
18. Temporal region must be convex without depressions
19. Bones on the brisket (Chest) must not be visible.

**IV. Purchasing work elephants**

The following are the desired qualities for a work elephant.

20. Tongue must be pinkish in colour
21. Skin must be elastic with several wrinkles.

## SENSITIVE POINTS (MARMAMMS) – HASTYAYURVEDA CONCEPT

*K. Chandrasekharan*

According to the ancient Indian text *Hastyayurveda*, there are 107 sensitive points on the elephant's body. These sensitive points are called as *Marmams*, in *Malayalam*. The text says that, injuries on any one of these points can cause serious health problems to the elephant. These points are distributed through out the body and their location and numbers are discussed below.

<i>Location</i>	<i>Numbers</i>
Limbs	44 (11 on each foot)
Lower abdomen	3
Chest	9
Back	14
Neck	12
Head	25
Total	107

The *marmams* are classified as follows:

<i>Classification</i>	<i>Numbers</i>
Asthi	8
Snayu	33
Dhamani	9
Sira	17
Sandhi	40

Based on their location these *marmams* are named as follows:

<i>Location</i>	<i>Name</i>
Lower joint of the limbs	<i>Chowlam</i>
Knee of forelimb	<i>Kopparam</i>
Knee of hind limb	<i>Janu</i>
Tip of trunk	<i>Jara</i>
Inside the mouth	<i>Anthakari</i>
Centre of head	<i>Avajam</i>
Between eyebrows	<i>Vataram</i>
Temporal region	<i>Arunan</i>
Behind the seating - area of mahout	<i>Shroni</i>
Pelvis	<i>Pakwi</i>
In front of penis	<i>Mutratravam</i>

The effect of injuries on the various *marmams*

<i>Marmmam</i>	<i>Effects</i>
Asthi	Swelling
Snayu	Chronic pain and nerve stretching
Dhamani	Blood flow
Sira	Viscous blood flows out, thirst and temporary insanity
Sandhi	Swelling at joints or joints become thin and weak

Besides the above mentioned regions, few other regions such as the anal opening, the heart, centre of the face, penis, between breasts, central pelvis, centre of the forehead bump are also extremely sensitive to pressure

or injury. There are at least 30 *marmams* in all these regions. Injuries are caused by excessive use of restraining devices. Mahouts have to be very careful about using their hook, long pole and stick.

## PREDICTION OF BODY WEIGHT IN INDIAN ELEPHANTS (*Elephas maximus indicus*)

*K.P. Sreekumar*

Knowledge on the body weight of an animal is of paramount importance in determining the metabolic activity, in estimating the dietary needs and in calculating the dosage of drugs. In metabolic studies the mass and surface area are important in estimating the heat production and vital activity. Correct dosages of tranquilizers are essential for the successful control of rogue elephants. Since recording the actual weight with sensitive platform balance/ weigh bridge is not feasible in many places where the elephants are normally housed or stationed, the practice is to estimate the body weight by prediction equations. Body weight is also a reliable index of the size of the animal. Nutritional status, age, sex, workload, physiological status and environment are some of the important factors that influence the body weight.

With a view to recommend relatively simpler and safer methods, measurements of length, girth, height etc. were used for deriving scientifically and factually acceptable equations to predict body weight.

### **Methodology**

The actual body weight of the animal was recorded using a weighbridge before feeding.

Body measurements were taken using a strong tape measure, which withstood the rough handling without stretching, shrinking, curling or breaking.

The measurements are recorded after the elephant is made to stand squarely on four legs on a level ground with head straight and in an upright position.

Height at shoulders (HT): Tape is fixed to a straight rod provided with a spirit level, placed horizontally on the shoulders. The straight-line distance between the rod and ground from the HT.

Chest girth (CG): Encircle the tape tightly around the body, just behind the elbows.

Neck girth (NG): Encircle the tape tightly at the base of the neck, in front of the shoulders.

Body length (L1): The head to tail distance i.e., the distance between the base of forehead (midpoint of the supraoccipital crest) along the curvature of the back to the base of the tail.

Body length (L2): Point of buttock (tuber ischii) to point of shoulder (greater tuberosity of the humerus) length.

Forefoot circumference (FFC): Circumference at the level of the sole including the nail.

Linear, non-linear and exponential regression equations were fitted using appropriate statistical tools to derive prediction equations.

**Formulae**

Kurt and Nettasinghe (1968)

$$1. BW = \frac{(HT + 22.39)^3}{(18.9)}$$

$$2. BW = \frac{(CG+60.6)^3}{(28.9)}$$

BW = kg., HT=cm., CG=cm.

Krishnamoorthy and Nair (1979)

$$BW = \frac{1.25 L^2 CG^2}{300}$$

BW = lbs., CG and L2= inches

Ananthasubramaniam and Co-workers (1982)

$$1. BW = 23 CG - 4984$$

$$2. BW = 6.9 L^2 + 20.7CG - 5556$$

$$3. BW = 8.2 CG + 18.4 NG - 3927$$

$$4. BW = 12.8 (CG + NG) - 4281$$

$$5. BW = 10^{-4} \times 2.4313 L^2 CG^{2.6}$$

$$6. BW = 10^{-5} \times 12.0539 L^2 CG^2$$

BW = kg., CG, L2, NG =cm.

Sukumar and Co-workers (1988)

$$1. BW = \{0.057 HT + 0.114\}^3 \text{ (males)}$$

$$2. BW = \{0.060 HT - 0.335\}^3 \text{ (females)}$$

BW = kg., HT=cm.

Sreekumar and Nirmalan (1989)

$$1. BW = -3249 + 25.95 HT$$

$$2. BW = 0.012164 HT^{2.2548}$$

$$3. BW = -4920 + 25.49 L^2$$

$$4. BW = -206 + 18.69 L^2$$

$$BW = -5088 + 22.87CG$$

$$6. BW = -2220 + 23.03 NG$$

$$7. BW = -4583 + 61.53 FFC$$

$$8. BW = -878 + 0.036(L^2 \times CG) - 0.8239HT$$

$$9. BW = -1754 + 0.030(L^2 \times CG) + 10.96 FFC$$

$$10. BW = -1010 + 0.036 (L^2 \times CG)$$

BW = kg., HT., L1, L2, CG, NG, FFC =cm.

Hile and Co-workers (1997)

$$1. BW = 17.9CG - 3408$$

$$2. 2. BW = 12.4CG + 9.33L^2 - 3351 \text{ (age 1-13)}$$

$$3. BW = 11.4CG + 6.89 L^2 + 22.8 FFC - 5250 \text{ (18- 26yrs)}$$

$$4. BW = 14.2CG + 13.2 L^2 - 4662 \text{ (29-39yrs)}$$

$$5. BW = 20.8CG - 4249 \text{ (40-57yrs)}$$

$$6. BW = 18.0CG - 3336$$

$$7. BW = 11.5 CG + 7.55 L^2 + 12.5FFC - 4061 \text{ (1-57 yrs)}$$

BW=kg., L2, CG, FFC =cm.

Kurt (2002)

$$1. BW = HT CG^2 / 10000 \text{ ( upto 6 yrs)}$$

$$2.. BW = 0.93 \times HT CG^2 / 10000 \text{ (>6yrs males)}$$

$$3. BW = 0.98 \times HT CG^2 / 10000 \text{ (>6yrs females)}$$

BW=kg. HT, CG =cm.

## MANAGEMENT PRACTICES IN KERALA

*Jacob. V. Cheeran*

### **Feeding**

Mature elephants feed continuously for a considerable length of time. In captivity the main cut fodder in Kerala is palm leaves and coconut leaves. Working animals are fed with concentrates consisting of grains, millets and pulses. Common salt should also be added. Elephant's capacity to digest food is poor and only 40 per cent is digested and the rest (60%) is passed out as faeces. The standard practice is to supply fodder at the rate of 5 per cent of the body weight. So a cow elephant will need 150-175 kg of fodder and a bull will need 200-275 kg of fodder. The growing calves and pregnant and lactating cows may take more food. The concentrate can be powdered and cooked depending upon the nature of the concentrate. This will help in better digestion and assimilation of the food given. Horse gram, ragi, rice, salt (100 gm) and jaggery are the common ingredients of the concentrate. Ordinarily 12-15 kgs of the concentrate are fed every day. On rest days concentrate ration is reduced. It has been found from practice in Kerala that if enough greens are available no concentrate is needed unless the animal is put to heavy work like timber hauling.

### **Restraining devices**

Elephants are not ordinarily let loose but tethered to a tree or a strong pole made of iron or concrete. Usually only one hind limb is tethered with one chain. During musth, special heavy chains are used. The diagonally

opposite forelimb also is tethered to the front. This will help to clean the hind portion. When the animal is not taken out regularly in musth, the chain of the hind limb is alternated. The chain that is tied is released only after another chain has been put on the other hind limb. During musth, special heavy chains (musth chains) are used and the diagonally opposite fore and hind limbs are tied, i.e., the right hind limb and the left forelimb. Chains could be of the following sizes ½", 5/8" and ¾" in thickness. Both fore and hind limbs can be hobbled with one chain. Another chain known as the cross chain is tied between the chains of the fore and the hind limb. The chains should have special locking devices at various lengths so that it can be shortened and lengthened depending upon the requirement.

Another chain known as the body chain goes around the body and is tied to the hind limb. If an animal misbehaves, the rider can easily release the chain and push down into the ground. This will act as a trailing chain and can be tethered on any tree or strong pillar. A trailing chain is always used when the mahout is not sure about the temperament of the animal.

A double rope is used around the neck and this is useful when the animal is being ridden. The mahout can put his feet through the rope to keep his feet in position and can also give toe commands. Ordinarily a rope with a length of 625 cm and 2 ½ - 3 cm in diameter is used for this purpose.

Elephant hooks are of different sizes and shapes. In Kerala it is made up of hard wood like teak, 100-125 cm long and the hook is made up of brass and the tip with a rounded prod. But in many other parts of the country it is short with a large hook and made of iron. Mahout will also carry a big knife as well as a stick, of one metre length made from the branches of tree which is flexible and tough.

A long rod made up of hard wood of 3-3 ½ meter long is used to prod the elephant from a distance. This is used also as a punishment and to control the animal by leaning it against the back of the ear. The

animals are trained to remain in the same place without pushing the rod down.

All these restraining instruments must be used very sparsely only. The knife is used very sparingly. It is often used to cut down the fodder and dress it.

### **Tethering site**

The tethering site should have shade and proximity to water. Surface should not be too hard and must be preferably mud. There should be provision for drainage and convenience to dispose dung, urine and fodder refuse. These wastes also can be incinerated periodically.



*Fig. 1. Restraining equipments*

1. *Knife*
2. *Ankusham*
3. *Long pole*
4. *Stick*

## TRANSPORTATION OF ELEPHANTS BY RAIL

*Jacob V. Cheeran, K. Chandrasekharan and K. Radhakrishnan*

Asiad 1982, the Asian athletic meet, was conducted at New Delhi in November, 1982. Each state was requested to exhibit their cultural display during the opening ceremony of the sports festival. Among the items selected from Kerala was a display of caparisoned elephants, typical as in a temple festival in Kerala. Hence it was decided to transport 34 elephants to New Delhi from Trichur by rail. The total distance covered was 3011 kilometres each way. The journey took seven days up and eight days down.

Since there was anxiety over the reaction or response of the elephants during rail journey it was decided to conduct a trial journey with two elephants from Trichur to Cochin and back for a total distance of 170 kms up and down and the response was good. Animals did not show any unusual excitement or reluctance to get onto open platform bogies which were reinforced and supported with GI steel pipes of 5 cm diameter.

A full train was chartered for the purpose and adult elephants were loaded in open platform goods bogies. Double bogies were chosen so as to accommodate two elephants in each. Calves were loaded into covered wagons (VPH Wagons) used for loading horses and motor car. The calves were found to be relaxed and lying down and sleeping during the journey.

### **Preparation of open bogies**

Double wagon bogies (BRH wagons 13 in number 13.8 m x 2.75 m, clearance from

ground 1.45 m) were used for loading adult elephants. The sides were fenced with galvanized iron tubes of 7.5 cm diameter. Corners and sides were reinforced with pipes fixed in vertical to the platform. Two teak logs were placed on either side of the elephant in a shape of 'V' so that the animal can keep balance easily and if necessary can lean on the logs and rest. The forelimbs were tied separately in the front and hindlimbs behind. The hindlimbs were kept reasonably close so as to put hobbles, if necessary. The elephants were loaded in pairs and made to stand facing each other. In between these two elephants, a small canopy was put with tarpaulins to accommodate mahouts of each elephant. This gave the elephants an opportunity to see each other as well as feel the presence of their mahouts. This made the animals to remain clam and relaxed. The fodder, palm leaves, was put in front of the animal and water was stored in steel drums of 100 litre capacity. The steel drums were made by cutting steel drum of 200 litres capacity in the middle and fixing handles. The sharp cut edges were rounded off. The water-troughs were filled as and when required, making the water available to the animal *ad-libitum* at all times of the day.

### **Elephants**

Elephants, 34 in number were selected from the captive elephants mostly from Trichur and suburbs. A few elephants selected from distant places, 100 to 120 kms away from Trichur were made to transport

on foot to Trichur to be loaded into the train from Trichur. The elephants were mostly owned by private individuals, temples and a few from the forest department. All animals had been inspected personally to assess their health and temperament. More animals were selected and were requested to be brought to the loading site, for unexpected replacements if necessary.

### **Fodder**

The captive elephants in Kerala are usually fed with palm leaves and to avoid digestive disturbances it was decided to carry three wagon loads (100 tons) of palm leaves along with. The animals were mostly fed with palm leaves in sufficient quantities.

### **Water**

Elephants being a shade loving animal with relatively poor thermoregulation, the availability of water is important. This had greater importance since the animals were carried in open wagons. It may be mentioned that it was the month of November, which is comparatively cooler compared to the hot summer. Provisions for adequate water was provided by keeping drums with the capacity of 100 litres for each animal as mentioned earlier. Since each open wagon was carrying two elephants, two drums were provided in each wagon. In important railway stations where there was facility for water, the drums were refilled with fresh water and the animals were prompted to have "spray wash" by themselves. The animals were also given wash with water hoses wherever these facilities were available. Advance information regarding the arrival of the train was given to the authorities concerned also as to store enough water in the storage tanks which were two in number with a capacity of 20,000 litres each.

### **Healthcare and medicines**

The anticipated ailments in the long distance journey were indigestion and impaction due to change in feeding and watering regimen, prolonged standing, stress and change in climate. Rope burn and chain injury were also anticipated due to tethering continuously for a long period, or due to struggling. Excitement and struggling due to unfamiliar sights, sounds and mode of transport were also anticipated. Hence stomachics, intramuscular purgatives in case of impaction, electrolytes and fluids for parenteral administration, dressing materials and antibiotics were also stocked in adequate quantities. Sedatives and tranquilisers like acepromazine, xylazine (Rompun) and stimulants like doxapram (Dopram) were also taken. Analgesic, antipyretics and diuretics were also stocked in sufficient quantities. To aid supportive treatment, dextrose parenteral and oral, liver extracts and B. complex injections were also stocked. Surgical instruments for minor surgical intervention were also carried along with the essential drugs.

### **Mahouts**

Each mature elephant (284 cm height and above) was provided with three mahouts and young animals with two mahouts. All through the journey, at least one mahout was accompanying the elephant in the wagon. When they are not in the wagon with elephants, mahouts could sleep or relax in the accompanying sleeping/passenger bogies. Thus there used to be two mahouts in company at any time, in each wagon carrying two elephants. This gave company to the mahouts and reassurance to the animals also. Shade and cover were provided for the mahouts by fixing tarpaulins in the middle of



the wagon i.e. in between the elephants as mentioned earlier.

### **Loading and unloading**

The animals were loaded into the wagons by using a heavy duty, short ramp closing the gap between the platform and bogie. The animals were made to walk into the wagon over the ramp. Since the animals were sniffing and trying to feel the gap between the bogie and the platform as well as the depth, at platform level the gaps were covered with gunny bags filled with paddy straw. Also animals were made to walk over the ramp quickly without any pause, thus avoiding the chance of feeling for the gap at platform. A couple of animals refused to get on to the open wagon. They were so recalcitrant that they had to be replaced by the “extras” that were kept ready. While unloading at Delhi most of the animals got out, without the help of the ramp. The reluctance shown by the animals while on loading to the bogies made us to worry that they may show greater reluctance to get on to the bogies on downward journey. But it is worth mentioning that none of the animals showed any reluctance to get into bogies on downward journey. Most of them did not even wait for the ramp to be made available. While it took six hours for loading at Trichur it took less than one hour at Delhi for loading all the animals.

Another point worth mentioning is the behaviour of the animals during the journey and at New Delhi. Most of the animals remained calm and relaxed after a few hours of journey except one animal which was given a sedative on the 4<sup>th</sup> day. The weight of the animals were taken before and after the journey and most of the animals had put on weight and one animal added 750 kg to its

body weight. All animals were drinking and eating normally suggesting that the journey had not caused any appreciable stress to the animals.

Sedatives like xylazine and acepromazine (ACP) (80-100 mg/MT and 40-60 mg/MT body wt.) were given to five animals while starting the journey from Trichur and then three animals were given sedative acepromazine 50-60 mg/MT body wt. on the next day and one animal on 4<sup>th</sup> day ACP 40 mg/MT making the total animals received sedative to nine. But however no sedatives were used in any animal during the return journey since they all got used to the train journey.

No rope burn or chain injury was noticed in any of the animals. This suggests that no undue attempts were made by the animals to break off due to fright or stress during the journey or at their camp in New Delhi. In the elephant camp at Delhi there was a constant stream of onlookers. Most of the visitors were not familiar with the behaviour of elephants and undue freedom even bordering to risk of their life was taken by being very close to the animals and feeding them. But all animals behaved very well without causing any mishap.

The animals while being selected, consideration was made to their maximum height and their period of musth. The height was taken into account considering the height of certain old tunnels and overbridges constructed with low clearance from the ground level. But it was interesting to note that the animals reflexly lowered their head while the trains were passing under these bridges and tunnels.

Animals did not show any sign of excitement either when the other trains were running parallel or trains running in opposite direction with their screeching whistle and rattling noises.

The musth period was taken into consideration to avoid any animal coming into musth while during the journey or at camp in Delhi. But one of the animals, a large bull, started showing symptoms of musth immediately after reaching New Delhi. Usually this animal used to come to musth only in December in Kerala. Probably the relatively cold weather, especially during night in Delhi might have advanced the occurrence of musth in this case. The animal was tied safely in Delhi and was transported back to Kerala in a lorry after the expiry of musth period.

While the animals were camping in Delhi, the fodder continued to be palm leaves which

were transported from Kerala. During the journey and in Delhi, sugarcane which was offered by the public was given only in limited quantity to avoid digestive problems.

The total contingent consisted of 303 persons. This included mahouts, one Circle Inspector of Police, three Sub Inspectors of Police and 21 Police Constables. The team also consisted of six Veterinary Surgeons, one Assistant Surgeon and a Compounder, Revenue officials, casual labourers, cooks, barbers, washerman etc. The total journey up and down including stay was for a period of one month.

## REPRODUCTION IN ELEPHANTS

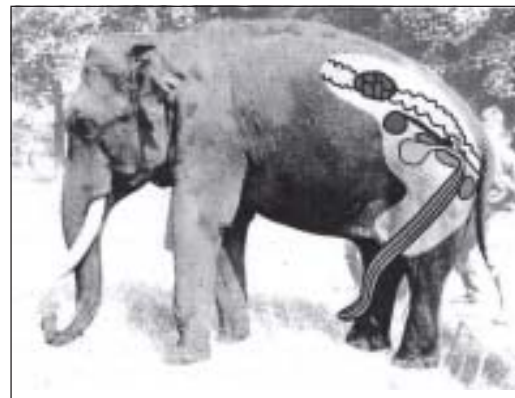
*G. Ajitkumar, K.N. Aravinda Ghosh and T. Sreekumaran*

The Asian elephant population on the earth during the beginning of the twentieth century was about one lakh. According to the recent statistics available with the International Elephant Foundation, now there are only 40000 Asian elephants on the earth. From this it is very clear that a sixty per cent decline in the Asian elephant population has occurred over a period of 100 years. More over, the Asian elephant population has fragmented and shrunk to India and a few other south-east Asian countries. Presently the worldwide captive elephant population is not self-sustaining. The current world population of captive elephants results primarily from imports out of Africa and Asia. The difficulty in establishing self-sustaining captive population is mainly due to low reproductive rate. There is a high incidence of undetected reproductive disorders in the captive elephant population. Some of these disorders may be attributed to continuous oestrous cyclicity in nulliparous females of prime breeding age (18-30y). After approximately 10-15 years of cyclicity with roughly 40 nonfertile ovulations, pathological alterations like uterine tumours (leiomyomas) and endometrial cysts (hyperplasia) often develop. These lesions usually remain undetected because of lack of symptoms (eg. oestrous cyclicity appears normal) or outward signs except that no pregnancy results from breeding (Hildebrandt *et al.*,2000).

### Male genital system

#### *Testis*

Just like in large marine mammals, the testes in elephants are placed inside the abdomen (testiconda). During organogenesis, the testis initially develops from the genital ridge located at the medial aspect of the mesonephros and as the metanephric kidney assumes a more cranial location, the testes assume their definitive position adjacent to the metanephros. In scrotal mammals, the testes and associated mesonephric ducts descend and are guided through the inguinal canal to the scrotum by the gubernaculum. At no stage of fetal development in the elephant any sign of a gubernaculum, processus vaginalis, inguinal canal or scrotum is seen. In scrotal mammals, a highly coiled spermatic artery is surrounded by a convoluted venous



*Fig 1. Male reproductive system*

pampiniform plexus draining the testis, which cools the arterial blood supply to the testis, but in the adult elephant, this structure is notably absent. If elephants were secondary testiconda, whose testes had once been scrotal, the pampiniform plexus would probably have been retained, as it is in the seals and whales. Thus it could be concluded that elephant like the dugong (sea cow) is a primary testiconda mammal that shows no evidence of prior testicular descent. The testis of adult elephant weighs 700-950 g and is wedge shaped. A single spermatic artery on either side supplies blood to the testis.

#### ***Efferent duct and Wolffian duct***

The excurrent duct of the male elephant can be divided into two parts; efferent duct and the Wolffian duct. The elephant has a poorly distinct epididymis and is very small compared to the testis. Additionally the epididymis is not well demarcated from the rest of the genital duct in the elephant, making it difficult to locate. The usual length of epididymis is 10 cm and width 1-2 cm. It is a moderately coiled structure. Wolffian duct is a much larger structure being about one mm in diameter initially and extremely coiled throughout the whole of its overall length of about 160 cm before opening into the ampulla.

#### ***Ampulla***

The Wolffian duct opens by means of a small papilla into the ampulla. The ampulla lies ventral to the seminal vesicles to form two common ejaculatory ducts.

#### ***Accessory sex glands***

All the three accessory sex glands viz. seminal vesicle, prostate and bulbo-urethral gland (Cowper's gland) are present in elephants. Seminal vesicles are two large

thick walled sacs lying within the pelvic cavity and are fusiform in shape. The secretion is usually clear, watery and alkaline. Prostate is situated on the dorsal wall of the urethra posterior to the seminal vesicles. The glands are mostly in the form of two discrete lobes, one on either side of the urethra posterior to the seminal vesicles. Bulbo-urethral glands lie together on the dorso-lateral aspect of the urethra close to the ischial arch, dorsal to the curve of penis.

#### ***Penis***

The length of the penis is about 4.5 feet, 15 inch in circumference and weighs about 7 kg. Glans penis is absent in elephants but the tip of the penis is more flat and resembles the hood of a snake. The corpus cavernosum penis is well developed which is divided into two halves by a thick septum. The opening at the ill-defined urethral process is 'Y' shaped, the two arms of the 'Y' being situated dorsally. No prepuce is seen in the elephants. There is a large paired levator penis muscle on the dorsal surface. The two levator penis muscles unite to form a common tendon which is inserted on the dorsum of the corpus cavernosum penis and is responsible for the 'S' shaped flexure of the penis at erection.

#### ***Seminology***

The semen is expelled from the genital tract in three fractions. The first fraction is the one that contains the maximum concentration of spermatozoa (2050 millions/ml) and the average volume is about 10.5 ml. The second fraction is less concentrated (1340 millions/ml) than the first one and the average volume is 17 ml. The third fraction which is about 50-100 ml in volume is distinctly yellow in colour due to

contamination with urine and is low in spermatozoal concentration. The average pH of semen is 7.05. The elephant spermatozoa resemble equine spermatozoa in many respects.

#### **Artificial insemination**

Since the Asian elephant population in the wild is at the verge of danger, it is very important that further knowledge and techniques for captive elephant reproduction be developed if the species is to continue to exist. The artificial insemination technique is of very much importance from the angle of *ex situ* conservation. The implications of successfully collecting and preserving elephant semen are profound in the context of propagating the Asian elephants in captivity. The ability to transport semen to fertile elephant cows circumventing the severe logistical problems of transporting elephants for breeding purposes is essential. Using manual rectal stimulation, sperm rich samples can be obtained with out dilution of the fluids from the accessory sex glands and with out extensive training of the animal to accept this method of semen collection. The penis is stimulated to protrusion and erection by rectal massage of the pelvic portions of the urethra. During an ejaculatory response, massage is also directed onto the area of the ampulla of the ductus deferens. Since semen collection by electro-ejaculation involves anaesthesia associated risk, manual manipulation/ massage technique is preferred. But the most limiting factor is that semen collection by manual manipulation is possible with only a few trained bulls. Another disadvantage is that semen collection by massage technique does not elucidate the status of the accessory glands. Trans-rectal ultrasonographic imaging provides a less invasive means for locating and measuring

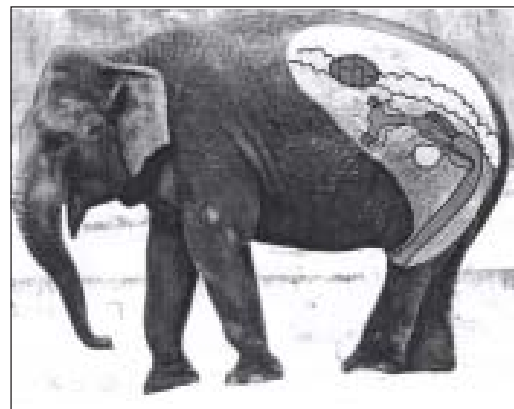
reproductive structures that are the basis for reproductive assessment in elephants.

#### **Musth and anti-androgens**

Adult male Asian elephants and both sexes of African elephants manifest usually a physiological and behavioural phenomenon known as musth. The symptoms and behavioural changes of musth usually last for one to three months or some times up to 5 months and the intensity varies in pre-musth, full musth (violent musth) and post-musth phases. The androgen level in the blood usually increases considerably during the period of musth and is stated to be the reason for the increased aggressive behaviour in musth elephants. Reduced aggression in castrated bull elephants further supports this concept. Based on this hypothesis trials were carried out with oral administration of an anti-androgen (Flutamide) to reduce the aggression in animals in musth and the results are encouraging.

#### **Female genital system**

A characteristic feature of the female reproductive tract is the long uro-genital canal (vestibule) which extends down through the perineal region to carry the vulva to a position



*Fig.2. Female reproductive system*

on the belly of the animal, anterior to the hind legs and similar to that of the male genital opening. The whole genitalia weigh about 25 kg.

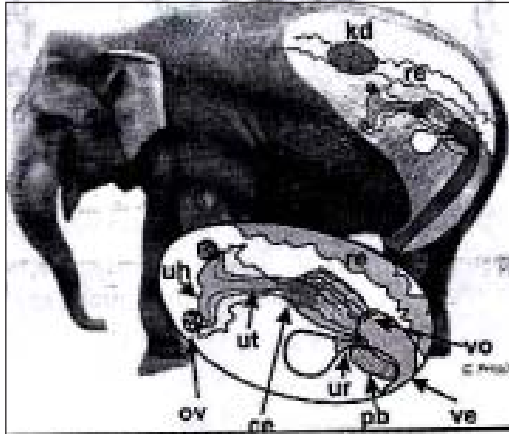


Fig.3. Female reproductive system in detail

kd	-	Kidney
re	-	Rectum
uh	-	Uterine horn
ut	-	Uterus
ov	-	Ovary
ce	-	Cervix
ur	-	Urethra
vo	-	Vagina
ve	-	Vestibule
pb	-	Pubis

### Ovaries

The ovaries are large, rounded, slightly lobulated and placed in bursa and located near the kidneys. The average ovarian measurement is 7 x 5 x 2.5 cm. They are almost completely enfolded by an expansion of the fimbrial funnel of the fallopian tube which forms an ovarian sac, of which outer wall is covered with peritoneum. It is anchored to the uterine horn by the ovarian ligament and the body wall anteriorly by the suspensory ligament. The ovarian sac is widely open

medially and is divided into inner and outer compartments. The outer compartment of the ovarian sac is fimbriated while the inner compartment is lined with peritoneum.

### Fallopian tubes

In adult Asian elephant, the length of the Fallopian tube is about 35 cm, the diameter at the fimbriated end is 4 mm and at the utero-tubal junction is 1 mm. Lumen at this point is very small and the muscularis forms a thick collar around the lumen.

### Uterus

The uterus is "T" shaped and mostly resembles that of equines. It consists of a well developed body and two horns. The horns themselves fuse caudally and then open into the common lumen of the body of the uterus. The walls of the uterus are thick. The os uterus is well defined, narrow and carried in a relatively massive papilla which projects in to the vaginal cavity. On examination of a uterus recovered on post-mortem of an adult cow elephant, the uterine body was found to be 12 cm long and the right and left horns were 75 and 65 cm long respectively. The length of cervix was 24 cm. It opened into the body in front and rear into the vagina by narrow openings. Its lumen was straight with longitudinal folds of mucous membrane. Mucous membrane on the floor of the uterus was also thrown into longitudinal folds. The uterine cornua were observed to meet each other at right angle at the median plane as seen in equidae. Both the horns united posteriorly and merged with the body of the uterus giving a false appearance of the body being longer in size. Each horn opened into the body of the uterus by a variable slit of 1.5 cm in length. An inter-cornual ligament was also observed on ventral aspect.

### **Vagina, vestibule and clitoris**

The vagina measures about 60 cm in length. The vaginal wall is thin and highly flexible. The passage from the vagina to the uro-genital canal (vestibule) is widely open and the urethral orifice opens as a simple opening on the ventral wall of the tract. The clitoris in elephant is very long and big measuring about 30-60 cm in length and 1.5-2 kg in weight.

### **Oestrous cycle**

The oestrous cycle of Asian and African elephant is 13-16 weeks in duration with an 8-10 week luteal and 4-6 week non-luteal phase. The previous concept was that a cow elephant comes into heat once in every three weeks. One unique aspect of the elephant oestrous cycle is the presence of two surges of luteinising hormone (LH) during the non-luteal phase. The two surges are quantitatively and qualitatively indistinguishable and occur consistently 19-22 days apart. Ovulation and subsequent rise in progesterone are observed only after the second LH surge and hence is termed the ovulatory LH surge (ovLH). The function of the first, anovulatory LH surge (anLH) is unknown. It may be significant, though, that these surges are three weeks apart, apparently supporting the hypothesis that waves of follicular activity occurs at this frequency. Unfortunately analysis of circulating oestrogens has not borne out this pattern, because concentrations are low and fluctuate with no clear pattern phase. The adaptation of ultrasonography to examine the elephant reproductive tract provides a new perspective for further investigating the dynamics of reproductive hormonal relationships in both male and female elephants.

The observed maturation and ovulation of only one Graafian follicle per cycle, in addition to the formation of luteal structures resembling corpora lutea suggest that an active endocrine mechanism exists in elephants to prevent multiple ovulations while still providing adequate luteal support. The presence and functional significance of multiple corpora lutea on the elephant ovary has long been a mystery. On average six to eight luteal structures are observed at any one time, some containing ovulation stigma (30-40%), whereas others do not. From the ultrasonography of ovary it is now apparent that multiple luteal structures do form during the ovarian cycle, with only one corpus luteum in response to the ovLH surge. If the non-ovulatory luteal structures are the result of luteinisation of follicles from the first wave, it is not clear why these structures are not steroidogenic. However the appearance of accessory corpora lutea 1-5 days before the ovLH surge coincident with the preovulatory rise in progesterone suggests that at least some of this steroidogenic activity may be independent of the ovLH surge. The observation that all luteal structures regressed at the end of the luteal phase eliminates the possibility that multiple corpora lutea are the result of accumulated structures from cycle to cycle as previously suggested.

### **Mating behaviour and act of copulation**

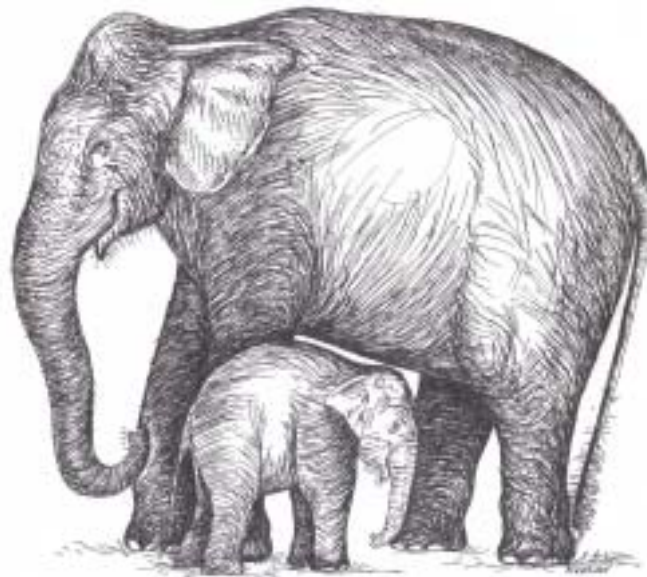
Prior to the actual act of copulation there is prolonged courtship behaviour accompanied by rumbling noise. Urine, temporal gland discharge etc. are tested by the partners as these materials contain certain pheromones. The male takes special attention in making contact with the uro-genital orifice and then places his trunk into his mouth after each contact. The vaginal

secretions from the uro-genital tract stimulate the vomero-nasal organ establishing a flehmen like response in elephants. Cow elephant may even fondle the erected penis of the partner. With these contact promoting and precopulatory behaviour male gets ready for mounting. Before actual mounting several false attempts are made. The female exhibits its arousal by standing response and by spreading its ears. The male mounts extending his forelegs over the back of the female, puts his legs close together and then attempts intromission. The swollen tip of the erected penis before intromission develops a marked 'S' shaped flexure. The penis is quite mobile and the male makes no pelvic movements, but rather the uro-genital tract opening is sought by a series of vigorous up and down movements of the penis. When the uro-genital opening is contacted by the tip of the penis, it is pulled back and the penis is inserted into it with a series of up and down jerks. Intromission is very brief, being about

30-40 seconds and the depth of intromission is less than one foot. The duration of the coitus will be about 1-2 minutes. The total quantity of semen ranges from 50-100 ml, which is mixed with viscid gelatinous material of egg white consistency. Following first mating the male is ready for second mating after half to one hour. Mating may be repeated 4-6 times a day and may last for 3-4 days.

#### **Signs of pregnancy, gestation length and parturition**

Signs of pregnancy during early period of gestation are not marked. Foetal movements can be visualized in the abdominal area from twelfth month of gestation onwards. Towards the end of gestation mammary glands become more firm and enlarged and on pressing watery to waxy type secretion ooze out through the teats. The average gestation length is 19-21 months. During the later stages of pregnancy, the pregnant female becomes



*Fig.4. Cow elephant with calf*



more lethargic and seeks secluded places. Cervical mucus is observed 12-14 hours before parturition. Usually birth takes place during night and rarely during day in domesticated ones. Signs of abdominal pain and discomfort will be shown two hours prior to parturition. Initially the animal will show a tendency to lie down and get up repeatedly. Vigorous repeated forcible straining is accompanied by the appearance of pink coloured water bag. With the protruding bag the female may move for a few minutes and then the bag ruptures with the fluid gushing out. Soon the female stretches out her hind legs wide apart and strains. The trunk and the forelimbs of the young one appear, followed by expulsion of head. The whole foetus is expelled out within seconds. The umbilical cord may tear off by its own, or it can be severed manually. The mother may turn the newborn and may throw sand over it to remove the placental debris. The newborn urinates, defecates and stands unassisted by the mother, walks and attempts sucking within an hour of birth. Expulsion of the foetal membranes occurs within one to

two hours. The placentation in elephant is annular and zonary and occupies the equator of an ovoid chorio-allantoic sac. The average birth weight of an elephant calf is 80-100 kg and the sex ratio is 1:1. Twinning is not uncommon in elephants. The mammary glands in elephants are pectoral and are two in number and the teat opens through lactopores (8-10 nos).

### **Conclusion**

Because of the low reproduction rates in captive elephants it is very difficult to maintain self-sustaining captive elephant groups. The development of scientific guided reproduction programmes in elephants will greatly enhance the potential for creating self-sustaining populations in captivity. For megavertebrates like elephants, it is critical that methods for evaluation of reproductive capacity be developed, including development and health status of female and male uro-genital tracts as well as semen parameters. At this juncture it is worthwhile to state that it is high time to start assisted reproductive techniques in our elephants too.

## CARE OF ELEPHANT CALVES

*V. Krishnamurthy*

An elephant calf is orphaned due to several reasons.

1. If the mother of a calf dies, it will be rejected by other lactating mothers of the herd. So the entire herd may abandon the calf.
2. Sometimes mothers reject their calves which are more likely in captivity.
3. When the entire herd is hurrying away from some danger, a calf may trail behind and get lost.
4. Calves sometimes fall into old pits and are abandoned by the herd.
5. Calves may follow buffalo herds that come into the forest to graze. Thus they become separated from their own herd.

### **Hand rearing of elephant calves**

#### **I. Monitoring**

Abandoned elephant calves are brought into the elephant camp or zoo by villagers. Raising orphaned calves is very challenging and success is not ensured all the time. Tamil Nadu Forest Department camps have occasionally received orphaned calves and have had moderate success in raising many of them. Over the years, they have understood the 'do's and 'don'ts' with regard to rearing orphaned calves. This knowledge coupled with observations made from the growth pattern, dietary requirements, and habits of other calves with their mothers, can be applied to rearing orphaned calves.

Villagers or people who find the calf normally over feed it with a variety of food like bananas, fruits, and vegetables. This may upset the calf's digestion. Therefore it is safer to underfeed the calf, during the first few days of its arrival at the camp.

The calf has to be checked for general health condition, injuries or sprains from falling into the pit. Calves below one month of age retain their umbilical cord. This may be infested with maggots and has to be treated. The colour of such young calves is normally light, the eyes are red in colour, and they always hang their head.

It is important to develop a strict feeding routine or feed chart for the calf, as soon as it is bought into the camp. Several points have to be followed to ensure a safe and healthy diet.

1. The animal must always be given fresh food.
2. The environment where food is prepared must be clean. Cooking vessels used must be sterilised before use.

#### **II. Diet of elephant calves**

1. Initial diet: For the first 45 days, after arrival, it is advisable to feed only milk. Milk powder i.e., Amul Spray (baby food, available in the market) may be used instead of milk, as it is rich in iron content. Milk powder can also be stored for long periods and can be prepared afresh before every feed. Goat's milk is an alternate or

substitute to milk powder, but it is difficult to obtain in sufficient quantities. Cow's milk is not advisable for calves, since it contains large fat globules and causes diarrhoea. Cow's milk available commercially from market, is not safe as it may be adulterated.

2. Mode of feeding: The milk can be fed using an enema can. Enema can offers the following advantages when compared to bottle feeding.

1. The flow of milk can be regulated.
2. The flow is smooth and uninterrupted
3. Easy to clean and store

Bottle feeding can be time consuming as each bottle has to be changed or refilled and the calf may get impatient. It may suck too hard at the nipple on the bottle, if one is not careful.

3. Frequency of feeding: Normally upto two months, calves suck their mother every 60-90 minutes. During each feed they consume at least 1 lit of milk. The same pattern can be applied in hand reared calves. Calf cry out when hungry. It is a sign of appetite and also progress in health. It can be fed regularly between 5 am and 10 pm.
4. Concentration of food: Studies have shown that concentration of mother's milk varies as the calf grows older. The first few days after delivery, the elephant milk contains colostrum, essential for the calves to develop immunity. It is therefore essential to duplicate the function of colostrum with artificially prepared milk. In a zoo condition, it is possible to draw the milk out of the mother which has rejected its calf and administer this milk to the calf.

Initially, the concentration of the milk powder must be very low (i.e. highly diluted with water). For the first week, the feed should contain 50 gms of milk powder in 1 litre of water. This can be continued and later the concentration of powder can be increased. If the calf is feeding well, it will manifest signs of health such as urination 10-12 times a day and faecal excretion twice a day. The dung may be semisolid and slightly yellow in colour. A healthy calf will rest between feedings.

5. Concentrate foods: After two months, the calf can be introduced to semisolid foods like cereals, rice, tapioca, ragi etc. Ragi has to be processed properly. Dirt and stones have to be removed by winnowing and the ragi soaked in water for 4-5 hours. The soaked ragi is then suspended in a moist sack and allowed to sprout. The sprouts are dried in the sun, fried in a pan and powdered finely. For adults, the powdering does not have to be very fine. The processed ragi has to be stored in a dry place, to prevent fungal attack. Ragi is an excellent concentrate feed, as it has a balanced calcium and phosphorus ratio.

A well nourished calf is very active. Hand reared calves generally have a slow growth rate when compared to calves raised by their mothers. After six months, the calf can be introduced to solid foods. The milk intake can be reduced to 1-½ litres/day by the end of the first year.

6. Green fodder: Calves have a tendency to eat mud. They should be discouraged from doing so until three to four months of age. Calves in a herd, imitate feeding habits of their mother or other adults of the herd. Around the 2<sup>nd</sup> or the 3<sup>rd</sup> month,

they eat their mother's fresh dung, which encourages the growth of bacterial flora in the intestine. This helps in digestion of green fodder, which the calf may begin eating soon. The hand reared calf is given a similar stimulant. Fresh dung of one of the healthy cow-elephants from the camp is collected, diluted in water, filtered and administered to the calf.

Around 8-9 months of age, calves consume 30-40 kg of fodder per day. They sometimes suffer from lack of appetite. Carminative mixture concentrate (which has to be stocked adequately in the camp) can be mixed with the feed, to help digestion. Further, 500 gms of glucose, vitamins and calcium tablets can also be administered, along with the feed.

Calves have to be weighed and measured regularly. Healthy calf weighs between 80 and 100 kgs at birth. They gain at least two inches in height every year.

### **III. Tethering area**

Calves must be kept in a clean and dry (preferably cemented) place. Foreign substances like plastic, paper, rubber must be removed as calves eat them. Gunny bags must be provided to sleep on, in the night. During winter, the calf requires warmth and so they can be housed in the cooking shed, where the stove can be lit, to provide warmth. In Mudumalai elephant camp, the mahout's family also sleeps in the shed, along with the calf, so that it feels protected.

### **IV. Weaning and training of calves**

Calves are weaned usually at the age of 15-18 months. Previously they were weaned

when they were two years old. Early weaning is done these days, so that the mother can be put to work earlier and it was noted that, this early separation did not affect the growth of the calf. The weaned calf put in the *kraal* and the *kavady* (assistant mahout) of the mother or cow elephant is in charge of the calf.

During the first two or three days of weaning, the calves cry continuously for their mother and some calves are very aggressive. The training of the calf begins as soon as it is enkralled. Basic commands like *Jhuk* (to bend down) etc. are taught. The calf is also trained to wear chains and hobbles. Within 10-15 days of enkralling, the preliminary training is completed and the calf is removed from the *kraal*. The calf has to be dewormed and vaccinated against endemic diseases, if any. The diet is changed from rice to ragi along with a few vitamins that are mixed in the food. Every morning and evening, the calf is trained for an hour. They are sent out for grazing with the adults during the day, but are chained at the camp in the night.

After the age of six, the animals have to undergo serious training at the camp. This helps in controlling vices and disciplining the animal, at an early age. Stereotype movements (like weaving, rocking forwards and backwards), due to chaining, must be controlled at a very early age, as it may persist throughout the animal's life. After six years of age, the animal has to be trained for light timber work and made to follow the same routine as the adults. This training does not exactly substitute actual work of the adult, but helps keep the calf fit. It also learns to be subservient and remains engaged mentally and physically.

## SIGNS OF HEALTH IN ELEPHANTS

*P. C. Alex*

The word 'Health' refers to the normal well being of an animal, which is revealed by its body condition and behaviour, whereas disease is a departure from health. Non-infectious conditions (malnutrition, deficiencies etc.) are monitored by body condition evaluation and infectious conditions are better monitored by parasitological, microbiological, pathological and serological findings.

The following points are considered good while selecting elephants. Short hind legs, massive body, thick wrinkled skin, thick trunk with a well developed hump, bright eyes, large ears, short neck carrying the head high, broad chest, long back sloping gently backward from the withers, without prominent spinal ridge, full hind quarters, long tail with full tuft, 18 to 20 white coloured nails, broad and domed forehead, well shaped long and massive tusks etc.

Bright eyes, flagging of ears, movement of tail, inspection of surroundings with trunk, bearing weight on all limbs and giving rest to limbs alternatively, protrusion of penis while urinating, alertness, thoraco-abdominal breathing, feeding continuously, obedience to command etc. suggest apparently normal health.

The palate, tongue and mucosa of trunk are of a healthy pink colour. The skin is soft and wrinkled. The bristles are firm to touch and not easy to pluck out. The light coloured spots and blotches on the head and trunk are pinkish. A moist secretion exudes around the nails. The general appearance is that of contentment. Urine is turbid and copious in quantity, light yellowish in colour and odour not unpleasant. The colour of dung varies and generally brownish and darkens on exposure to air. It is passed in large lumps of 4 to 6 boli and 5 to 6 times a day. A healthy elephant may lie down once or twice during the night and never during the day.

### **Signs of illness**

Animal not active and alert. The characteristic movements of the animal will be missing. Skin changes its healthy appearance and blotches may be pale. Mucous membrane may change its appearance. The eyes are dull, retracted and abnormal discharge may be detected. Food intake will be reduced/absent. In case of colic, animal may lie down and get up several times. Urine less in quantity and deep coloured. Dung may be hard and coated with mucus or diarrhoea with or without mucus may be present.

## FEEDING OF ELEPHANT

*A.D. Mercy*

Elephant is a non-ruminant herbivore coming under the order proboscidae, family elephantidae and genus *elephas*. Asian elephant is *Elephas maximus* and the Indian elephant is referred to as *E. indicus* or *E. maximus indicus*. Indian elephants are divided into three classes, the Koomeriah or the thorough-bred, half bred and third rate (Sanyal, 1995). African elephants (*Loxodonta africana*) are of two types depending upon their habitat, the Bush or Savana elephant and the Forest elephant (Balakrishnan *et al.*, 1994). Forest elephants are smaller than the Bush elephant with small round ears and thinner slightly curved tusks.

In general, the male elephants are heavier than the females. Asian female (cow) elephant can attain a maximum weight of 3700 kg and a height of 2.4 meters while their males (bulls) reach 5000 kg in weight and 3.2 meters in height. The African elephant is larger than the Asian elephant, cows reaching up to 4000 kg and the bulls 6400 kg in weight.

There are different formulae developed to estimate the body weight of elephants using their body measurements. Sreekumar and Nirmalan (1989) have developed an equation using body length and girth to arrive at the body weight of Indian elephants with considerable accuracy.

Elephants like other large animals have difficulty in losing excess body heat through skin surface. Elephant's ear when viewed with infra red thermography, showed a remarkable rate of heat dissipation up to 70W at an atmospheric temperature of 32°C,

allowing to shed almost 100% of the total heat when maximally vasodilated and flapped gently (Willer *et al.*, 2000).

### Feeding Habits

Elephants under natural habitat are continuous feeders, spending on an average 12 to 20 hours a day for eating. The digestive system of elephant is suited to adapt to their continuous feeding habit. The main reasons for the continuous feeding may be the lower efficiency and the shorter time spent in the gastro-intestinal tract of elephants. Elephants feed on a wide variety of plants ranging from grasses, tree leaves, twigs, barks of trees, roots, fruits and even flowers (Moss, 1988). They have a unique way of eating. The grasses will be held by their short brittle stems, kick until the base is dislodged, remove the dirt and dust, knocking it loose against their knees. Some grass will come out by their roots and they will bite off the part that is palatable and drop the rest. They eat in a steady rhythmic pattern. First twisting their trunk around a bunch of vegetation pulling to one side and ripping the bunch free, thus placing it in the mouth and immediately reaching for more as they chew. Elephants are also very careful at removing the thorny branches and manipulating them with their trunks, tusks and feet to remove the bark from larger branches or to bend the thorns in one direction before placing them in their mouths.

Elephants test small samples of leaves if they contain high concentration of saponins, phenolics and other plant toxins (Cheeke, 1999). Young immature leaves have higher

levels of chemical defenses than mature leaves that are above the normal reach of herbivorous animals. Hence, they usually push over the trees to get access to the leaves.

Elephants also eat soil rich in minerals. Sodium, calcium and phosphorus deficiencies were the reasons attributed to the soil eating.

### **Digestive Organs**

The prehensile organs of the elephant are the mouth, the proboscis and the lower lip. The teeth have a specialized and complex structure that allows to tear the toughest plants because of the front and back movements. They have a total of six sets of teeth by the time they reach 55 to 60 years. They have two incisors (tusks) and four molars, one on each side, upper and lower. Teeth measure approximately 4 inches wide and 12 inches long. They are made of dentine and wear down layer by layer from the grinding of the food. The ones that replace the worn out teeth move forward from the back and not up from the bottom. Each new molar is larger than the last and it also carries more ridges, which aids in grinding food (Schmick, 1997).

The stomach is a simple cylindrical sac situated on the left side with the spleen attached and with a number of transverse, nearly circular folds projecting inwards from the cardiac wall which is essentially a storage organ (Ananthasubramaniam, 1992; Eltringham, 1999). The folds disappear when the stomach is distended. The small intestine is reported to be 21.5 feet long according to Evans (1910) while Schmick (1997) reported that the small intestine is approximately 80 feet, the appendix five feet, large intestine 21 feet and the rectum 13 feet in length. The main compartments of large intestine are the enlarged caecum and colon, which are not

separated from each other. Most of the digestion takes place in the caecum, which acts as a fermentation chamber where cellulose in the food is broken down by the microorganisms such as bacteria and protozoa. These microbes are acquired by coprophagy. The starches, soluble polysaccharides, cellulose and protein are digested or fermented in the colon (Spinage, 1995). The length of the tract per unit weight is less in elephants when compared to that of other herbivores (Benedict, 1936) which is another reason for the continuous feeding behavior of elephants.

### **Dry matter consumption**

Bhaskaran Nair and Ananthasubramaniam (1979) reported that the dry matter (DM) consumption of elephants fed chopped (30 cm) palm leaves ranged from 4.1 to 5.1 per cent of body weight while it was only 1.5 to 2.1 per cent when fed as whole. Lower DM consumption of 1.5 to 2.1 was observed for Asian elephants and 1.4 to 1.6 per cent of body weight for African elephants (Roehrs *et al.*, 1989). Higher DM consumption of 6 to 8 per cent of body weight was reported by Eltringham (1999).

### **Rate of passage**

The food residue begins to pass out of the body through the intestinal tract of elephants in 24 hours after feeding and completely disappears from the body in 50 hours (Benedict, 1936 and Bhaskaran Nair and Ananthasubramaniam, 1979). It is also reported that the rate of passage of ingesta measured using markers, ranged from 21 to 24 hours in Asian elephants and 10 to 18 hours in African elephants.

### **Nutrient digestion**

The food is mixed with copious amounts

of saliva to soften the coarse food and ease the passage to the stomach. About 70 per cent of digestive tract contents are found in the caecum and proximal colon. These segments harbour anaerobic microorganisms and fungi which can ferment plant cell wall carbohydrates, simple sugars, starches and protein. The products of fermentation are the volatile fatty acids, the molar proportion of acetate, propionate and butyrate being 75:12:10 respectively.

The dry matter (DM) digestibilities reported for elephants are lower than that of the other herbivores fed similar diets. African elephants registered lower DM digestibility than Asian elephants fed the same diet under captivity (Reichard *et al.*, 1982). Free ranging elephants digest diets to a greater degree than the captive elephants. A study conducted in Asian elephants fed palm leaves *ad libitum* showed DM digestibility of 45.8 per cent and when the feed was restricted to 75 per cent of *ad libitum* fed, DM digestibility was 51.5 per cent (Ananthasubramaniam, 1979). Crude protein digestibility recorded

by the above author was 89 per cent. The crude fibre digestibility was 18.5 per cent and the apparent digestibility of energy in palm leaves was 54.9 and 56.7 per cent, respectively, when fed *ad libitum* and when feed was restricted to 75 per cent. Asian elephants showed higher digestibility of cell wall constituents than the African elephants.

### Nutrient requirements

Since horses show close similarity to elephants when compared to the other herbivores, scientists are using the NRC standards for horses for feeding elephants. Dietary crude protein requirement of horses range from 8 per cent for mature animals and up to 15 per cent for young growing animals and is found to be almost adequate for elephants. Ananthasubramaniam (1979) recommended the nutrient requirements of Indian elephants based on the work done in the College of Veterinary and Animal Sciences, Mannuthy. Nutrient requirements expressed per unit of metabolic body size (body weight in kg<sup>0.73</sup>) and are given below.

Sl.No.	Type of animal	DM (g)	DCP (g)	TDN (g)	DE kcal	ME kcal	Calcium(g)
1.	Maintenance-adult (2500-6000 kg)	108	6	58	278	237	0.5
2.	Young growing elephants (500 to 3500 kg)	142	7	70	335	279	0.6

It was reported that when palm leaves are fed as the sole feed for adult elephants, they are likely to suffer from phosphorus deficiency. Phosphorus must be supplemented at the rate of 30 g and 60 g, respectively, for the young and adult elephants. It was also reported that the

vitamin B<sub>12</sub> content of elephant blood was 16.94 and 18.05 microgram/100 ml for the young and adult elephants, respectively.

Mineral requirements of elephants were also found to be similar to that of horses. Calcium requirement for tusk growth was found to be 8 to 9 g and that for lactating



cow elephant, 60 g per day. Elephants prefer sodium rich water and soil.

Black Rhino and elephants under captivity have higher vitamin E requirement and elephants deficient in vitamin E developed cardiac lesions similar to Mulberry heart disease. Under natural habitat of these animals, they are continuous feeders and bile is continuously getting mixed with the feed while under captivity, they are fed as meals and thus require more quantity of bile in short period of time. Insufficiency of bile due to the absence of gall bladder reduces the digestion and absorption of fat and fat-soluble vitamins in these animals. Because of this, water soluble vitamin E preparations are better absorbed than the fat-soluble forms (Papas *et al.*, 1991). Rapid degradation of unsaturated fatty acids occurs in stored feed. Thus elephants and Rhino under captivity have higher requirements of vitamin E (Dierenfeld, 1994).

#### ***Feeding of orphan elephant calves***

The composition of the milk of Asian and African elephants as reported by Robbins (1983) is given below.

Type of elephant	Water (%)	Fat (%)	Protein (%)	Sugar (%)	Ash (%)	Energy (kcal/g)
African	82	5.0	4.0	5.3	0.7	0.88
Asian	82.3	7.3	4.5	5.2	0.6	1.12

Fat droplets in elephant milk are smaller than that of cow's milk. Feeding of cow's milk to elephant calves below one month of age develop severe diarrhoea and even end up in death. Hence diluted cows milk (1:1)

#### ***Feeding schedule of working elephants suggested by Ananthasubramaniam (1979)***

Roughage (palm leaves, coconut leaves, bamboo leaves, grass, etc.)		
Concentrate	-	150-200 kg
Horse gram	-	5 kg
Ragi	-	7 kg
Rice	-	3 kg
Min. mixture	-	100 g
Jaggery	-	50 g
Drinking water	-	average 250 litre

#### ***Proposed feeding schedule of elephants in the different zoos of Kerala (Yalakki, 2001)***

Cooked rice	-	6 kg
Coconut leaves/ palm leaves	-	100 kg
Grass	-	50 kg
Salt	-	100 g
Plantain	-	3 kg
Banana	-	2 kg
Sugar cane	-	5 kg/week
Jaggery	-	2 kg
Asafoetida	-	100 g/month

along with added vitamin C should be fed at intervals of 2 to 3 hours, for a total of 4 to 5 litres a day. A grain mixture is usually recommended after 6 months of age. A mixture of diluted milk, fine ragi powder,

glucose, vitamin and mineral is found to be useful. Another mixture containing milk powder-50 g, cooked rice-500 g, sugar-200 g and water-8.5 litres is also recommended.

Fatty acid of elephant milk fat comprised of capric and lauric acids (82%) while in cow's milk, palmitic and oleic acids are the predominating acids. By the end of the first month, undiluted milk can be given with the saturated fatty acids. Maximum daily milk intake will be at about 9 months of age and the consumption is 20 litres per day. Weaning at the age of one year is done by adding cereals into the milk and gradually introducing them to the natural browses and hay.

Healthy calves gain approximately 31 kilograms/month during their first year of life.

#### Standard rations for young calves

Feeds	6 months- 1 year	1-3 years	3-6 years
Ragi	4 kg	4 kg	6 kg
Horse-gram	-	1 kg	1 kg
Salt	30 g	50 g	50 g
Jaggery	100 g	100 g	200 g
Green fodder	15-25 kg	25-50 kg	50-90 kg

## FEEDING AND MANAGEMENT OF CAPTIVE ASIAN ELEPHANTS

*E.K. Easwaran*

The feeding and management of the largest land mammal, the elephant, is a bit difficult task as its requirements are complex.

### **Feeding**

The trunk or the proboscis is the prehensile organ. The dental formula is (I 1/0; C 0/0; M 6/6). The incisors in the upper jaw are modified into the tusks in male and tushes in female. There will be only one set of molars in the buccal cavity at any one time. Molar progression and replacement will take place five times in the life span of elephant; hence the total molars are 24 in numbers. The elephant is a simple stomach animal with a digestive system similar to horse. The stomach is a simple cylindrical sac situated on the left side and can hold up to 200 to 300 kg. of food. The length of small intestine is about 65-75 feet; the large intestine is about 35-45 feet; the caecum is about 3-5 feet and the rectum is about 8-13 feet. The caecum has three taeniae (muscular bands) and is the main chamber for cellulose digestion through anaerobic fermentation. The majority of digestion takes place in the caecum and anterior part of small intestine. The flexures in large intestine are the site of constipation and colic. The liver is devoid of gall bladder. The dung takes the spherical form in the posterior aspect of large intestine. A healthy elephant passes 5-8 dung boli 15-20 times a day. Approximately an elephant requires roughages of about 5 per cent of its body weight and 200-250 liters of good drinking water every day.

Elephants are continuous feeders under natural habitat and spend on an average 20 hours for feeding every day. Compared to the body size, the digestive system is short and is adapted to this continuous feeding habit. The continuous feeding is essential since the efficiency of digestive system is low and food is retained only for a shorter time in the gastro-intestinal tract. Elephants eat a large variety of plant materials. They have a rhythmic pattern of eating. In addition they also eat soil rich in minerals.

The prehensile organs are the proboscis, mouth and lower lip. They also use the tusk and forelegs to procure and dress the food materials. The teeth have a specialized and complex structure that allows it to tear the toughest plants and other food materials.

The food residue begins to pass out of the body through the intestine tract of elephants in 24 hours time and completely passes out in 50 hours of time. The food is mixed with copious amounts of saliva to soften the coarse food and for easy passage through the stomach. Seventy per cent of the contents are present in the caecum where anaerobic microorganisms and fungi break down the plant nutrients to volatile fatty acids. The ratio of acetate, propionate and butyrate is estimated as 75:12:10 respectively.

The dry matter digestibility of Asian elephant is estimated to be 45.8 to 51.5 per cent; Crude fiber and crude protein

digestibility is about 18.5 per cent in captive animals. Free ranging animals digest diet to a greater degree than the captive animals.

Captive animals fed on palm leaves alone are deficient in phosphorus and must be supplemented with 30-60 g/day for young and adult animals. Calcium requirement for tusk growth was found to be 8-9 g/day and for lactating cow 60 g/day. Elephants have a high affinity to sodium rich water and soil. Also Vitamin E is critical as the deficiency can lead to cardiac lesions similar to mulberry heart diseases. In captivity Vit. E and other vitamins are to be provided.

The concentrated feed in the ration should be cooked well and fed in the morning and evening in equal quantities. Also feed should be given before taking them for work. So also feed should be given only after bathing if animal is given a bath. The animals can be fed with cut fodder comprised of Caryotta palm leaves and Coconut palm leaves. Enough resting time should be provided for eating. Elephant should not be made to drink water immediately after work. Improper feeding habits can lead to impaction of intestine, which may be lethal at times. The feeding schedule of forest camp elephants are as follows.

Item	Below 3 months	3 to 6 months	6 to 12 months	1 to 2 years	2 to 4 years	4 to 7 years	7 to 12 years	12 to 20 years	Above 20 years			
									During rest		During work	
Milk	10 litres								Male	Female	Male	Female
Ragi	2 kg. of Ragitone		4 kg	3 kg	3 kg	4 kg	6 kg	6 kg	2 kg	2 kg	7 kg	6 kg
Horse Gram	—	—		1 kg	2 kg	2 kg	3 kg	4 kg	2 kg	1 kg	5 kg	4 kg
Wheat/Rice	1 kg. High quality wheat			1 kg	2 kg	2 kg	3 kg	3 kg	2 kg	1 kg	3 kg	3 kg
Common Salt	10 g	15 g	20 g	50 g	50 g	100 g	100 g	100 g	100 g	100 gm	100 g	100 g
Mineral Mixtures	20 g	25 g	25 g	50 g	75 g	100 g	100 g	100 g	100 g	100 g	100 g	100 g
Jaggery	500 g	500 g	250 g	200 g	100 g	100 g	50 g	50 g	50 g	50 g	50 g	50 g
Green Fodder (Coconut leaves/palm leaves)	—	5 kg green grass	10 kg green grass	50 kg	100 kg	150 kg	200 kg	250 kg	250 kg	250 kg	250 kg	250 kg
Glucose	500 g	250 g	—	—	—	—	—	—				
Complan	100 g/day in two doses											
Coconut milk	Obtained from 2 medium sized coconuts			—	—	—	—	—				
Ashta-choomam	50 g four days in a week				—	—	—	—				
Potable water	<i>Ad libitum</i>											

### Feeding of orphan calves

The dietary requirements of newborn calves are very difficult to meet. The elephant milk is more similar to human milk in composition. The fat droplets in elephant's milk are smaller than cow's milk. Many calves will not tolerate cow's milk especially those below one month of age. They develop diarrhoea and may die. Atmost cleanliness is required throughout the preparation and feeding of diet. A rice-based formula is given below.

1. Whole milk powder : 500 g
2. Cooked brown rice : 500 g
3. Sucrose : 200 g
4. Water : 8.5 l
5. Bone meal at the rate of 825 mg/100g is to be added for Ca and P supplementation.

Other vitamins and mineral supplements should also be given. Another preparation called Enfamil can also be given especially to cow's milk in tolerant calves but is not available in Kerala state.

Fatty acids of elephant milk to the extent of 82per cent is comprised of capric and lauric acid. Cow's milk is predominant with palmitic and oleic acid. Coconut oil is rich in capric acid. Hence supplementation with

coconut oil or coconut milk is very useful. Supplementation with Vit. B complex, Vit. E and Vit. C is also of great value.

### Management

The major components are management of young animals, adult animals, working animals, animals in pregnancy and males in musth.

The companionship of very affectionate mahouts/attendants, who can virtually give the psychological comfort offered by the mother is the key point in nursing an elephant calf. This is also highly essential to impart the discipline in calves other wise later they become highly disobedient.

Each elephant should be provided with at least two experienced mahouts. Calves should be given special attention not to develop vices and unhealthy temperament.

Skin has few sweat glands hence the heat tolerance is poor. The simple stomach, poor digestibility and absence of gall bladder necessitate the animal for continuous feeding. Thus they need long periods for feeding. They cannot carry very heavy loads but can pull considerable weight. The management regime should take into consideration all these aspects.

### Housing

The following floor space is to be provided

<i>Category</i>	<i>Minimum floor area</i>
Weaned calf (height below 1.50 m)	5m x 2.5m
Sub-adult elephant (height 1.50m to 2.25m)	7m x 3.5m
Cow elephant with un-weaned calf	9m x 5m
Adult elephant (height above 2.25m)	9m x 5m

1. They must be provided with a stable (tethering place) in a clean and healthy environment with sufficient shade to keep them cool during rest period.
2. Elephant should not be made to stand on ground contaminated with urine and filth. Proper arrangements for drainage of water, removal of excreta, leftover food items and residual water are necessary
3. Also very careful housing with soft and clean bedding is required for the calves.

#### Work schedule

The workload should be based on the nature of work and age of the animal. The animals should be put to work only during the cool hours of the day.

The following scale of loads (Gears, riders and materials all included) is suggested for elephants of different heights

#### Load carrying

Height of elephant	Load permitted
Below 1.50 m	Not to be used for carrying load
1.50 m to 1.80 m	Not exceeding 150 kg. (to carry only fodder and trainer)
1.80 m to 2.25 m	Not exceeding 200 kg.
2.25 m to 2.55 m	Not exceeding 300 kg.
Above 2.55 m	Not exceeding 400 kg.

In hilly or otherwise difficult terrain, the load limits as suggested above may be reduced to 50 per cent.

#### Timber - hauling

1. Elephants of height below 2.10 m should not be deployed for logging operations.
2. Elephants of height from 2.10 m to 2.25 m should not be used for dragging timber logs exceeding 750 kg in weight.
3. Elephants should not be engaged for dragging logs exceeding 1000 kg in weight.

#### Norms and standards for transportation

1. Elephant should be properly fed and given

water before loading. Sufficient fodder should be carried for the journey. Watering arrangement *en route* should be made.

2. Trucks with length less than 12 feet should not be used for carrying elephants except calves (height below 1.50 m).
3. One truck should not be used to carry more than two weaned calves (height below 1.50 m) or one cow elephant with one un-weaned calf or one adult/sub-adult elephant (height above 1.50 m).
4. At least 12-hour rest should be given to elephants for every 12 hours of journey by trucks.
5. Cow elephants in advanced stage of pregnancy should not be transported by trucks.

6. Each truck wagon carrying elephant should have at least two attendant mahouts.
7. Sedatives as prescribed by a qualified veterinary doctor may be used to control nervous or temperamental elephants.
8. Animal should not be made to walk continuously for more than three hours.
9. Animal should not be made to walk for more than 30 km a day and any transportation for more than 50 km should be carried out in a vehicle.

### **Training**

The elephants are imparted with various trainings according to their age. The training will be initiated as soon as the animal is received. Training for obedience, moving to left, right and for placing the feet firmly on ground are taught in the kraal. Then animal will be taken out from the kraal, initially with the help of *Koonkie* elephants if required and the other tasks such as bathing in river, walking along the roads, carrying fodder, timber hauling works, standing in processions etc. are taught. The whole training may take 1 to 2 years. Training for timber hauling and standing in processions should be taught once the animal is above 1.80 m in height (approximately after 5 years.)

### **Musth**

Musth is a physiological phenomenon seen in healthy bull elephants. The temporal gland, an apocrine gland, will engorge and a peculiar fluid will ooze out from the gland on to the face. At about 15 years of age elephants show a type of musth known as 'Moda' musth where the secretion resembles the honey. Invariably the musth is observed in the same time every year and the duration may extend to 2-3 months. The elephant may be reluctant to take feed and water. Succulent feeds must be given during this period. Plenty of water should be provided for drinking and water should be sprayed over the body to cool the animal. Animal may be highly aggressive and disobedient and hence should not be untied from the tethering site.

### **Veterinary care**

Proper veterinary care should be provided through a registered veterinarian. Timely vaccination, deworming and treatment of ailments is highly essential.

### **Retirement of elephants**

An elephant will normally retire from its work on attaining the age of 65 years. Healthy elephants above this age may be allowed to put to light works.

## ELEPHANTS AND WORK

*P.C. Saseendran, K.S. Anil, Anilkumar Nair and A. Prasad*

In Kerala, out of the estimated 800 captive animals, about 250 are with temple trusts and others are with private owners. Most of these private owners make up the cost of maintaining the animal by lending them for festivals and interestingly this season is over by the first quarter of every year. Another lucrative source of income is leasing the animals for work in forest for tree felling operations and also for timber hauling operations in timber mills. Presently due to environmental protection strictures, tree felling and auction in forest have almost come to a standstill. Hence elephants are mainly put to work in timber mills.

The Department of Livestock Production Management, College of Veterinary and Animal Sciences, Mannuthy took up some studies to assess the work efficiency of elephants in timber mills. The working period in timber mills is from 8.30 am. to 4.30 pm. Maximum work (34%) occurred during 8.30 to 9.30 am. and minimum work during 12.30 to 2.30 pm. Types of work

in timber mills can be classified as hauling, carrying and moving. Hauling is the method of dragging timber using 'vakka' attached to the log by means of a chain on one end and the other end of which is held by the elephant between its upper and lower molars. During carrying, logs of smaller magnitude are carried on the tusks or by the trunk and at no point the log touches the ground. While moving, the elephants used its forehead, trunk and limbs to move the log for short distances especially during stalking. An animal in work was found to spend 55 per cent of its working time for hauling, 41 per cent for carrying and the rest in stalking.

The elephants were carrying only smaller logs on their tusks. Mean weight of the log carried was 450 kg, which worked out to be 9.6 per cent animals body weight. Average of the maximum weight carried by the elephants was estimated as 1100 kg equivalent to 23 per cent of its body weight. The average weight of log during stalking was less when compared to carrying.



*Fig.1. Elephant involved in timber hauling*



Draught developed by the animal during hauling was measured by a special instrument called elephant draught power monitor. The average draught developed during hauling was 1,800 kg (38%). Maximum weight hauled by the animal ranged between 9,000 to 10,000 kg which comes to 188 per cent of the body weight. Average horse-power developed during carrying and hauling was 7–7.5. The speed of the animal during work was 1.2 mps, which gradually declined as the work progressed.

Physiological parameters like body temperature, pulse rate and respiration rate showed definite changes during work. The change was also influenced by the environmental factors like solar radiation and ambient temperature. Monitoring of physiological parameters during rest days revealed that there was an average 0.84 degree Fahrenheit increase in body temperature from 8.30 am. – 1.30 pm. even when the elephants were kept in shady places with out work. Corresponding increase in respiration and pulse were also recorded.

Increases in physiological parameters are in congruence with the duration of work and amount of work done. In a simulating type of work 10, 20 and 30 per cent of the body weight was made to haul by the animal. At 10 per cent of the body weight even after

3 hours of continuous work the animal did not exhibit any stress signs. Where as for 20 and 30 per cent draft the fatigue signs were shown by the end of 2 hours of work onwards.

Signs of stress includes reluctance to move, refusal to obey mahout's commands and in later stages incoordination of leg movements. Frequency of urination also increases. Towards the later stage of work there will be continuous appearance of tears from the eyes. Another sign is increase in spraying of saliva by trunk on its body. Maximum frequency of spraying of saliva observed was 2/minute and the maximum frequency of fanning of ears was found to be 45/minute.

Based on the above observations and other findings, a fatigue scorecard for elephants in work has been developed. A score of one was given for every unit increase of pulse and respiration from the normal level at the end of each hour of work. In case of body temperature a score of one was given for every 0.1 unit increase in rectal temperature from the normal level. With respect to speed, for every unit of reduction of speed at the end of each hour of work from the normal a score of one was allotted. Animals attaining a score of 15 were found to be fatigued.

## MUSTH: OBSERVATIONS BASED ON STUDIES ON 140 ELEPHANTS IN KERALA OVER 10 YEARS

*K. Radhakrishnan*

An investigation was carried out on 140 elephants over a period of 10 years to understand musth in elephants. It was observed that musth occurred mostly in well nourished elephants, between the age group of 21-80 years. "Moda" or juvenile musth was observed in 11 elephants in the age group of 15-20 years. The duration was usually three months but there was an exceptional case of 5 five months duration in one male. Musth occurs mostly in the cold season, the month of December. Based on behavioural manifestations, the musth period is divided into three phases; pre-musth, violent musth and post-musth.

### **Some behavioural patterns and precautionary measures**

A cruel look appears on the elephant's face, with the eyeballs rolling when somebody approaches it. The body becomes taut and tightly stretched and the trunk is extended forwards. There is a tendency to attack strangers and mahouts.

The musth elephants pull at their chains and fiddle around with it as if trying to remove them. Hence the chains must be stronger and old ones must be replaced with good and strong ones. An ideal distance of two feet must exist between the tree and the elephant, while teathering.

Some elephants exhibit a tendency to fiddle with a particular loop. The mahouts must anticipate and know before hand and should have spare chains in hand. Usually a circular loop called the "*Thirukanni*" is found

on the chain which allows the chain to twist without being broken. This must be checked for any damage.

During musth, elephants are chained at the same spot until the intensity of the phase subsides and they become approachable. During such times it is likely that the elephant may get chain sores. To prevent this one must use a long stick to hold up the chains or shift their position from a distance at regular intervals.

It is always wise to double check the chains and prepare them in advance for musth.

### **I. Symptoms of pre-musth**

Engorgement of temporal glands.

Discharge is observed at the temporal gland openings. This initial discharge is not the actual musth fluid and is a dirty brown coloured, viscous fluid with a strong smell. Sometimes this fluid itself may block the opening due to its viscous nature or the opening may be too small and the flow is obstructed. This is very uncomfortable to the elephant and it starts to scratch the area with its trunk using twigs and other sharp objects. They may hurt this area and cause abscessation. This is a very serious condition leading to obstruction of the duct which further necessitate surgical intervention. To prevent this condition one may aid the flow on noticing the symptoms by squeezing out the fluid.

The perineal region, below the tail and

anus enlarges. This is an important symptom. This is the area where the penis of the elephant is located.

The penis will enlarge and the elephant will exhibit tendency to masturbate. The penis strikes against the belly of the elephant and the elephant may ejaculate. Sometimes the penis becomes so big that it trails on the ground. The mahouts then hold it up with a cloth to prevent trauma.

There is a tendency to gore during musth. The third mahout must be warned by the senior mahout of the danger of this condition and must be careful while approaching the elephant. There is an intense feeling of vengeance towards mahouts.

## II. Violent musth

### *Initial phase of violent musth*

The secretion of the temporal fluid is slow and is more viscous. Penis is partially relaxed. Semen discharge is less or nil. Behaviour is unruly and it does not obey commands. Will react violently even to the voice of the mahout. The body is stretched and taut and stiff. The trunk is extended forward as if reaching out for something. The ears are spread out as if listening intently to sounds.

### *Middle phase of violent musth*

The temporal fluid flows very fast (like tear drops) and has a pungent odour like that

of gun powder and can be felt even from long distances.

Some elephants may have a red mark around the temporal region. The behaviour is more aggressive and the trunk is beaten on the ground as an indication of discontent and anger. Tendency to pull more violently at chains and tethers. No desire to eat or drink., i.e., lack of appetite. Some owners try to offer it more palatable food like banana and curd rice during these times.

### *Final phase of violent musth*

This phase may last for a month. The glands became less in size thus subsiding the flow of liquid. Starts urinating normally, by erecting penis. The nature of the animal becomes less aggressive and violent. It may even start obeying commands.

## III. Post-musth

This is the final stage of musth. The gland is completely deflated and flow stops completely. Urination is normal. The behaviour reverts to normal. Yet one must be careful and the elephant must always have some sort of restraining chain around one of the legs while being moved around.

The musth can begin manifesting in a male any time after 15 years of age, i.e., after it has attained puberty.



*Fig.2. An elephant in musth*

## USE OF ANTIANDROGEN IN CONTROLLING MUSTH IN CAPTIVE ELEPHANTS

*K. Chandrasekharan and Jacob V. Cheeran*

Adult male Asian elephants and both sexes of African elephants manifest annually a physiological, behavioural phenomenon known as musth. This condition is characterized by enlargement of temporal glands with copious flow of secretion and aggressive episodes. The main manifestations are spreading of ears, alertness, fully opened ogling eyes with roving eye balls, stiff and tense body, extended blowing trunk and a charging or destructing tendency towards human beings especially mahouts. This condition is mostly seen during winter season and the elephant is to be tethered safely by putting chains on both front and hind legs. The symptoms and behavioural changes of musth usually last for one to three months or some time up to five months and their intensity varies in pre-musth, violent musth and post-musth phases (Jainudeen *et al.*, 1972 and Chandrasekharan *et al.*, 1989). The androgen level in the blood usually increases considerably during the period of musth and it is stated to be the reason for the increased aggressive behaviour in musth elephants (Jainudeen *et al.*, 1972; Rasmussen *et al.*, 1984; Cooper *et al.*, 1990 and Niemuller and Liptrap, 1991). Based on this hypothesis, a trial with the oral administration of an antiandrogen, a sedative and diuretic was undertaken in elephants under pre-musth and in the last phase of violent musth in order to make them more tractable and can be put to use and the results are furnished in this paper.

### Materials and method

During the present study, 22 captive elephants showing different phases of musth, maintained by private individuals and Devaswoms in different parts of Kerala were selected. The age of the elephants varied from 25 to 65 years. Nineteen elephants were in the pre-musth phase showing reluctance to obey the commands of mahouts, slight engorgement of temporal glands with small quantity of discharge at the temporal opening, enlargement at the phase of violent musth showed slight regression of the temporal glands with flowing discharge, dribbling urination and charging tendency against mahouts. Flutamide (Drogenil 250mg Tab., Fulford (India) Ltd., Bombay) is a potent non-steroidal antiandrogen, haloperidol (Serenace 10 mg tab, Seane (India) Ltd., Bombay) a sedative and potassium iodide a diuretic were powdered, concealed with in jaggery bolus and administered orally to each elephant. Flutamide @ 2500 mg, 5000 mg and 7500 mg was administered to five, ten and four elephants respectively during their pre musth phase and @ 5000 mg to three elephants during the last phase of musth once daily continuously for three days. Haloperidol @ 100 mg and pot. iodide @ 20 gm per animal were also administered to all the 22 elephants.

The change in the behaviour and other symptoms of musth were observed for a period of two months and all the elephants were provided with sufficient quantity of

palm leaves and water. The elephants in pre-musth phase were engaged for usual work but during last phase of musth they were under full restraints.

## Results and discussion

### *Elephants in pre-musth*

The enlargement of temporal glands, tendency to masturbate and swelling at the base of the penis have reduced considerably in two elephants from three days onwards following administration of flutamide @ 2500 mg/animal. All these two elephants came into musth after 30 days and lasted for three months but with reduced aggressiveness. Other three elephants started showing musth symptoms on the 15<sup>th</sup>, 20<sup>th</sup> and 25<sup>th</sup> day following the treatment with all its characteristic musth symptoms.

Out of the ten elephants received flutamide @ 5000 mg, seven elephants showed reduced musth symptoms from the second day onwards and came into musth after 45 to 60 days and lasted for two to three months with less aggressiveness. Other three elephants in the group failed to show musth symptoms during the stipulated period but came into musth as usual during subsequent season.

All the four elephants dosed with flutamide @ 7500 mg did not show musth symptoms in the stipulated time and were normal in behaviour. They came into musth in next season as usual.

### *Elephants in the last phase of musth*

All the three elephants, administered flutamide @ 5000 mg started to show reduction of all the musth symptoms from the second day onwards and became normal in behaviour and activities. They were released from the tethering site on the 5<sup>th</sup>, 7<sup>th</sup> and 10<sup>th</sup> day and were used for routine festival parade and work.

Flutamide was absorbed rapidly after administration and gets converted into 2-hydroxy flutamide before action (Neri, 1976). It was found to cause regression of androgen target tissues such as prostate and seminal vesicle in rats (Marchetti and Labrie, 1988 and Chandolia *et al.*, 1991) and improvement in clinical symptoms in prostate cancer patients (Aso *et al.*, 1993) by binding the androgen receptor and thereby blocking the androgenic action (Sogant *et al.*, 1975 and Beland *et al.*, 1990).

During the present study the reduction in the aggressive behaviour and other musth symptoms observed in the treated elephants may be due to the reduction in the concentration of testosterone level in the blood. This also supports the observations of Jainudeen *et al.* (1972), Rasmussen *et al.* (1984), Cooper *et al.* (1990) and Niemuller and Liptrap (1991) in respect of the aggressiveness and high level of testosterone during musth in elephants. It also confirms the finding of Flanagan and Flanagan (1983) of reduced aggressiveness observed in a castrated bull elephant. The initial daily dose of flutamide @ 2500 mg/elephant is not found to be sufficient to reduce aggressive behaviour in pre-musth phase. The drug is well tolerated and does not prevent the occurrence of musth during the subsequent seasons.

## Summary

A combination of flutamide @ 5000 mg and 7500 mg haloperidole @ 100 mg and potassium iodide @ 20 per elephant administered orally once in daily for a continuous period of three days is found to be very effective in controlling aggressive behaviour and other musth symptoms in captive elephants during their pre-musth and in the last phase of violent musth. The drugs are well tolerated.

## ELEPHANT STATUS, STRESS AND MUSTH

*P.C. Saseendran and K.S. Anil*

India has got unique place in the Asian elephant conservation considering the fact that one half of the Asian elephant population (20000) is seen in this part of the world. Kerala is the southern most state of India which lies at the western coast of the Indian peninsula at 10°30'N 76°24'E. The state has 3.88 million ha<sup>2</sup> area in which 1.12 million ha<sup>2</sup> is under the forest. The two national parks and 12 sanctuaries of the state covered 2312 km<sup>2</sup> comprising 24.6 per cent of the total forest land and 5.9 per cent of the total land area of the state. The forest cover of Kerala is 29 per cent of the land area of the state and 1.26 per cent land area of the nation. Half of the South Indian population of wild Asian elephants are in this small state having one of the heaviest population density of 880/m<sup>2</sup>, among Indian states.

Kerala has long history of elephant culture and tribal populations are coexisting with the wild fauna including the elephants without encroaching into their habitats. Conflicts were occurred when the settlers encroached to the wild animal's habitats and started cultivation in and around it. Conflicts were grouped into crop damage, death of humans or elephants, injury to the people and killing of the domestic animals. Among the wild animals, elephants have done maximum damage to the crop. The damage to the crop ranged from 0-55 per cent and the average was 20 per cent. Death of men and elephants have occurred in the conflict. During the 1985 to 1993 period, 30 human casualties were reported in Kerala, of which twenty-seven deaths were due to herd and three due to solitary tuskers. During 1994 to 2003 period,

67 human beings lost their lives due to elephants, in which 62 were due to herds.

In India captive elephant population is 15 per cent of the total population (Sukumar, 1989). Kerala has more than 30 per cent elephants as captive population. The spurt of captive population from 250 in 1983 to 612 in 2000 (Bist *et al.*, 2001) in Kerala has occurred inspite of the existing ban on elephant capture in Kerala. Due to afforestation programme and log felling ban in the northeastern states of India, elephants has become no longer remunerative to the owners. The surplus elephants found their way to Kerala where they are used for ceremonious purposes. Relationship between elephants and humans were that of respect and reverence. Conflict in captivity has occurred when the elephants were ill treated by the inexperienced mahouts or taken for work at musth stages. Annually nine mahouts are loosing their life in the conflict.

### **Stress**

Stress is an adaptive phenomenon, considered as cumulative response of an animal resulting from interaction with its environment via receptors.

### **Stressor**

A stress-producing factor; any stimulus that elicits a nonspecific response when perceived by an organism. Stressors can be classified as somatic, psychological, behavioural and miscellaneous stressors.

1. Somatic stressors: Stressors that may act during restraint and handling procedures include strange sounds, sights, odors, etc.

In elephants this occur starting from displacing it from the forest to the captivity. This includes the change of the place, taking them to the unfamiliar surroundings and to festivals, the crowd, fireworks and even tranquilisation for controlling the unruly one act as somatic stressors.

2. Psychological stressors: Act intensely on the higher primates, including man. eg. Apprehension, anxiety, fright, terror, frustration and dangerous non-specific reactions.

As the elephants are more intelligent than many other animals apprehension on the house breaking schedules, long period of confinement, lack of freedom of expression all make the elephant frustrated.

3. Behavioural stressors: Closely allied to restraint stressors are the many behavioural stressors, that act prior to actual restraint or are experienced following restraint, such as unfamiliar surroundings, over crowding, territorial and hierarchical upsets, upset biological rhythms, lack of social contact or, conversely, lack of isolation and lack of habitual of imprinted foods.
4. Miscellaneous stressors: Include malnutrition, toxins, parasites, infectious agents, burns, surgery, drugs, chemical and physical immobilisation and confinement.

These stressors may act over a long period, contributing to the exhaustion of general adaptation systems. Fatal adrenal shock may be triggered if an animal in an imminent exhaustion phase is subjected to a restraint procedure that overtaxes the already depleted body reserves. Usually, when the stimulation is of short duration, the animal adjusts without any harm. Domestic animals seldom suffer serious adverse effects. However, certain wild species may injure themselves during the alarm phase or pass quickly into fatal shock.

### Specific response

The response by an organism that is appropriate for the stimulated receptor is controlled by voluntary motor pathway and sympathetic nervous system.

The stimulus eliciting a voluntary motor response may be initiated peripherally or internally. The impulse is relayed to the thalamus and on to the neocortex, where it is categorized and integrated for transmission to motor areas, which relay the information back through the lower brain centers, through the spinal cord and thence to the peripheral nerves. Response of the voluntary motor system may include avoidance, struggling, escape attempts, running, hiding, defensive or protective postures, vocalization and aggressive behaviour. In general, animals respond in a manner characteristic of the species when placed in a crisis situation. Restraint practices must be adapted to minimize or counter the injurious effects of such responses on both the animal and the restrainer.

Stimulation of the sympathetic nervous system and the adrenal medulla results in the flight-or-fight reaction or, as described by Seyle, the alarm reaction. The major medical problem associated with the alarm reaction is trauma to the animals as it seeks to escape. Contusions, concussions, lacerations, nerve injuries, hematomas and fractures are common sequel to injudicious restraint practices. The alarm response changes the body's reaction to many drugs, including some commonly used for chemical restraint. These restraint agents are potentially lethal unless used with wisdom and understanding.

In elephants the damage caused by the aggressive elephants to the life and property is getting elephantine publicity. It needs event war analysis of the specific stressors to devise counter measures to prevent the recurrence.

### Non-specific response

Produced by the hypothalamic adeno-hypophyseal adrenal pathway (HAAP). Continuous stimulation of the adrenal cortex and the subsequent excess production of cortisol elicit many adverse metabolic responses and resultant biochemical and endocrine changes.

Clinical signs may include muscle weakness and trembling, bilaterally symmetrical alopecia, atrophy of temporal muscles, enlarged abdomen, weight loss, increased susceptibility to bacterial infections, impaired antibody response, vaccination failure, high blood pressure, poor wound healing, frequent urination and high consumption of water.

Physiological adaptation: The development of qualitatively new protective processes.

Exhaustion: The failure of a physiological adaptive mechanism.

### Measurement of stress and welfare

#### 1. Hands-on studies

Blood sampling, invasive monitoring e.g. ECG, X-ray, scanning etc. come under the hands on studies.

#### 2. Hands-off studies

Hands-off studies include monitoring of the animal, environment and its behaviour to it. Basic concept of the stress and welfare is based up on the "Five Freedoms". "An animal should at least have sufficient freedom of movement to turn around, groom itself, get up, lie down and stretch its limbs."

1. Freedom from thirst, hunger and malnutrition by ready access to fresh water and a diet to maintain full health and vigour.
2. Freedom from discomfort by providing a suitable environment, including shelter and a comfortable resting area.
3. Freedom from pain, injury, and disease by prevention or rapid diagnosis and treatment.

4. Freedom to express normal behaviour by providing sufficient space, proper facilities and company of the animal's own kind.
5. Freedom from fear and distress by ensuring conditions that avoid mental suffering.

### Stressfull conditions of elephants

#### Musth

Male elephants in captivity or wild state show periodically the phenomenon of musth which is characterized by engorgement of temporal gland and discharge, excessive bulging at perineal region, frequent erection of penis, dribbling of urine etc. The temperament is highly unpredictable and elephants in musth will easily get provoked by slight irritation. Typical musth will be exhibited by most of the healthy males over 20-25 years of age. Annual periodicity is noticed and majority of musth occur in winter season. Proper restraint and careful handling and management are essential during the musth period.

In elephants the cortisol level was found to increase in stressful conditions of musth in parallel with the elevated testosterone.

Elephants were found to be under stress in disease conditions, when exposed to extremes of climate, walk or transport etc. The behavioural changes and cortisol levels have been noted.

The study of animal behaviour is critical to the animal welfare issues and ethology plays an important role in animal welfare. For measuring stress, development of ethogram and assay of stress hormone can be employed. In hormonal assay the latest method is by non-invasive technique. In this method assay will be done from urine or faeces. Both RIA and EIA can be employed for it. The combination of ethogram and monitoring physiological parameters especially stress hormones will serve as the effective indicator of stress level in elephants.



## CAPTIVE ELEPHANT PRACTICE - TIPS TO VETERINARIANS

*P. C. Alex and G. Ajitkumar*

Elephant being an unpredictable and massive animal, it is always advisable to take extra care while approaching and handling it. The following tips will help the practising veterinarians during detailed clinical examination of the elephant.

Collect the detailed history and try to learn the character and behavioural pattern of the elephant before starting clinical examination. Avoid approaching an elephant which is not properly restrained. Approach it in presence of the mahout. 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. Some elephants are notorious for attacking while crossing through the front side.

While approaching the hindquarters, make sure that the tail is properly secured as the elephant can beat dangerously with its tail. The limbs should be secured properly/separately with chains while performing clinical examination. Avoid standing in between the forelimbs and hind limbs when the elephant is recumbent.

While approaching the elephant, do not expose surgical instruments because previous painful experiences with the

instruments may evoke some sort of resistance or non-co-operation from the animal.

Ensure the use of analgesics/sedatives while handling painful lesions in order to maximize co-operation from the animal.

### **Points to be considered while darting a rogue elephant**

Ascertain whether the elephant is exhibiting signs of musth, as in majority of cases the animal may be in the pre-musth or post-musth period and if so take extreme care. Since the temperament of the elephant is unpredictable, it is always better to keep a safe distance/position from the elephant while approaching it.

In most of the situations in which tranquilisation is warranted, the mahout may be in an injured state or the elephant may be driving him away or chasing him. In such situations resort to the help of the owner or mahouts of other elephants who have previous experience in tackling such situations.

Always get the consent form filled in and signed by the owner or his authorized representative and get it countersigned by the local police official or officer in charge of law and order.

Estimate the body weight of the animal from a distance and prepare a dart based on it and keep it ready for use.

In some situations, the elephant may be under partial or total restraint and if the animal is trying to break the chain, take measures to reinforce it.

Get the help from the police for controlling the mob as on many occasions the elephant running amuck gets further irritated due to provocation from the public.

While approaching the animal for darting, hide the syringe projector from the animal and select a convenient and safe place to stand with the syringe projector for darting.

Darting operation during late evening hours and night should be avoided as far as possible due to obvious reasons.

It is risky to perform darting operation near water bodies and in unfavourable terrains.

If the mahout or public is sitting on the back of the elephant, extreme care should be taken to avoid hitting of the dart on them.

Once the dart hits the animal, it may run for a while usually in the forward direction and in such a situation, in order to prevent it from running long distances, suitable action may be taken.

Though the hitting of the dart on the body of the elephant can be ascertained from a safe distance, the veterinarian may not be in

a position to check whether the syringe charge has exploded and the medicine has entered the body of the elephant. Therefore after darting, he has to patiently wait for 20-30 minutes to ascertain that the medicine is acting on the body by monitoring the behavioural changes of the elephant. The classical signs of sedation are complete relaxation of the penis, standing fixed at a place, lack of movements of ears and trunk, sleepy appearance, snoring etc.

In situations wherein the elephant under sedation shows signs of over dosage such as trying to lie down with a relaxed penis, feeling very sleepy, the antidote should be used with out delay and hence always make sure the availability of the antidote whenever darting is performed.

After darting if the animal is exposed to direct sunlight for a pretty long period, translocate to a safe and shady area and tether to a strong tree.

If the elephant is not coming under control within one hour of first darting, a second dart may be tried and the dosage is determined based on the clinical assessment of the animal.

## ADMINISTRATION OF MEDICINES IN ELEPHANTS – POINTS TO PONDER

*G Ajitkumar and P.C. Alex*

As in other domestic species of animals, the routes of administration of medicines in elephants include oral and parenteral. Among parenteral routes intramuscular, intravenous and subcutaneous routes are practised in elephants. Many a times, the veterinarian may not be in a position to go near the animal for parenteral administration of medicines (eg. in musth). In such situations, darting with the help of a syringe projector becomes imperative. It is always advisable to administer drugs after proper restraint that too in presence of the mahouts.

### **Oral medication**

Forceful and compulsory oral medication is out of question in elephants for obvious reasons. Elephant being an animal with high sense of smell, it is very difficult to incorporate medicines along with foodstuffs. By offering foodstuffs which are not impregnated with the medicine initially several times, one can win the confidence of the elephant. Subsequently, the same type of foodstuff can be offered with the medicine inside. The common foodstuffs used to administer tablets/boli include cooked plain rice balls, cooked rice-jaggery balls, plain jaggery, pineapple, banana, apple, loaves of bread etc. In docile animals one may be able to ascertain whether the elephant has consumed the medicine or not. In aggressive animals we may not be in a position to make sure of the proper consumption of the medicine.

### **Intravenous route**

The 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. The ear pinna has to be washed with plenty of water and scrubbed well to remove dirt sticking on the surface. Then the ear has to be secured well by folding it anteriorly and holding at the tip. After cleaning the ear pinna, mop it dry with a towel or cotton and touch with antiseptics like Tr. Iodine or 60 per cent 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 pulsations). Sharp stainless steel needle or disposable needle (14-16 G) can be introduced into the vein. I/V canula (14-16 G) is preferred over needle. Extreme care should be taken to ensure that the medicine is properly going into the vein and not entering the peripheral areas. Ear being an organ which adds to the beauty of elephant, perivenous infiltration should be avoided to avert subsequent inflammation and puckering of pinna. After the administration, application of glycerine-magsulph paste over the area helps to relieve mild inflammation. In disease conditions which warrant regular repeated intravenous administration of fluid (eg. impaction of colon), extreme care should be taken to minimize trauma to the ear. In

cold climate, manual fanning of the ear pinna or washing the pinna with warm water helps in improving circulation to the pinna and thus engorgement of veins. Saphenous vein on the inner aspect of the hind limb can also be utilized for intravenous medication.

#### **Intramuscular route**

The thick muscled gluteal region is ideal for intramuscular injections. Since the skin of elephant is very thick (pachyderm), the needle selected for intramuscular injection should be long enough (3-4 inches) to ensure deep deposition of the drug. Short needle may result in subcutaneous passage of the drug. Since elephants are notorious for abscessation, extra care should be taken to sterilise the area before injection and to massage the area after injection. Preparations like iodine ointment may be applied over the injection site to prevent subsequent local tissue reactions. It is preferable to administer intramuscular injections in recumbent position and attention should be paid to see that the limbs are kept stretched

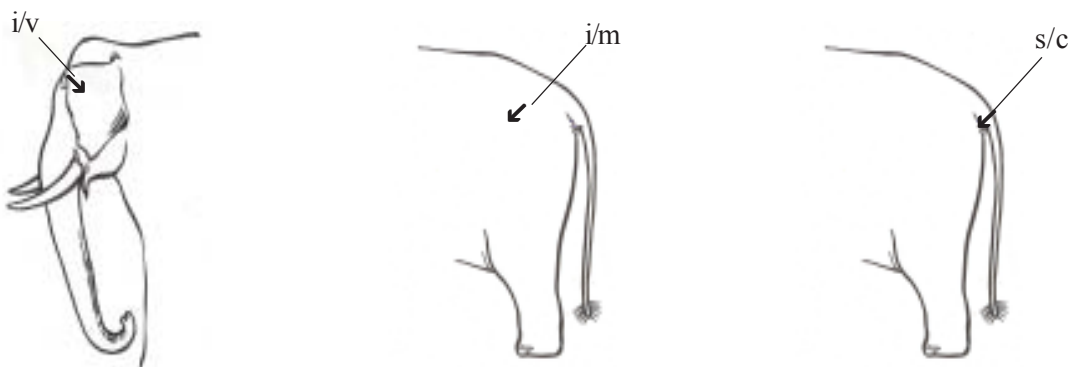
straight during the administration. Though the thigh region and shoulder region have also been identified as sites for intramuscular injections, majority of the experienced veterinarians prefer the gluteal region.

#### **Subcutaneous route**

Subcutaneous administration of medicines are not commonly practised in elephants. However, drugs like Antricide are given subcutaneously. The loose folds of skin on both sides of the base of tail (caudal fold) is the preferred site.

#### **Subconjunctival route**

The subconjunctival route of administration of drug is generally practised in conditions like corneal opacity (eg. Placentrex administration). Since the prominent third eyelid prevents access to the subconjunctival area through the palpebral fissure 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.



*Fig.1. Sites of intravenous (i/v), intramuscular (i/m) and subcutaneous (s/c) injections*

## HANDLING AND CARE OF SYRINGE PROJECTORS

*G. Ajitkumar*

The syringe projector has got many uses. Any drug that can be given with a hand syringe can be delivered with a syringe projector from a distance. The major areas in which syringe projector is utilized include handling and treatment of livestock, treatment of zoo animals and wildlife management.

Common uses of syringe projector

1. Tranquilisation to lower stress during handling, transportation, treatment, relocation (translocation) etc.
2. Humane capture of wildlife without the use of traps or nets.
3. Immobilisation to collect blood samples and other clinical materials as part of disease investigation.
4. Immobilisation of animals for putting identification marks in migratory studies.
5. Immobilisation of animals for radio-collaring and tracking.
6. For tissue and skin biopsy sampling.
7. Injection of antibiotics in disease conditions.
8. Administration of vaccines for disease prevention.

The various types of syringe projectors are short range, mid range, long range and extra long range. The short range and mid range projectors are pistol type whereas the long range and extra long range projectors are rifle type. The pistol type projectors are easier to carry, easier to shoot from the inside of vehicle, easier to hide from animal view and more convenient. The rifle type projectors

are a better choice for longer distances and many are comfortable with a rifle type than a pistol type.

Based on the power utilized for projection, two types, viz. cartridge fired projectors and CO<sub>2</sub> powered projectors are available. In cartridge fired projectors power loads are used. The power loads are available in four strengths based on the range of projection. They are very low, low, medium and high. Specific colour marks are put on the cartridge for easier identification of each type.

Syringe charge (cap-chur charge) is the one that is placed in the syringe behind the rubber plunger. One end of the syringe charge is solid and the other end is swaged. The solid end must be put into the rubber plunger for the syringe to work properly. When a syringe contacts the target animal, the syringe charge is automatically triggered and the expanding gas generated drives the rubber plunger forward, injecting the animal with the liquid carried in the syringe. Syringe charges are available in different strengths based on the capacity of syringe (eg. 1-3 ml, 4-10 ml, 15 ml).

Different types of needles are available in the market. The opening of the needle may be at the tip or at sides (side port needles). The chances of blockage of needle on entry into the body of the animal are less in case of side port needles and hence they are preferred over needles with opening at the tip. Plain needles can be used for medicating or tranquilising, but in most cases this type of needle will come out of the animal

before the medication can be completely delivered. Hence needles with a provision (barb or collar) to prevent falling off from the body of the animal are preferred over plain needles. Body weight is the most common factor when choosing needle length. Animals with thick hair and/or large amount of body fat require longer needle length than those with thin hair and/or low body fat. Intramuscular medication needs longer needle than subcutaneous medication. The most common cause of bouncing out of the syringe and bending and breaking of needle is a 'hard hit'. When the syringe impacts on an animal, the syringe charge goes off to force the drug out of the syringe and inject the medicine into the animal. A 'hard hit' occurs when the range is too close, literally causing the syringe to hit too hard. This can cause bounce out. When a bounce out occurs, it looks as if the syringe is flying side ways. This will also cause the syringe to hit the animal and fail to inject all of the medication. Hard hits are also the most common cause of bent or broken needles.

#### **Instructions for loading the syringe projector for darting an elephant**

1. Open the syringe projector, clean the barrel with a cleaning brush/cleaning rod and cotton and lubricate.
2. Select a syringe barrel (7-10 ml capacity), collar needle and tail piece and assemble.
3. Pass the syringe assembly through the barrel of the gun to ensure free movement of it inside the barrel.
4. Dismantle the syringe assembly.
5. Select a rubber plunger, lubricate it and with the help of a plastic/glass rod (positioner), push it through the inside of the syringe barrel several times to ensure free movement.
6. Bring the rubber plunger to one end of the syringe barrel with the open end of the plunger facing out (since the threads are the same on either end of the syringe barrel, it does not matter at which end the plunger is placed).
7. Place the syringe charge into the rubber plunger. The solid end of the charge is inserted into the plunger with the swaged end pointing towards the tail piece.
8. Screw the tail piece on to the syringe barrel.
9. Hold the syringe barrel with tail piece down and pour the required quantity of medicine with the help of a hand syringe in to the syringe barrel. If the medicine does not fill the syringe barrel upto bottom of the threads, finish filling with distilled water (always fill the syringe to bottom of the threads).
10. Screw the nose plug and needle on to the syringe barrel.
11. Introduce syringe assembly into the barrel of the syringe projector and push it forward a little in order to create a space just behind the syringe assembly for placing the adaptor.
12. Place the adaptor at the rear end of the barrel and insert the power load (0.22 blank) into the hole at the rear end of the adaptor (breech loading).
13. Close the projector and put the safety catch.

PS: On recovery of the syringe after darting, always remove the tail piece first to release any pressure remaining in the syringe. After each use, the projector should be cleaned well, oiled and kept in a safe moisture free and dust free cabin. The CO<sub>2</sub> powered projectors should always be stored with CO<sub>2</sub> gas in them (under pressure) to keep the seals and 'O' rings from going bad.

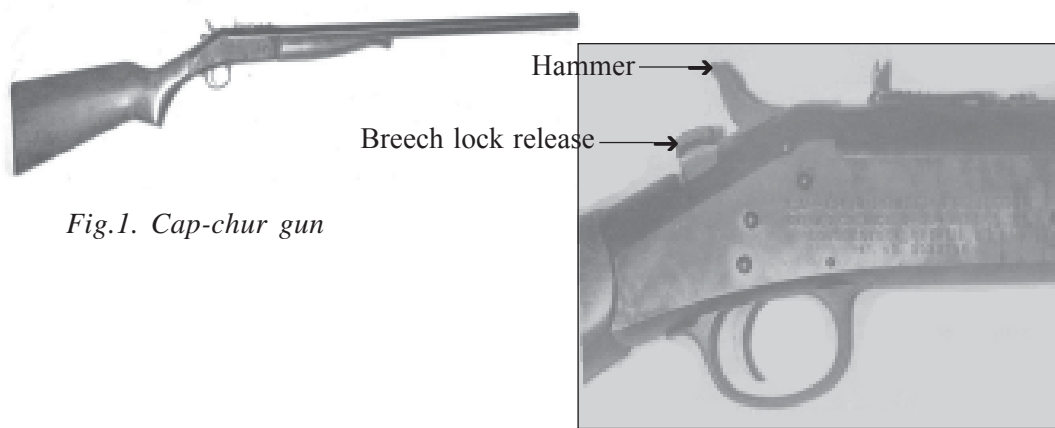


Fig.1. Cap-chur gun

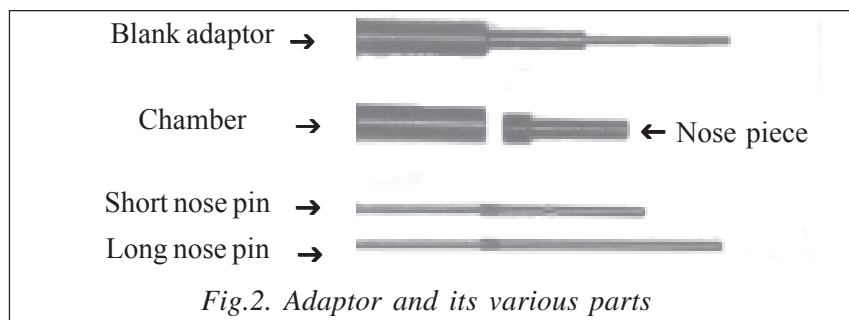


Fig.2. Adaptor and its various parts



Fig.3. Syringe charge and power load

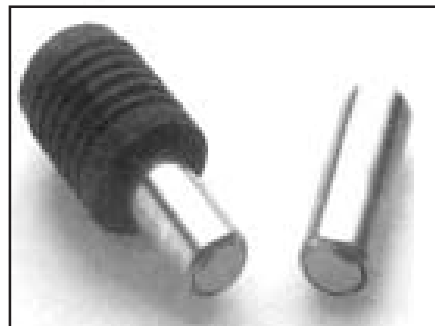


Fig.4. Plunger with syringe charge

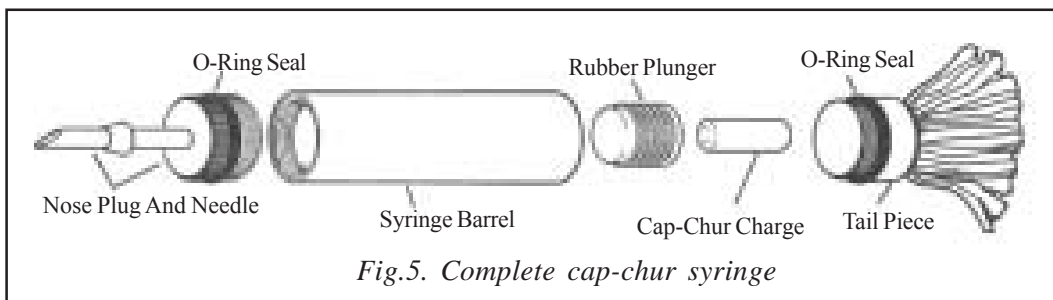


Fig.5. Complete cap-chur syringe

## PRINCIPLES AND PRACTICE OF FIXING DOSE OF DRUGS FOR ELEPHANTS

*Jacob V. Cheeran, K. Chandrasekharan and K. Radhakrishnan*

The traditional thumb rule of determining dose in domestic animals has been Dog-1, Cat – 1/2, Sheep and Goat – 3, Horse – 16, Cattle – 24. However this was valid only for galenicals like Tinctures and Pulvis and also to some extent for pure chemicals used as drugs like potassium iodide, ammonium chloride etc.

Development of modern techniques like determination of half life and minimum effective concentration changed the course and pattern of determining the dose of drugs in animals as well as in man. Some drugs which are of low therapeutic margin is, even recommended considering the surface area of the body (e.g. antineoplastic drugs).

Wild animals provide not enough number, for experimental purposes, to arrive at a proper recommendation for fixing dose of drugs. In such circumstances pharmacologists often extrapolate the dose from their 'evolutionary cousins' some of which are domestic animals. Unfortunately in elephants such 'close cousins' do not exist neither in the wild nor in the domestic category. This makes fixing of dosage all the more difficult. Hence often the dose has been arbitrarily fixed from clinical experiences.

The article details the above principles as well as lists of dose of various pharmacological and chemotherapeutic agents used in clinical practice in elephants (Table).

Elephant being a non-ruminant ungulate is comparable to the horse and pig and in computing doses also, this may be borne in mind. Being a simple stomached animal, microbial degradation of antihistaminics, glycosides and other similar active medicinal principles are very unlikely. This is an advantage in elephants for oral medication compared to cattle. Since force feeding by mouth is impossible, a lot of patience is required in oral medication. The tablets can be embedded in eatables like banana or bread. Liquid drugs can be mixed with syrup, jaggery, salt or tamarind to make it more acceptable. Its powerful olfactory sense makes the animal sniff at any new food item and reject objects with any unusual smell. Hence plantain or jaggery may be given immediately before and after the drugged bread or plantain.

Intramuscular injection can be given at the rump region making the animal to sit in a dog sitting posture. If the animal is less tractable, it may be made to lie down and hobbled. Injection can be given using 15/16 gauge needle. It should be made sure that the needle is perpendicular to the body surface. Otherwise it is likely to enter subcutaneously. The person can stand on the dorsal side with an assistant helping him by holding the tail. A ribbed or reinforced lumbar puncture/spinal needle may also be used.

Intravenous injection is given in ear veins and perivascular effusion especially of



concentrated and irritating drugs should be avoided. Concentrated solution of thiopental sodium has caused sloughing of the skin (George *et al.*, 1989). The position of the needle whether it is in the artery or vein should be carefully checked by moving the ear flap up and down and feeling for the pulse.

More than one vein can be punctured at a time and injections given. When electrolytes and parenteral alimentations are required as in the case of impaction, 20-30 litres of dextrose, vitamins and amino acids are given. If repeated injections are given on subsequent days the animal may refuse to lie down and then I.V. injection can be given in a standing position. But then the bottle will have to be hung from the branch of a tree or rafters of the building.

Most of the animals treated are adult bulls and hence the doses prescribed 'per animal' are for animals weighing 4-5 tonnes of body weight.

During sedation/anaesthesia with intramuscular agents, if the animal shows any sign of recovery  $1/3^{\text{rd}}$  of the initial dose may be given (e.g. xylazine).

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 lie down which is under severe sedation.

For ectoparasites, organophosphorus compounds (malathion, fenitrothion) synthetic pyrethroids (fenvalerate, deltamethrin) etc. are used in the same strength as recommended for cattle and horse.

Table. Dose of pharmacological and chemotherapeutic agents used in clinical practice in elephants

Sl. No.	Name of the drug	Major action	Dose	Route	Trade name	Remarks
1	2	3	4	5	6	7
1.	Acepromazine	Sedation	50-60 mg/Ton	I.M.	-	Do not expose to direct sun light for long periods (Photo-sensitization)
2.	Amino acid with sorbitol	Parenteral alimentation	100-200 ml/animal	I.V.	-	-
3.	Ampicillin	Antibacterial	10-15 g/animal	I.V.	-	-
4.	Analgin, Pitofenone, Fenipiverinium	Spasmolytic analgesic	60-90 ml	I.M.	Baralgan	Analgin 0.5, Pitofenone HCl 2 mg. Fenipiverinium bromide 0.02 mg/ml
5.	Atropine	Anticholinergic	40-50 mg/Ton	I.M.		
6.	B-Complex	Vitamin	50 ml/animal	I.V.	Polybion	B-Complex injection
7.	Calcium borogluconate	Calcium	500-900 ml/animal	I.V.		
8.	Calcium pantothenate	Peristaltic	50-70 ml/animal	I.V.		
9.	Carbachol	Cholinergic	5-10 mg/animal	I.M.		Intramuscular purgative in impaction
10.	Chloramphenico succinate	Antibacterial	10-15 g/animal i/v		Chloromycetin	

1	2	3	4	5	6	7
11.	Dexamethazone	Glucocorticoid	1-3 g/Ton			Heatstroke
12.	Diprenorphine	Morphine antagonist	2 mg – 1 mg Etorphine	I.M./I.V.	Revivon M 50-50	Used in Etorphine Immobilisation
13.	Doxapram	Analeptic	100 mg/Ton	I.M./I.V.	Dopram	Used in Xylazine sedation
14.	Ephedrine	Sympatho-mimetic	200-400 mg/animal	I.M./I.V.	-	To reverse Xylazine
15.	Etorphine	Sedative	1 mg/450 kg 6-8 mg/animal	I.M.	Immobilon	Immobilon with Acepromazine
16.	Frusemide	Diuretic	300-500 mg/animal	I.M.		
17.	Haloperidol	Sedative	40 mg/animal	Oral/I.M.		
18.	Meperidine	Sedative	750-1500 mg/Ton	I.M.		
19.	Metaclopramide	Antemetic	250-400 mg/animal	I.V.	Perinorm	
20.	Morphine	Sedative	30-60 mg/Ton	I.M.		
21.	Morphine	Analgesic	60-200 mg/Ton with sedation	I.M.		
22.	Naloxone	Morphine antagonist	30-50 mg/animal	I.M./I.V.		To reverse morphine or its derivatives

1	2	3	4	5	6	7
23.	Neostigmine	Cholinergic	4-5 mg/animal	I.M.	Prostigine	Purgative in impaction In anaesthesia if prolonged
24.	Oxygen		15-20 L/ min	Inhalation		
25.	Penicillin	Antimicrobial	12-16 million.I.U./ animal	I.M.		
26.	Pheniramine	Antihistaminic	1700-2300 mg/ animal	I.M.		
27.	Phenylbutazone	Analgesic	10-15 g/ animal	I.M.		
28.	Xylazine	Sedative, Analgesic, Muscle relaxant, Anaesthetic	80-150 mg/Ton	I.M.	Rompun	Wait till full induction. 15-20 min.. Peak action at 45 min..Can be combined withAcepromazine
<b>SPECIFIC CONDITIONS</b>						
Surra: (Trypanosomosis)						
1.	Diminazene	Antiprotozoan	3-8 mg/kg	I.M.	Berenil	
2.	Quinapyramine methyl sulphate	Antiprotozoan	2-3 mg/kg	S.C.	Antricide	
Tetanus						
1.	Crystalline Penicillin	Antimicrobial	30-45 millium.I.U.	I.M./I.V.		
2.	Antitetanus Serum	Anti serum	0.1-0.25 millium.I.U.	I.M.		
3.	Diazepam	Anti convulsant	400-800 mg/ animal	I.M.		
4.	Electrolyte Solution	Electrolytes	15-25 litres	I.V.		

1	2	3	4	5	6	7
	Anthelmintics:					
1.	Albendazole		2.5 mg/kg	Oral	Albomar	
2.	Bephenium hydroxy naphthoate		25 mg/kg	Oral	Alcopar	
3.	Fenbendazole		2-2.5 mg/kg	Oral	Panacur, Panfugal	
4.	Levamisole		2.5-3 mg/kg	Oral	Helmonil	
5.	Mebendazole		2.5-5 mg/kg	Oral	Eben, Mebex	
6.	Morantel citrate		2 mg/kg	Oral	Banminth Forte	
7.	Morantel tartarate		2-4 mg/kg	Oral	Banminth II	
8.	Oxibendazole		2.5 mg/kg	Oral		
9.	Tetramisole		3-5 mg/kg	Oral	Nilverm, Curaminth	
10.	Thiabendazole		20 mg/kg	Oral	Thiabendal	

1	2	3	4	5	6	7
Filariasis:						
	Lithium Antimony thiomalate – solution	Filaricidal	60 ml/elephant/ S.C.at tail fold		Anthiomaline	
Amphistomosis:						
1	Hexachlorophene		10 mg/kg	Oral	Flukin	
2	Rafoxanide		5-6 mg/kg	Oral	Ranide, Amfanide	
3	Oxyclozanide		5-7.5 mg/kg	Oral	Distodin	
Bivittellolharziasis:						
	Lithium antimony thiomalate – 6%	Filaricidal	200 ml/animal	S/C.	Antimosan, Anthiomaline	6 injections at weekly intervals
Cestodiasis:						
1	Hexachlorophene		10 mg/kg	Oral	Flukin	
2	Niclosamide		75-100 mg/kg	Oral	Niclex	
3	Oxyclozanide		3-4 mg/kg	Oral	Distodin	
4	Praziquantel		2.5-4 mg/kg	Oral	Droncit	

## REVIEW OF THE INCIDENCE, ETIOLOGY AND CONTROL OF COMMON DISEASES OF ASIAN ELEPHANTS WITH SPECIAL REFERENCE TO KERALA

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Asian elephants have been observed to be susceptible to various parasitic diseases such as helminthosis, trypanosomiasis and ectoparasitic infestations, bacterial diseases such as tetanus, tuberculosis, haemorrhagic septicaemia, salmonellosis and anthrax, viral diseases such as foot and mouth disease, pox, herpes and rabies and non-specific diseases like impaction of colon, foot rot and corneal opacity. A detailed study extending over two decades on captive and wild elephants in Kerala, revealed high incidence of helminthosis (285), ectoparasitic infestation (235), impaction of colon (169) and footrot (125). Diseases such as trypanosomiasis (21), tetanus (8), tuberculosis (5), pox (2) and anthrax (1) were also encountered. The line of treatment against the diseases mentioned, have been discussed in detail.

### **Introduction**

The Indian treatise, Palakapya's "Hasthyaurveda" written over 2000 years ago is perhaps, the first comprehensive treatise on diseases of elephants covering diseases like "Kshaya" (Tuberculosis), stiffness of mouth (Tetanus), helminthiasis, colic,

constipation, foot rot, jaundice etc., and prescribed ayurvedic remedies. His masterly description of the physiological characters of elephants still forms a *magna carta* for all those concerned with elephants. Later works on diseases of elephants such as those of Gilchrist (1851), Slym (1873), Sanderson (1878), Steel (1885), Evans (1910), Hepburn (1913), Milroy (1922), Pfaff (1940) and Ferrier (1947) have only reiterated Palakapya's findings but have prescribed modern (allopathic) remedies. More recent works like those of McGaughey (1961a, 1961b, 1962, 1965), Chandrasekharan (1979, 1992), Panicker (1985, 1990) and Radhakrishnan (1992) have used modern laboratory diagnostics and documented specific and non-specific diseases of elephants.

We have in a span of about 30 years recorded 519 cases of parasitic, 14 cases of bacterial, two cases of viral and 404 non-specific cases among captive elephants and 68 cases of parasitic infections among wild elephants. The details of the prevalence of diseases are furnished in Table 1.

Table 1. Prevalence of diseases among captive and wild elephants in Kerala

Name of disease	Number of cases encountered		Total
	In male elephants	In female elephants	
<b>Captive elephants</b>			
<i>Parasitic diseases</i>			
Gastro-intestinal helminthosis	218	27	245
Cutaneous filariasis	13	2	15
Trypanosomiasis	20	1	21
Gastric myiasis	3	-	3
Louse infestation	210	25	235
<i>Bacterial diseases</i>			
Tuberculosis	5	-	5
Tetanus	8	-	8
Anthrax	-	1	1
<i>Viral disease</i>			
Elephant pox	2	-	2
<i>Non-specific diseases</i>			
Impaction of colon	153	16	169
Foot rot	110	15	125
Corneal opacity	45	10	55
Arthritis	40	5	45
Decay of tusk pulp	5	-	5
Sun burn	5	-	5
<b>Wild elephants</b>			
Gastro-intestinal helminthosis	14	12	26
Cutaneous filariasis	5	-	5
Gastric myiasis	4	3	7
Louse infestation	16	12	28
Tick infestation	1	1	2

### Parasitic Diseases

#### Gastro-intestinal helminthosis:

Gastro-intestinal helminthosis formed about 47 per cent in captive and about 38 per cent in wild elephants of the total recorded cases. Out of the 31 different species of helminths recorded from Asian elephants, a total of 21 species were observed in Kerala elephants. The list of helminths and other

parasites recorded from Kerala elephants is furnished in Table 2. Infection of strongyle worms were observed almost in all captive elephants and in 38 per cent of wild elephants. The 63 elephants in which amphistomes were recorded, comprised mostly of elephants brought from Bihar and U.P. states. In addition, *Bivitellobilharzia* eggs and cestode eggs were found in the dung samples of 53 and 12 elephants respectively.



Table 2. Parasites recorded from elephants in Kerala

Name of the parasite	Location
<b>Round worms</b>	
<i>Murshidia indica</i>	Intestine
<i>Murshidia murshida</i>	Intestine
<i>Murshidia falcifera</i>	Intestine
<i>Quilonea travancra</i>	Intestine
<i>Quilonea renniei</i>	Intestine
<i>Amira pileata</i>	Intestine
<i>Decrusia additicta</i>	Intestine
<i>Cholangium epistomum</i>	Intestine
<i>Equinurbia sipunculiformis</i>	Intestine
<i>Bathmostomum sangeri</i>	
<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
<b>Amphistomes</b>	
<i>Pseudodiscus collinsi</i>	Stomach & Intestine
<i>Pseudodiscus hawkesi</i>	Stomach & Intestine
<i>Gastrodiscus secundus</i>	Stomach & Intestine
<i>Pfenderius papillatus</i>	Stomach & Intestine
<b>Blood fluke</b>	
<i>Bivitellobilharzia nairi</i>	Portal vessels
<b>Tape worm</b>	
<i>Anoplocephala manubriata</i>	Intestine
<b>Protozoa</b>	
<i>Trypanosoma evansi</i>	Blood
<b>Ectoparasites</b>	
<b>Louse</b>	
<i>Haematomyzus elephantis</i>	Skin
<b>Ticks</b>	
<i>Boophilus annulatus</i>	Skin
<i>Haemophysalis spinigera</i>	Skin
<i>Rhipicephalus haemophysaloides</i>	Skin
<i>Ornithodoros savignyi</i>	Skin
<b>Fly</b>	
<i>Cobboldia elephantis</i> maggots	Stomach

Elephants infected with gastro-intestinal helminths were generally anaemic with frequent colic accompanied by foul smelling diarrhoea. Mud eating and oedematous swelling on the lower part of the jowl, neck, brisket and abdomen are indicative of fairly high infection with helminths.

In the case of *Grammocephalus varedatus* infestation, we observed in post-mortem examination, haemorrhage, erosion, proliferation of lymphoid tissue, ulcers and

necrotic foci in the bile ducts with the presence of large numbers of adult and immature worms, whereas in the case of infection with *Parabronema smithi*, small tumours and ulcers were observed on the sub-mucous and muscular layers of stomach.

All cases responded well to treatment with known anthelmintics. The doses of the more common drugs standardized for elephants are given in Table 3.

Table 3. Details of drugs useful against helminthiasis in elephants

Name of drug	Dose rate	Route of administration
<b>Strongylosis</b>		
Tetramisole hydrochloride	3 to 5 mg/kg B.W.	Orally
Parbendazole	6 to 10 mg/kg B.W.	Orally
Morantel tartrate	2 to 4 mg/kg B.W.	Orally
Morantel citrate	2 mg/kg B.W.	Orally
Thiabendazole	20 mg/kg B.W.	Orally
Thiophanate	14 mg/kg B.W.	Orally
Oxibendazole	2.5 mg/kg B.W.	Orally
Mebendazole	2.5 to 4 mg/kg B.W.	Orally
Levamisole	2.5 to 3 mg/kg B.W.	Orally
Albendazole	2.5 mg/kg B.W.	Orally
Fenbendazole	2.5 mg/kg B.W.	Orally
Bephenium hydroxynaphthoate	25 mg/kg B.W.	Orally
<b>Amphistomosis</b>		
Hexachlorophene	10 mg/kg B.W.	Orally
Rafoxanide	7.5 mg/kg B.W.	Orally
Oxyclozanide	5 to 7.5 mg/kg B.W.	Orally
<b>Cestodiasis</b>		
Praziquantel	2.5 to 4 mg/kg B.W.	Orally
Oxyclozanide	3.4 mg/kg B.W.	Orally
Niclosamide	70 mg/kg B.W.	Orally
Hexachlorophene	10 mg/kg B.W.	Orally
<b>Bivittellobilharsiasis</b>		
Anthiomaline	50 ml/2000 kg B.W.	S/C at weekly interval for 8 weeks

### Cutaneous filariosis

Cutaneous filariosis formed three per cent of parasitic cases in captive and about seven per cent in wild elephants. The disease is characterized by nodules of the size of large gooseberry, mostly on the sides, underneath the abdomen and lateral aspects of the hind limbs. The nodules rupture one to two days after their appearance, oozing of blood at about 10 seconds interval for about 30 minutes. Then oozing stops spontaneously. Later, these nodules become fibrosed and new ones emerge at other sites. The species of the filarid worm identified by Alwar *et al.* (1959) was *Indofilaria pattabhiramani* which they recovered from the nodules. Seneviratne *et al.* (1967) also identified this parasite from Sri Lankan elephants, where as Bhattacharjee (1967) reported cuticular dermatitis caused by *Stephanofilaria srivastavi*.

An interesting observation was that bleeding from the nodules occurred during day time only and that too in the morning. Off feed and restlessness for no apparent reason were the other symptoms. Microscopic examination of the exudates revealed microfilaria. In addition to *Indofilaria pattabhiramani*, a new filarid worm *Indofilaria elephantis* was identified and recorded by Chandrasekharan *et al.* (1972). Anthiomaline 50 ml per 2000 kg body weight S/C at weekly intervals for 8 weeks was found safe and effective in controlling the disease (tail fold is the ideal site for S/C injection).

**Trypanosomosis:** Trypanosomosis or surra caused by *Trypanosoma evansi* and transmitted by biting flies was recorded in 21 captive elephants during rainy season. Initial symptoms of intermittent fever and anorexia

sometimes go unnoticed resulting in swelling on dependent parts, anaemia and inability to carry out heavy work like logging. Death is generally due to extreme anaemia and dehydration. Two to three i/m injections of Berenil @ 5 to 8 mg per kg. body weight at weekly intervals or Antricide methyl sulphate @ 3 to 5 mg per kg body weight S/C have been found useful.

**Gastric myiasis:** Maggots of the fly *Cobboldia elephantis* were recovered from the stomach contents of seven wild elephants and three captive elephants. Dullness, anorexia, colic and loose motion were noticed in captive elephants. Tetramisole hydrochloride @ 4 mg per kg body weight administered orally was found to be effective.

**Louse infestation:** Widely prevalent in both captive (235 cases) and wild elephants (38 cases), caused by *Haematomyzus elephantis* (Chandrasekharan *et al.* 1972b). Restlessness and actions associated with pruritus are common symptoms. Organophosphorus compound (Sumithion) at one per cent strength as a wash or dip was found to be very effective.

**Tick infestation:** Four different species of ticks such as *Boophilus annulatus*, *Haemaphysalis spinigera*, *Rhipicephalus haemophysaloides* and *Ornithodoros savignyi* were recorded from two wild elephants. None of the captive elephants showed ticks on their body.

### Bacterial diseases

**Tuberculosis:** Human form of tuberculosis was isolated from lung exudates of an elephant by Evans (loc.cit.). Later, Narayanan (1935), McGaughey (1961b), Seneviratne and Wettimury (1966) and Chandrasekharan (1992) also reported the incidence of tuberculosis in Asian elephants.

Five captive elephants, suspected for tuberculosis showed symptoms of anorexia, progressive weakness, cough and discharge from trunk. Reluctance to work with rapid exhaustion and breathlessness were the initial symptoms noticed. Four cases which died were confirmed for tuberculosis through isolation of the organism, *Mycobacterium tuberculosis* from lung exudates and observance of typical nodules in the lungs. The lone suspected case was treated successfully with I/M administration of Streptomycin 100 gm on alternate days for a period of four weeks. A combination of Rifampin and Isoniacid is also found to be effective. Thirty capsules twice daily for 1 to 3 months is recommended in chronic cases. Supportive nutrients and tonics have also to be given.

**Tetanus:** This condition, with typical characteristics like locked jaw (complete or partial), inability to drink or swallow, salivation and impaired appetite leading to stiffness of limbs, paroxysms and jerky movements of muscles, had been recorded by Hepburn (loc. cit.), McGaughey (1962a) and Chandrasekharan (1992).

Although correctly diagnosed, seven of the eight almost terminal cases succumbed within two to three days of initiation of treatment due to development of toxemia. The lone survivor responded to the treatment with muscle relaxants (Diazepam 250 mg), antitetanus serum (2.5 lakhs units), antibiotics (Crystalline penicillin 450 lakhs units) and intravenous infusion with electrolytes and glucose which were repeated on the succeeding day.

**Anthrax:** Anthrax is an acute fatal disease caused by *Bacillus anthracis*. This disease is well known in Asian elephants (Evans, loc. cit., Howard, 1913, Hepburn, loc cit; Gupta,

1928; McGaughey, 1961a, Arora, 1992). During the course of observation only one case of Anthrax was encountered in a cow elephant. The elephant died suddenly without showing much symptoms, except shivering. The causative organism was identified after death.

### Viral Diseases

The viral diseases encountered in elephants were elephant pox, foot and mouth disease, rabies and herpes.

**Elephant pox:** This affection, though rare was earlier recorded by Steel (loc. cit.), Evans (loc cit), McGaughey (1962a) followed by Kuntze (1974) and Gehring and Mayer (1978).

The two cases of pox encountered in captive elephants showed preliminary symptoms typical of many other febrile conditions including oedema on head, trunk and lower abdomen. The condition, however, could be confirmed through eruption of pustules on the buccal mucosa, tongue, ventral aspect of the trunk, ear flap and abdomen. Since severe conjunctivitis is a common feature, it should be treated urgently, as the sequel may be opacity (as observed in one case). Treatment is by and large, symptomatic and pain relievers like Analgin.

**Herpes virus infection :** In African Elephants, these viruses can cause either benign localized skin nodules with pinkish colour on the trunk and head or vulval lymphoid patches around genital openings and have also been found in pulmonary nodules in otherwise healthy african elephants. The growths or lesions usually regress after several weeks and thought to represent occasional reactivation from hidden "latent" infections.

In Asian elephants, Endotheliotrophic Elephant Herpes Virus (EEHV) causes fatal haemorrhagic disease, attacking endothelial cells (blood vessels, heart and similar organs). This disease is 90 per cent fatal and preferentially targets juvenile captive zoo elephants. The first case was identified in 1995 at the Washington Zoo.

Up to November 2008, there have been 31 known cases in North America and 18 in Europe, including six animals that survived when treated with an anti-herpes virus drug (famcyclovir). Although most cases have involved captive born Asian elephants between the ages of 4 months and 18 years, several cases have involved older wild-born Asian adults as well as occasionally newborns and three were in African elephants. Of 78 Asian elephants born in the United States and Canada between 1978 and 2007 that lived up to two months of age, at least 19 have since died of this disease.

The virus seems to spread from immune, otherwise healthy African elephants to Asian elephants, especially older calves who may not have developed antibodies. However, there also appear to be a small proportion of wild-born captive adult "carrier" Asian elephants who have antibodies and therefore presumably survived mild infections when young.

It is possible to screen the DNA blood samples of suspected cases for EEHV within 12 hours and this test has been used to confirm acute EEHV disease cases and to trigger successful famcyclovir treatment of symptomatic animals. Afflicted young elephants usually die very fast, in several cases within 24 hours after the first signs, but there are six confirmed examples of cures in which EEHV1 infected calves with positive

PCR DNA blood tests survived after fast early treatment with famcyclovir (500 mg/70 kg body weight, 3-4 weeks). The blood test has never been positive in healthy animals, but unfortunately even this expensive drug treatment was not effective in many other cases.

#### *Control:*

Intermingling of African and Asian elephants should be avoided. It is better to restrict the exposure of captive born juvenile Asian elephants to wild born Asian elephants as they are likely to be seropositive carriers. The practice of utilizing common keepers and workers for both African and Asian elephants in zoos should also be discontinued.

#### **Non-specific diseases**

***Impaction of colon:*** A very common occurrence in elephants, more in captive than wild. Any part of the very long colon may get impacted with the fibrous food materials, a single mass weighing up to 100 kg at times, with 50-60 kg being the more frequent weight of the impacted mass. Depending on the severity of the case, there may be two to three such masses with a few more less heavier ones.

Although highly fibrous type of diet can lead to impaction, the more common reasons are managemental errors. The tendency of mahouts to feed and water elephants almost immediately after a long strenuous walk in the hot and humid summer season (which is the season of festivals requiring elephants) when the animals are very hungry and thirsty, has been the most frequent cause in the initiation of intestinal stasis followed by colic, straining and the other symptoms associated with abdominal discomfort. Low water consumption and diseases of teeth can also give rise to impaction.

Besides the symptoms mentioned and absence of voiding dung, the animal stops eating and drinking entirely and as the days progress there is total absence of straining with occasional complications like tympany, dehydration and vomiting. Death may occur due to rupture of colon and consequent peritonitis.

The almost static condition may last for up to 75 days and the maximum duration for the most successfully treated case was about 59 days. Twenty to thirty days is the most frequent duration observed from the onset till the large mass is voided or removed manually from the rectum.

In a total of 169 cases, the following line of treatment was adopted:

1. Analgesics and antispasmodics (Novalgin or Beralgan, 60-100 ml I/M)
2. Antihistamine (Avil 70-100 ml I/M)
3. Drugs acting on smooth muscles (Calcium pantothenate 50-70 ml, Perinorm 50-60 ml, Calcium borogluconate 450 to 900 ml I/V).
4. Antibiotics (Chloromycetin succinate 10-20gm or Ampicillin 10-15 gm I/V).
5. Parasympathetic stimulants (Carbachol 5-10 mg or Prostigmin 3-4 mg I/M).
6. Electrolytes and Dextrose saline, Dextrose solution (15-25 liters I/V).

**Foot rot:** One hundred and twenty five cases of foot rot (Canker, Pododermatitis) were treated in captive elephants. Poor unhygienic management with tethering of elephants for a number of days continuously on wet and decaying vegetable matter mixed with urine and dung, is the most common cause. Tripathy *et al.* (1992) opined that *Stephanofilaria* sp. as the causative agent, although no formal identification of any

organism has been made. But the widely prevalent opinion and the response to treatment point to fungus as the causative agent.

The symptoms appear as black patches on foot space between and just above nails. The skin gets necrosed, sloughs off leaving ulcers or granulating wounds. There is usually excess granulations of sponge like tissue which bleed at the slightest provocation. Animals feel considerable pain and lameness.

The treatment procedure found some what successful is as follows:

1. Cleaning the foot pad in 1/1000 Pot. Permanganate solution.
2. Antiseptic foot bath in 1 to 2 per cent formalin or Gentian violet.
3. Cauterisation with copper sulphate.
4. Foot dressing with Triple sulph mixed in Ol. Picis. liquidum
5. I/M administration of streptomycin and arsenicals.

**Corneal opacity:** A condition observed more among elephants brought to Kerala from northern states than native elephants. The reasons are primarily Vitamin A deficiency and injury. Opacity as a consequence of pox was noticed in one elephant.

Discharge from the eyes, whitish patch or ulcer on the cornea and defective vision are the common symptoms noticed in affected elephants (McGaughey, 1965).

The following line of treatment was adopted and proved to be effective

- 1 Eye wash with normal saline or boric lotion.
- 2 Application with dionoresolvant cream
- 3 Sub-conjunctival administration of Placentex @ 2 ml on alternate days for three weeks.
- 4 Vitamin A supplementation.

**Arthritis:** During the course of study, 55 cases of arthritis were noticed. The working elephants were found to be more susceptible to different types of inflammatory conditions on the joints. Contusion of joints due to fall, hitting by logs and ill treatment by mahouts with long pole or with some other instruments are found to be the important causes of this condition. The joints of all the four legs were found to be affected in most of the conditions due to rheumatism

The important symptoms are pain on movements, dragging tendency of legs and oedematous swelling on the joints. The elephants exhibit inability to bear its body weight and some times trunk is used to support its body. Some time the animal may die due to septicaemia or suppurative arthritis.

The following line of treatment is found to be effective in most of the cases:

1. I/M administration of analgesics like Novalgin 60 to 90 ml.
2. I/M administration of anti-inflammatory drugs—Esgipyrin 60 to 90 ml, Artisone-S 90 ml.
3. I/M administration of diuretics—Lasix 40 ml.
4. I/M administration of antibiotics – Dicrysticin, 8 to 10 large doses or Ampicillin 10 to 15 gm or Crystelline penicillin 400 to 600 lakhs units.
5. I/M administration of corticosteroids such as Betnesol 80 to 100 mg, Dexona or Hostacortin - H.
6. Oral administration of antirheumatic drugs.
7. External application of counter irritants like Iodine ointment or Icthmol glycerine.
8. Exposure to infra red rays on the affected area.

**Decay of tusk (dental) pulp:** The tusks in elephants are modified incisor teeth and have dental pulp extending about two-third of its length. Accidental injuries during work or

mischevious activities or cutting the tusk short and the subsequent infection are the important causes for decay of pulp. Five cases of decay and disintegration of dental pulp were treated and in all the cases the affected tusk was removed because of the damage to the root of the tusk. The decay in tusk pulp was bilateral in one elephant and unilateral in other animals. In all the cases, there was severe suppuration of the pulp with disintegration of the pulp leaving an infected tract to the full length of the tusk and the alveoli. The root of the tusk was shaky and the tusk lost its normal colour, was not growing in length and had a hollow sound on tapping. Initially cleaning with antiseptics and hydrogen peroxide and packing the tract with antibiotic cream were tried, parenteral administration of antibiotics were also given. Since the tusks became shaky, they were extracted by cutting close to the alveoli and removing the root by cutting longitudinally after tranquilising the elephants with xylazine. After removal of the tusks the alveoli was treated by cleaning with hydrogen peroxide and dressing with antibiotic creams. Healing was uneventful. In four elephants where the decay of pulp was unilateral, artificial tusks were prepared with soft wood and fixed in position with the help of clamps.

**Sun burn:** Five cases of sun burn condition were encountered during the course of study. The exact cause was not fully known but it was attributed to the photosensitisation property of a phenothiazine derivative, acepromazine. In all the cases, burn lesions were noticed after the administration of acepromazine along with xylazine. The lesions were noticed on head dome and over the back bone. The conditions were treated with administering antibiotics and external application with antiseptic ointments.

## ANAESTHESIA FOR SURGICAL MANIPULATIONS IN THE ELEPHANT

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### Introduction

General anaesthesia is rarely practised for surgical handling of the elephant because of its size making it difficult to move parts of the body under anaesthesia, the difficulty in monitoring vital functions and its readiness to obey commands during handling. Local anaesthesia with or without sedatives are usually employed for minor surgical manipulations. However, when extensive, painful and time consuming manipulations are required central nervous system depressants have to be administered. Use of trichlorethylene (Kodituwakku *et al.*, 1961), etorphine (Gray and Nettashinghe, 1970), xylazine (Schmidt, 1975) and intraval sodium (Nair *et al.*, 1979) for inducing anaesthesia in elephants have been reported.

The present report is an analysis of ten surgical cases in which central nervous system depressants were used for anaesthetizing the animals.

### Materials and methods

During the past one decade, about 100 clinical cases which required surgical manipulations were attended. Topical anaesthesia using ethyl chloride spray and local infiltration anaesthesia using xylocaine hydrochloride were used in minor surgical conditions like superficial wounds, sinuses and ulcers. In ten animals as presented in Table 1 central nervous system depressants were used. The details of the drugs, their dose and duration of effect are presented in Table 2.

Table 1. Details of animals and lesions and the treatment adopted

Sl. No.	Animals	Approximate age (years)	Lesions observed	Treatment adopted
1.	Tusker	30	Wound on the tip of trunk	Scarification and suturing
2.	Tusker	25	Penetrating wound on the middle of trunk	Scarification and suturing
3.	Baby tusker	8	Sinus on the chest	Resection of sinus, removed a bullet from the sinus
4.	Cow elephant	30	Bullet wounds on the back	Resection and extraction of bullets
5.	Tusker	35	Fibrous mass on the temporal region	Resection of the fibrous mass
6.	Tusker	35	Wound at the tip of trunk - tip split	Scarification and suturing
7.	Cow elephant	30	Penetrating glass piece on the foot	Resection and removal of glass piece
8.	Tusker	30	Abscess and sinus on the tarsal region	Opening the abscess and sinus for drainage
9.	Cow elephant	35	Ventral hernia	Herniorrhaphy
10.	Tusker	35	Gangrene of the ear	Resection of gangrenous skin and cartilage.



Table 2. Drugs used, dose and duration of effects

Sl. No.	Animal	Approximate body wt. (kg)	Drugs used	Quantity used	Route of admn.	Induction (min)	Duration (min)	Position
1.	Tusker	3000	Chloral hydrate Thiopentone sod.	100 gm 4 gm	Oral I/V	30 5	60	Recumbent
2.	Tusker	3000	Flaxedil Thiopentone sod.	1600mg 4 gm	I/M I/V	5	40	-do-
3.	Baby tusker	1500	Xylazine	150 mg	I/M	15	40	Standing
4.	Cow elephant	3000	Xylazine Acepromazine	350 mg 150 mg	I/M I/M	12	60	Recumbent
5.	Tusker	4000	Xylazine	450 mg	I/M	10	45	-do-
6.	Tusker	3500	Xylazine	400 mg	I/M	12	30	-do-
7.	Cow elephant	2500	Xylazine Acepromazine	300 mg 150 mg	I/M I/M	15	60	-do-
8.	Tusker	3000	Xylazine	400 mg	I/M	12	45	Standing
9.	Cow elephant	3000	Xylazine Ketamine	350 mg 350 mg	I/M	10	120	Recumbent
10.	Tusker	3500	Xylazine	400 mg	I/M	15	40	-do-

### Results

In animal no.1 where chloral hydrate with thiopentone was used, induction of anaesthesia was noticed in 30 min after administration. In animal no. 2 where thiopentone and Flaxedil were used induction was complete in 5 min. In both the cases, the animals became recumbent, the tail and

trunk relaxed and the animals were unconscious. Surgical manipulations like resection of the wound edges and suturing elicited pain and movement and hence ethyl chloride spray and local infiltration with lignocaine were adopted to alleviate pain. Anaesthesia lasted for 60 min and 40 mts in the two animals. Recovery was uneventful.

In the remaining eight animals where xylazine alone or with acepromazine or ketamine were used, induction of anaesthesia was noticed in 10 to 15 min. The effects of depression were progressive beginning with relaxation of the trunk, tail and ears. The animals became unsteady on the limbs and later the penis protruded. When the animals were left standing, it kept on the limbs but when the animals were made to lie down narcosis deepened. Both in the standing and recumbent position it produced snoring sounds and there was salivation and lacrimation. Surgical manipulations like resection, suturing or surgical dissection and exploration and removal of foreign bodies did not elicit any response. Analgesia was good. Duration of anaesthesia varied from 30 to 60 min. Recovery from anaesthesia was uneventful and smooth.

### **Discussion**

Anaesthesia using central nervous system depressants became necessary in the 10 animals because of the painful conditions which required extensive and time consuming dissection. Use of chloral hydrate and thiopentone sodium was sufficient to control the animals but because of the poor analgesia local anaesthetics had to be used. Xylazine alone or with acepromazine or ketamine produced narcosis, analgesia and relaxation of muscles and surgery could be done with more efficiency. Since the latter group of drugs could be administered I/M in small volume, preanaesthetic control of the animals was also simple. The induction time was short with xylazine or its combinations but the duration of anaesthesia was satisfactory. In both the groups of drugs, untoward postanaesthetic complications were not encountered.

## MANAGEMENT OF SURGICAL AFFECTIONS IN CAPTIVE ELEPHANTS

*K.N. Muraleedharan Nair, K. Chandrasekharan and  
K. Radhakrishnan*

During the last 25 years, large number of surgical conditions were attended in captive elephants in Kerala. Most of the conditions were comparable to similar affections observed in other domestic animals. However, management of the conditions for correcting the injury and promoting healing demanded special attention. Owing to the delay in the healing of wounds, treatment/attention had to be continued for periods much longer than in other domestic animals. Though the response to the drugs/medicines used was satisfactory, large quantity needed per dose made it a costly treatment.

### **Anaesthesia for surgery**

Anaesthesia was employed in all cases where the manipulations were painful, needed extensive and time-consuming dissection in the regions like the trunk and limbs. Agents like chloral hydrate and thiopentone have been tried but because of poor analgesia and the risk involved with such drugs, they are not being used now. The drugs used now and their doses are:

1. Xylazine 0.1 to 0.11 mg/kg 1M
2. Acepromazine 0.1 mg/kg 1M
3. Ketamine 5-10 mg/kg 1M
4. Etorphine 1 mg/1000 kg 1M

Combinations of drugs can be used *viz.* Xylazine-Acepromazine, Xylazine – Ketamine, Etorphine – Acepromazine are more efficient and the dose of individual drugs can be reduced up to 50 per cent when combinations are used. When animals are to be secured in standing position xylazine or its combinations and if they are to be secured in recumbency, xylazine or etorphine and combinations are used. xylazine and its

combinations when used in captive elephants, the signs of anaesthesia are

- (i) Relaxation of trunk, tail and ear
- (ii) Snoring sound produced when depression is deep
- (iii) Profuse lacrimation and salivation
- (iv) Protrusion of penis.

Induction will be complete in 20 minutes after administration and the anaesthetic affect lasts for 40 - 60 minutes after a single dose. Recovery will be smooth and takes 4–6 hours. When anaesthesia is to be prolonged, subsequent doses will have to be administered – usually half the dose of what was used initially.

Etorphine is usually employed for capturing wild animals. The induction will be fast (5-8 minutes) and anaesthesia lasts for 1-2 hours.

Since xylazine has analgesic properties, surgical manipulations can be carried out painless and without local anaesthetics.

Local anaesthesia as infiltration or nerve block is rarely attempted in elephants because of the difficulty in administration and the large volume required for infiltration. Moreover, local anaesthesia does not in any way aid in controlling the animal.

### **Surgical Conditions:**

#### **1. Wounds**

Closed and open wounds have been treated.

##### *a. Closed Wounds:*

Caused by falls, heavy falling objects, automobile pressure at bony prominences and tusk charging by other elephants.

In all cases, the wounds were with extensive subcutaneous crush injury with formation of haematoma. Haematomas formed at bony prominences like external angle of ilium progressively get enlarged and spread to adjoining parts.

Initially the haematoma is non inflammatory but develop inflammation later as part of the healing process. Infection may lead on to formation of abscess.

*b. Open wounds:*

All categories of open wounds were attended to in elephants – animal inflicted, man made and accidental. Animal inflicted injuries were penetrating and lacerated wounds. Man made wounds were incised, punctured and bullet wounds. Wounds developed from pressure of the tethering chain, ropes and controlling equipment were also open wounds. Complications like maggot infestation, cellulitis and gangrenous changes were also observed.

Open wounds were invariably contaminated and many a times, septic.

Treatment:

*a. Closed wounds:*

Haematomas formed at the site of injury were treated as closed wounds on the following lines:

- (i) Topical application of thrombophob/hirudoid ointment when haematomas were small.
- (ii) In large haematomas, counter irritants like iodine ointment or paste made of Aloe in egg white.
- (iii) Oral administration of Chimeral forte to promote absorption
- (iv) Oral administration of Potassium iodide at the rate of 25 g daily for one week, as resolvent

- (v) Oral administration of Aspirin tabs, diuretics, antihistaminics
- (vi) Parenteral administration of antibiotics
- (vii) Rest

*b. Open wounds:*

- (i) Wounds were cleaned with soap and water or antiseptics like Savlon/Dettol solution
- (ii) Bleeding points were controlled with ligature/forceps/styptics
- (iii) Removal of debris, cleaning the wounds and suturing when wounds were fresh or when they were extensive.
- (iv) Tetanus toxoid (5-10 ml) was administered
- (v) Contaminated or septic wounds were cleaned, dressed with antiseptics/antibiotics and bandaged. This was repeated on alternate days.
- (vi) Magsulph-glycerine paste was applied when there was oedema/ too much of dead tissue
- (vii) Depending on the nature of infection, parenteral administration of antibiotics (Penicillin and Streptomycin/Metrodinazole/Tetracyclin/Ampicillin/Chloromycetin, Amoxycillin
- (viii) In deep penetrating wounds, drainage was provided
- (ix) Rest  
Treatment continued till healing is complete.

Wounds on the trunk and abdomen are discussed separately.

## 2. Abscess

Abscesses were observed in all parts of the body in elephants. They were seen developing from

- (i) secondary contamination of haematoma

- (ii) secondary to penetrating wounds and
- (iii) iatrogenic infection.

Latent period of development of abscess varied from weeks to months. Development of abscess and maturation were like in other animals.

*Treatment:*

- (i) Hastening maturation using counter irritants like iodine ointment
- (ii) Opening and draining contents and treating it as open septic wounds

### 3. Sinuses

Sinuses noticed in elephants were usually the result of open abscess/wounds with incomplete drainage. Presence of foreign bodies like bullets and sequestered bone also cause development of inflammatory tracts, which did not show any tendency to heal. Sinuses were often noticed at external angle of ilium and at the point of elbow.

The sinus tracts were usually indurated and hard and showed poor granulation.

*Treatment:*

Providing drainage and removal of foreign bodies along with cauterization and removal of fibrous tissue. Repeated application of triple sulphate (Equal parts of copper sulphate, zinc sulphate and ferrous sulphate) was effective in removing fibrous tissue and promoting granulation. Surgical resection of the sinus tract was also performed, in a few cases.

### 4. Cyst

Cysts were noticed at the point of elbow, point of hip and carpal joint developed probably due to repeated irritation in lying down and getting up – similar to capped elbow in other animals. Hyperkeratinisation of the skin was common. Injury, pain, inflammation and increase in size of the swelling interfered with the use of the limb.

*Treatment:*

Exploratory puncture was done to study the nature of contents. Cyst contained clear fluid with cell debris or casts. It was treated by drainage of contents and destruction of capsule. Tr. iodine was injected into the capsule after destroying it by surgery or chemical cauterization with Triple sulph.

### 5. Necrosis and gangrene

Necrosis and gangrene involving the ear and skin at the back were observed. This was found to be caused by:

- (i) Phlebitis consequent to injection/irritants in ear vein
- (ii) Photosensitisation
- (iii) Suppurative infection with cellulitis and
- (iv) Trauma

The tissue became cold, dry, leathery and shrunken. A line demarcating the healthy and dead tissue became apparent after a few days. The dead tissue later sloughed off leaving ulcers. On the ear, it may take a long time before the necrosed cartilage gets separated. Exposure to direct sunlight after administration of phenothiazine derivatives causes photosensitisation and necrosis.

*Treatment:*

- (i) Prevent complications: use antiseptics/ fly repellents.
- (ii) Hasten separation by application of counter irritants on the healthy tissue.
- (iii) Resection of necrotic tissue is not advisable, till it starts separation by aseptic/septic ulceration.

### 6. Arthritis

Arthritis was observed in elephants of all age groups and in both male and female. It was found to be caused by:

- (i) trauma
- (ii) infection and
- (iii) as an old age syndrome

The elbow, carpal joint, stifle joint and the tarsal joint were seen affected. Dry arthritis, purulent arthritis, chronic arthritis and ankylosing arthritis were observed in them. The symptoms noticed were:

- (i) Swelling involving the joint with oedema of the limb distal to the joint.
- (ii) Tenderness and pain over extensive areas
- (iii) Lameness
- (iv) Signs of septicaemia/toxaemia in purulent arthritis – fever, anorexia, wasting, progressive debility
- (v) It may point and burst leaving sinuses or open joint
- (vi) Stiffness of joint or limb in ankylosing arthritis. Pain and lameness will be diminished when ankylosis takes place.
- (vii) In fatal cases, necrosis of articular cartilage and bone were observed on post-mortem examination.

*Treatment:*

- (i) External application of counter irritants/absorbents: Iodine ointment/ Icthamol glycerine.
- (ii) Anti-inflammatory drugs orally/parenterally – Aspirin/NSAIDS/Butazone.
- (iii) Antibiotics parenterally in septic arthritis: Penicillins/Tetracyclines.
- (iv) Diuretics orally/parenterally to relieve oedema: Lasix/Frusemide
- (v) Draining of pus, if it can be approached, using large bore needles and infusion of antibiotic solution.
- (vi) Rest

## 7. Fractures and dislocations

Fractures and dislocations were observed in elephants as a result of trauma – mostly in automobile accidents. Fractures of femur, tibia, radius and ulna, ilium, vertebrae and mandible were attended. Dislocation of hip joint has also been observed.

Because of the body size and weight immobilization of fracture or dislocation is difficult in elephants.

In case of fracture of tibia in a calf, use of modified Thomas splint was successful. A case of fracture of external angle of ilium with distraction was treated with counter irritants and anti-inflammatory drugs effectively. In fractures of femur and radius and ulna, effective immobilization could not be achieved. Vertebral fractures were fatal.

## 8. Perforating wounds on the trunk

Wounds were the common lesions of the trunk caused by:

- (i) crushing between logs of wood
- (ii) pointed objects tearing through and
- (iii) penetrating objects including the tusk penetrating through

Injuries to the trunk cause difficulty in prehension and in drinking. Since the trunk is supported by both longitudinal and circular muscles, the wound edges gape. Bleeding will be profuse and the animal repeatedly sneezes. The lesions are extremely painful, especially if it is near the tip.

*Treatment:*

- (i) General anaesthesia for control
- (ii) Clean, remove debris, freshen wound edges and suture the wound by '8' type or near and far tension sutures. Relaxation sutures are applied to protect the primary sutures.

- (iii) Dressing the wounds with antiseptics
- (iv) Parenteral administration of antibiotics
- (v) Rest
- (vi) Animal should not be permitted to take water or fodder with the trunk till healing is complete. Animal may be hand fed.

### 9. Sinusitis

Frontal sinusitis was observed in young and old animals. It was characterized by clear to cloudy nasal discharge. Work or walking increased the quantum of discharge which was offensive smelling.

It responds to antibiotic therapy. Broad-spectrum penicillin, ciprofloxacin, rifamycin, INH and vitamins and minerals were found to reduce the discharge. The treatment had to be continued for 3-6 months.

### 10. Temporal adenitis

Hypertrophy of the temporal glands and secretion from it was noticed during musth. The gland during this period may get injured or infected resulting in temporal adenitis. Retention of secretions may also cause adenitis.

Two types of lesions have been observed.

- (i) Chronic adenitis resulting in thickening and enlargement of the gland and supporting tissue.
- (ii) Purulent adenitis with discharge of pus through the temporal duct orifice.

In chronic adenitis, the gland becomes swollen, hard and painful. The gland and adjacent tissues become indurated and hard. It may get injured resulting in recurrent inflammation at the temporal region. The gland does not show discharge during musth but it may become oedematous.

In purulent form, the gland becomes swollen and oedematous and pus may be discharged through the orifice. The swelling

will be tender and painful. It subsequently behaves like an abscess, point and burst. Owing to irritation, the animal may try to rub or scratch the temporal region and the skin may get injured.

Recurrent injury to the swollen gland is possible when the animal lies down and gets up.

*Treatment:*

- (i) In the chronic form, counter irritants can be applied to resolve the adenitis.
- (ii) In recurrent inflammation, anti-inflammatory drugs may be administered orally and parenterally.
- (iii) The indurated gland may be surgically removed under general anaesthesia.
- (iv) Opening the swelling and cauterizing the gland with caustics like triple sulphate.
- (v) Purulent form may be opened and drained and treated as open wound.

### 11. Broken tusk

Tusk gets broken in:

- (i) automobile accidents
- (ii) fall from a height and
- (iii) charging against hard objects.

The break may be at any part of the exposed tusk with or without exposing the pulp. When the pulp is exposed, it bleeds profusely. The animal shows signs of severe pain.

This may be treated by trimming the broken end and dressing with tincture benzoin. The wound may be sealed with wax. Repeated antiseptic dressing and use of a metal cap would aid recovery.

### 12. Split tusk

The tusk may develop crack or split longitudinally at any part of the exposed

portion. The split may extend to the pulp where in it gets infected and cause decay of the pulp. Serous or serosanguenous discharge may be noticed from the split. When the pulp undergoes decay, the tusk may become loose and shaky.

### 13. Exposure and decay of tusk pulp

The pulp of the tusk gets exposed when the tusk is broken, split or when it is cut short. The exposed pulp gets infected and undergoes decay. There will be offensive smelling discharge and the pulp cavity becomes open. The tusk gradually becomes discoloured and loses its luster. The tusk may subsequently become loose and shaky. Because of irritation, the animal by itself damages the tusk and breaks it.

The pulp does not regenerate. Hence when it degenerates, the growth of tusk will be arrested.

*Treatment:*

- (i) When the tusk is cut short, it bleeds and the bleeding may be controlled with styptics. The wound may be sealed and contamination be prevented.
- (ii) The pulp when undergoes decay, the cavity may be cleaned with antiseptics and dressed with antibiotics periodically.
- (iii) Parenteral administration of antibiotics

### 14. Loss/shedding of tusk

Loss/shedding of tusk *in toto* were observed in severe fall with the tusk struck or entangled. The tusk gets completely separated from the alveoli (osseous socket) at the root. The cavity will be raw and bleeding.

*Treatment:*

Cleaning and dressing with antiseptics and styptics. It was treated as open wound. The cavity does not get completely obliterated. Hence periodic cleaning and dressing is needed.

### 15. Otitis

Purulent otitis developed as an extension of infection from peripheral lesions was observed. The discharge is intermittent and offensive smelling.

It responded to dressing and parenteral administration of antibiotics.

### 16. Keratitis/conjunctivitis/corneal ulcer/corneal opacity

Conjunctivitis, Keratitis and Corneal Ulcer in elephants were caused by trauma or injury from foreign body. The inflammation, when became chronic, causes opacity of cornea. The signs noticed were.

- (i) Profuse lacrimation with soiling of the cheek.
- (ii) Photophobia – animal shows difficulty in opening the eye.
- (iii) Frothy mass of mucus forming at the inner canthus.
- (iv) Congestion of conjunctiva
- (v) Ulcers and vascularisation of cornea.
- (vi) Varying degrees of opacity of cornea.

*Treatment:*

- (i) Cleaning and dressing with antiseptic/antibiotic eye drops.
- (ii) Placentrex subconjunctival, in chronic cases. 5-10 injections given on alternate days.
- (iii) Anti-inflammatory eye drops – diclofenac/betnesol.

### 17. Cataract

Opacity of lens is usually seen in old animals. Partial to complete blindness occurs,

*Treatment:*

Bell Resolvant/Dinoresolvant can be applied but being a disease of senility there will be no recovery.



### 18. Rupture of eye

Occurs as a result of trauma. Extirpation of eye is done with general anaesthesia.

### 19. Penetrating wounds on Chest and Abdomen

All the cases of abdominal and thoracic wounds were those caused by attack of tuskers. Penetrating wounds with laceration of peripheral tissue was noticed. The depth and direction of wounds varied. The tissue in the vicinity of wounds was seen severely damaged.

The wounds were cleaned and treated as open wounds.

### 20. Perforating wounds on abdomen with hernia/prolapse of viscera

The tusk charge injuries that perforated the abdominal wall led on to escape of viscera under cover of parietal peritoneum or without peritoneal covering. The size of the prolapsed/herniated mass varied with the size of the abdominal wound. The organs prolapsed/herniated included omentum and intestines. Depending on the duration of exposure, the viscera showed signs of strangulation, infection or dessication.

#### *Treatment:*

The animal was handled under general anaesthesia. Under antiseptic preparation, the wounds were freshened. All dead tissue was removed. The abdominal wound was sutured with catgut after reducing the herniated/prolapsed mass. Provision for drainage was made while suturing. Antiseptic and antibiotic coverage was provided to prevent contamination and infection. Controlled feeding and parenteral alimentation was necessary till healing was noticed.

### 21. Foot Rot

A degenerative lesion, involving footpad, nails and underlying tissues. Usually seen in

elephants continuously lodged on moist, dirty floor. It is further aggravated by bacterial and fungal infection.

Foot rot is characterized by:

- (i) Disintegration of keratinised footpad.
- (ii) disintegration/splitting of nails
- (iii) separation of portions of foot pad
- (iv) purulent pododermatitis with sinuses on pastern region, between nails and above the nails
- (v) exposure of sensitive tissue beneath nail and foot pad
- (vi) ulcers on foot
- (vii) lameness

#### *Treatment:*

It can be treated by removing all dead and loose tissue and giving formalin footbath. The lesions can be dressed with gentian violet or castellanis paint. Excess granulation can be removed by rubbing with copper sulphate crystals. Lodge the animal in clean, dry surroundings.

### 22. Pododermatitis

Dermatitis of the pastern region and skin at the junction of the nail. The condition develops from exposure to moist, unhygienic floor.

It is characterized by hypertrophy and keratinisation of skin. Skin becomes thick and hyperkeratosed. It may show splits and ulcers. Foot will be oedematous and painful. Lameness is also noticed.

#### *Treatment:*

Remove loose flakes of skin and keratinised tissue and loose nails. Exuberant granulation can be removed with copper sulphate crystals. Gentian violet or castellanis paint can be used for dressing. Keep the animals in clean dry surroundings.

## FOOT DISORDERS AND THEIR CARE IN ELEPHANTS

*K. Rajankutty*

Foot disorders are common in both wild and captive elephants. There are even reports of death of captive elephants due to foot problems. Asian elephants seem to have more foot problems compared to African elephants. The major causes of foot problems are chronically wet and dirty conditions of the standing places. The other causes include use of concrete flooring, specific diseases like Foot and Mouth Disease, penetrating injuries, falling of heavy logs on the foot, prolonged work etc. Following are certain foot disorders commonly encountered in elephants.

**(1) Cracked sole:** Elephants exposed to wet condition and poor sanitation is more prone to this condition. Cracks often penetrate into the foot and expose deep tissues to dirt and infection. The clinical signs include lameness, pain, exudation, erosion and ulceration of the edges of the crack, exuberant granulation and development of a hole in the bottom of the foot. Treatment measures include debridement of cracks, antiseptic irrigation, parenteral and topical use of antibiotic preparations, bandaging of the foot, stabling of elephants in saw dust places and application of leather/fibre glass boots.

**(2) Overworn sole:** Elephants that stand constantly in moist condition can over wear the soles of their feet if they are forced to walk on rough surface. The affected elephant will have tender sole and will be reluctant to move on. Treatment includes adequate rest, foot bath with 1% formalin, application of tar ointment etc.

**(3) Overgrown sole:** This condition occurs as a result of inadequate or uneven wear of the sole or improper trimming of the sole. Irregular shape of the foot, layered appearance of the sole, lameness, pruritis, presence of fissures are the clinical signs observed. Secondary infection and abscessation are the other complications. Corrective trimming of the sole and topical application of antiseptic preparations are the treatments adopted.

**(4) Cracked heel:** Common in elephants exposed to wet condition and poor sanitation. The cracks are seen at the junction of skin and sole at the posterior of the foot. The treatment recommended is as that of cracked sole.

**(5) Overgrown nails:** This condition occurs due to inadequate or improper wear of nails. The nails will extend beyond the foot and will have a deformed shape with roughened and layered appearance. Treated by corrective trimming of the nails and topical application of antiseptic preparations.

**(6) Split nails:** Inadequate wear or trimming, combined with moist condition results to split nails. Usually the splits will be vertical. Deeper splits may expose the sensitive laminae to infection and the underlying tissues get necrosed. The condition can be better treated by corrective trimming the nails and topical application of antiseptic preparations.

**(7) Ingrown nails:** Inadequate or improper wear leads to ingrown nails. Lameness, pain, inflammation and exuberant granulation are the clinical signs. Trimming of the nails, excision of exuberant granulation and topical application of antiseptic/antibiotic preparations are the treatment measures recommended.

**(8) Overgrown cuticle:** Overgrowth of cuticle usually seen concurrently with overgrowth of sole or overgrowth of nail. The overgrown cuticle appears as a roughened, split area of skin proximal to the nail. Regular application of vegetable oil or mineral oil gradually softens the cuticle and the elephant itself rub off the excess cuticle.

**(9) Penetrating injuries:** Penetrating injuries are caused by sharp pointed objects like thorns, nails, needles, restraining instruments etc. The treatment includes exploration and removal of the foreign body, if present, irrigation of wound with antiseptic lotion like providone iodine solution, administration of tetanus toxoid (50-100 L.F Unit/animal, IM), heavy dose of parenteral antibiotics etc.

**(10) Crush injuries:** Usually occurs in elephants used for timber hauling due to the falling of heavy logs. Cold water irrigation, ice packing followed by application of Magsulph - Glycerine paste, administration of Acetyl Salicylic Acid tablets (Aspirin) (20-40 tab B.I.D./animal), tetanus toxoid, parenteral antibiotics, etc.

**(11) Laminitis:** Prolonged work, chilling of exhausted animals or over-feeding are the causes for laminitis. It has also been reported as a complication of foot and mouth disease. Severe lameness, inability to stand, high fever, hotness around the foot pads on palpation are

the clinical signs. Treatment includes slinging of the elephant, administration of antihistaminics, analgesics, and anti-inflammatory agents along with systemic antibiotics.

**(12) Abscessation of the foot:** Occurs in elephant as a sequale to foot injury and poor foot care. Fever, lameness, pain or warmth on palpation and swelling of the entire foot above the nails are the clinical signs. The treatment includes maturing of the abscess by the application of iodine ointment, surgical drainage, repeated flushing of the cavity with antiseptic solution, packing of the cavity with triple sulph powder (A mixture of copper sulphate, zinc sulphate and ferrous sulphate in equal parts) for one week to facilitate separation of pyogenic membrane, dressing of the cavity with Bismuth Iodoform Paraffin Paste (BIPP) or Healing Dust (JJ & DeChane) and administration of parenteral antibiotics.

**(13) Pododermatitis:** The pastern, heel and sole regions will show rough flake like hypertrophic lesions. May be due to fungal infection. Thorough cleaning of the region with 1% copper sulphate solution followed by painting of the area with Gentian Violet solution or Castlani's paint may give a cure to this condition. Prolonged treatment is required. Castlani's paint is prepared as follows: First dissolve 8 g of Resorcinol in 4 gram of Phenol liquid. To this add 8 ml of Methylated spirit and 4 ml of Acetone. Allow to remain for one hour. Then add 0.8 gram of boric acid and make up the total volume to 100 ml with distilled water. 0.4 gram Magenta is also added to it as a colouring material. Magenta can be substituted with Basic Fuchsin.

**(14) Foot rot:** The sole region shows necrotic changes with foul smelling discharge.

In the forefoot, the lesion will be vegetative type and in hind foot will be ulcerative type. Scrubbing and cleaning of the foot, foot bath with 1% formalin, daily dressing with triple sulph powder/Healing Dust followed by application of tar ointment and administration of parenteral antibiotics are the remedial measures employed.

*Control measures*

1. Daily work and care of foot.
2. Daily washing routines to maintain perfect skin and foot conditions.
3. Maintenance of good healthy body conditions.
4. Frequent examination and curing of foot to remove the foreign objects.
5. Regular rasping of toe nails and proper trimming of soles. The entire sole must be removed twice a year.
6. The mahouts may be educated about the importance of foot care.
7. Avoid prolonged work, sudden chilling of exhausted animals, over-feeding etc. to prevent laminitis.
8. The elephants should be kept in dry place with good sanitation.
9. During musth period it is necessary to tether in a specific place for a prolonged period. Hence selection of an elevated area is preferred to provide drainage for excreta to maintain hygienic condition of foot.

## FLUID THERAPY IN ELEPHANTS WITH SPECIAL REFERENCE TO INTESTINAL IMPACTION

*P.C. Alex*

Water is the commonest solvent and life sustaining medium. Maintenance of proper water balance is very important for all physiological processes. Approximately 70% of the body weight in adult animals is made up of water. Out of that 50% is intracellular, 15% interstitial and 5% plasma. Loss of 10% of body water results in serious metabolic disturbances. Rational fluid therapy requires some fundamental knowledge of body fluid physiology. It is supportive and very often life saving. Depending on the seriousness of ailment, fluid therapy may take precedence over other forms of treatment and efforts for diagnosis.

Water balance is normally maintained by careful regulation of water intake and excretion. Water is derived from ingestion of liquids, solid feeds containing water and metabolic water. Water deprivation can be tolerated for highly variable periods. Simple water deprivation results in contribution to the circulating fluids from intracellular and extra cellular spaces.

Daily water requirement is dependent upon variables such as insensible water loss, urinary and faecal loss, ambient temperature etc. The correction of water deficit requires a consideration of initial deficit status, daily basal needs and continuing abnormal loss.

The fluids are administered with the following objectives. 1) to restore the volume of body fluids to its normal level 2) to correct the acid-base imbalances 3) to correct electrolyte imbalances 4) to provide nutritional

supplementation. To practice fluid therapy, a veterinarian must be familiar with 1) the course and pathogenesis of dehydration, electrolyte disturbance pattern associated with acidosis and alkalosis and composition of electrolyte solutions available for treatment.

Dehydration may be due to lack of fluid intake eg., toxæmia or excess loss of water. eg., excess carbohydrate feeding, intestinal obstruction.

The acidity of body fluids depends on the concentration of hydrogen ion ( $H^+$ ). All the enzyme reactions inside the body cell operate optimally within a narrow range of  $p^H$  of about 7.35 to 7.45. The body has an elaborate acid base regulatory system to guard against changes in  $p^H$ . In herbivores, the diets are rich in potassium salts of organic acids, which are oxidized to form excess bicarbonates and decrease the  $H^+$  concentration or increase the  $p^H$ . Therefore in herbivores, the mechanism is directed to counteract or neutralize the excess bases produced. When herbivores become anorectic, they are potassium depleted.

The acid base balance of the body is mainly regulated by means of three mechanisms, 1) the buffer systems 2) the lungs and 3) the kidney. The buffer systems are immediately responsible for correcting the changes in  $p^H$ . Of the buffer systems, the most important is the bicarbonate buffer system. The respiratory system plays a dominant role in the regulation by altering the carbonic acid

level in plasma, the kidney helps to maintain the acid base balance by conserving or recovering the extra cellular stores of bicarbonate.

Changes in the blood  $p^H$  that are caused primarily by alteration of  $HCO_3^-$  are usually associated with metabolic disturbances and are conveniently called 'metabolic'. Any factor which decreases the  $HCO_3^-$ , increases the  $H^+$  ion concentration and hence decreases the  $p^H$  and is called metabolic acidosis. In metabolic alkalosis (vomiting, high intestinal obstruction) plasma bicarbonate is high and plasma potassium and chloride low). Similarly any factor, which causes the increase of  $PCO_2$  (hypoventilation) would cause a decrease in  $H^+$  and increase in  $p^H$  (respiratory alkalosis.)

Although the status of dehydration and fluid requirement for correction can be judged with the help of PCV, the administration of correct therapy may be difficult in elephant practice. The calculation of fluid requirement is based on the total normal turnover of water (65 ml/kg/24 hrs) plus requirement for the abnormal losses.

#### **Type of solutions commonly used in practice**

- Dextrose solution
- Sodium Chloride solution
- Ringers solution
- Alkalizing solution
  - Lactated Ringers solution
  - Acetated Ringers solution
  - Sodium bicarbonate solution
- Acidifying solution
  - Isotonic saline
  - 0.9% Ammonium Chloride solution
- Other fluids
  - Calcium borogluconate
  - 20% Mannitol

Five per cent dextrose solution is isotonic and is preferred for routine use. In general, dextrose requirement must be calculated based on energy requirement of animals. Normally 2.5 per cent dextrose, one litre will give 100 calories of energy. Based on this principle, total requirement of energy for 24 hrs. must be calculated and according to the dehydration level, the fluid may be given. In case of toxæmia, dextrose must be given by mixing with B complex vitamins. Sodium chloride preferred as 0.9 % solution with dextrose. In mild metabolic acidosis lactated Ringers solution is preferred. It is not indicated in severe acidosis and hepatic disorders. The most conservative fluid therapy consists of using a balanced electrolyte solution, isotonic and incapable of inducing abnormalities.

#### **Disease conditions that require intensive fluid therapy**

Gastrointestinal tract impaction is an important disease condition affecting elephants of all ages irrespective of the work for which they are used. The clinical signs of the affected elephants vary with the duration and location of the obstruction. The duration of the disease may range from 4 to 40 days. The dehydration is minimal especially in the initial stages of the disease as the kidney compensates effectively. In addition water is preserved by reduced fecal output and increased absorption which results in dry, scant faeces.

In a study conducted in College of Veterinary and Animal Sciences, Mannuthy the following observations were made. A significant increase in PCV but no significant alternations in Hb, ESR, TEC, TLC and DLC were observed in elephants affected with GI impaction. Biochemical changes in blood

included a significant increase in urea nitrogen and lactate levels. Serum chloride level decreased and bicarbonate level increased. Decreases in the levels of glucose and potassium in the affected elephants were significant. Variations in total protein, sodium, creatinine and aspartate amino transferase in the blood were not significant.

The above findings suggested the presence of mild metabolic alkalosis with hypochloremia and hypokalemia. There was a negative energy balance as evidenced by hypoglycemia. Liver function was not

affected. Based on these results, it was recommended to infuse a balanced electrolyte solution/dextrose saline/gastric replacement solution along with other supportive treatments in elephants during the course of gastrointestinal tract impaction. Electrolyte replacement rather than volume replacement is of paramount importance especially in the initial stages of the disease.

Heat exhaustion involves loss of both sodium and chloride and usually associated with respiratory alkalosis due to hyperventilation. Hence administration of Dextrose saline will be ideal.

## HEALTHCARE MANAGEMENT OF THE ELEPHANTS OF NORTH-EAST INDIA

*K.K. Sarma*

The North-Eastern region of India with Assam and seven sister states is an important area in the Asian elephant (*Elephas maximus*) distribution map of the world. With its vibrant humid evergreen forests and hills, this region, despite being the hotbed of political turmoil for over half a century, shelters approximately one fifth of the total Asian elephant population of the world today. Rough distribution of elephants in the states are as follows:

Distribution of elephants in NE India

Sl. No.	State	Elephant population	
		Wild	Captivity
1.	Assam	5312	1200-1500
2.	Arunachal Pradesh	1607	600-700
3.	Meghalaya	1840	14-20
4.	Nagaland	147	10-15
5.	Manipur	10-15	NA (not available)
6.	Tripura	40	NA
7.	Mizoram	28	Nil

Out of approximately 1500 captive elephants of Assam, the Forest and Wildlife department owns 141 elephants, which is roughly 10% of the total captive elephant population of the state. The distribution of these elephants are shown below:

Distribution of captive elephants in NE India

Sl. No.	Park/facility	Number of elephants
1.	Kaziranga National Park	54
2.	Manas National Park	27
3.	Orang National Park	27
4.	Nameri National Park	12
5.	Pobitora Wildlife Sanctuary	8
6.	Sonai-Rupai Wildlife Sanctuary	2
7.	Assam State Zoo, Guwahati	10

The chief duty of these departmental elephants includes patrolling, communication, transportation, supply, road clearing and tourist safaris. In the recent years, the departmental and other domestic trained elephants are being used as *koonkies* to chase away the crop raiding wild herds on an experimental basis with very encouraging results. Most of the privately owned elephants were exclusively used for lumbering works to harvest valuable woods from the forests in the difficult terrain. Some specially trained monitor *koonkies* were used for capturing of new recruits from the wild for restocking of the depleted captive elephant populations. This method is known as *mela shikar*, where the selected wild calves are noosed. Elephants are also engaged to rescue flood affected people and even to carry polling officials and materials



to far flung inaccessible areas during general elections. Some private elephants are also used in religious, cultural and social functions and processions.

However, logging was the chief mode of engagement and livelihood for most of the privately owned elephants and their owners. After the ban on logging in December 1996, the captive elephant culture received a serious jolt, and unable to bear the economic fallout of this, many elephants were sold for the temples of Kerala and many others were taken away by the traders of Bihar and Uttar Pradesh; majority of which were alleged to have clandestinely sent across the international border to Nepal to work in the tourism fields. After few years of uncertainty, majority of the elephants, particularly of lower and middle Assam have now managed to find logging works either in some privately owned logging fields of Meghalaya or have been engaged in the foot hills of Arunachal Pradesh in illegal logging works.

Diseases commonly encountered in the elephants of this region are either parasitism or traumatic injuries. Incidences of infectious and metabolic diseases are relatively low in the privately owned elephants or are scantily reported.

**Parasitic diseases:** The area experiences very high rainfall during the summer season that extends from mid April to mid September. Humidity level is also very high. Such a favourable climate is mainly responsible for very high incidence of both endo and ecto parasites (90% or above) in elephant population. Frequently encountered helminthes are Amphiostomes, Fasciola, Ascaris and Strongyle species. Cutaneous filariasis is very commonly seen during the summer months. Very pathogenic *Cobboldia*

*elephantis* larvae have been found to be very common particularly in the elephants of the foot hills of Bhutan and Arunachal Pradesh. Louse (*Haematomyzus elephantis*) is also commonly seen.

**Diseases due to trauma:** Though commercial logging is illegal in the region, some elephants are still being engaged in many illegal or private logging fields. Very high incidences of injury have been recorded in these operations including fracture, dislocation, abscess, sores and rope burns. Farra gall is experienced by almost every logging elephant in their working lives. This is because of ill designed and ill fitted logging harness and extended working hours, well into the mid-day. Farra gall has also been recorded in the forest departmental elephants either from defective designs of saddles or from unregulated period of use.

Other miscellaneous injuries like accidental or malicious gunshot wounds, injuries caused by the attack of wild bulls are also very common. Wild bulls generally bite off the tails of the captive elephants. While the hobbled captive bulls are allowed night grazing, they stand no chance against the wild attacker and are often badly injured in these attacks. Foot diseases are also fairly common and the pedicure techniques are not satisfactory.

Though fresh capture of wild elephant calf for restocking captive elephant population has been banned by law, unavoidable circumstances occasionally force the wildlife authorities to capture a few stray animals to avoid public ire. Captive born and wild rescued calves also need to be assimilated to the working elephant force which necessitates training. The traditional training method of Assam is by far the most humane, yet it has been observed that the training of

young recruits, irrespective of their origin (wild or captive born) is conducted too ritualistically. Rope burns and abscessation are commonly observed as a result of this.

Unlike the western facilities, or even the temple elephants of Kerala, the captive elephant of the region are not over weight because of near natural living conditions and rations containing very little grains; hence the incidence of arthritis is very low. For the same reason, other metabolic diseases are also very rare. The fodder and forages contains less fiber and are succulent in nature; so conditions like impacted alimentary canal due to coarse fodder is also very rare. However, urban living conditions particularly in the begging elephants, intestinal obstruction due to ingestion of polythene bags have been encountered.

Tusk injuries, slackness and accidental and malicious exposure of dental pulp is common. Broken tusk has been recorded as logging injuries.

After the ban on logging industries, many virile bulls of this region developed musth and created problems. Musth was known to have occurred before also but sudden cessation on the work which demands tremendous effort; the elephants are forced to a sedentary life style that leads to development of musth in these bulls. The traditional control measures proved ineffective when these massive bulls developed musth and ran amuck. Though most of these bulls were chemically immobilized and disciplined, few also had to be destroyed. Some of these bulls became feral and has created problems in many reserved forests.

Though the region has an ancient elephant keeping tradition and modern veterinary education made its inroads into the region

from sixty years back; the healthcare management scenario of the elephants of the region is still dismal. A multiplicity of reasons might have contributed to such a situation.

The tradition bound owners still largely depend on the ancient methods and has scant respect for the modern veterinary treatment system. Most of the elephants live in the remote and inaccessible areas and it has been difficult for the vets to reach the elephants for treatment.

The veterinary curriculum has very little or nothing about the diseases of elephants and their treatments and the vets are naturally, therefore, ill equipped with knowledge and skill about elephant diseases and their treatment.

What little transformation from traditional to modern method of treatment started taking place, the ban on logging and its economic fallout yet again deterred the elephant owners from seeking veterinary help as the high cost of modern treatment became unbearable for the bankrupt elephant owners.

Though the British army veterinarians like Evans (1910) studied and documented about veterinary remedies in the elephants of the region, the legacy was not carried forth subsequently. Very little scientific studies in the health front emanated from this region. There are at present very few veterinarians dedicated to the healthcare of elephants and they are also doing the job out of personal motivation only. There is very little government or social support for them or their activities.

Out of the government owned elephants, the Kaziranga National Park, Manas and Assam State Zoo have provisions for staff veterinarians. Orang National Park with 27

departmental elephants has no post for in-house veterinarian. Most of the privately owned elephants are only sporadically seen by a vet. There is hardly any protocol for preemptive treatment or preventive vaccination. At best the elephants receive some treatment from the private vets or paravets whenever the owners decide to get veterinary treatment for their charge. Most of these vets or paravets have little knowledge about the treatment of elephants.

It is not difficult to understand that the proper healthcare management of the captive elephant population of the region is extremely essential as they share the same habitat with their wild counterparts. There is always the fear of spread of diseases to the free ranging population which are already very much threatened from various other factors like habitat loss, degradation, loss of corridor, isolation, increased incidence of revenge killing by farmers, electrocution, train accidents, etc. there has been some move to improve the healthcare management practice in the recent years. The Project Elephant Directorate has initiated a scheme for preparation of a comprehensive healthcare management protocol specifically for the elephants of the region. Attempts are being made to bring all the privately owned elephants under the umbrella of government by compulsory microchipping and registration. The Project Elephant scheme also has provisions for preemptive healthcare services for the benefit of these elephants.

Some NGOs are also trying to arrange free healthcare services for the captive elephants of the region.

The Project Elephant has extended its attention for the healthcare and welfare programme of captive elephants only from the year 2001 onwards in realizing their value for the overall conservation of the species. These has also changed the official stand of the forest department of Assam in respect of the captive elephants of Assam, the department started annual festivals dedicated to the elephants, prior to this development the status of the elephants of the region used to be like the proverbial dog of the washer man. The forest department disowned them at the pretext that they are only domestic animals and therefore belonged to the Animal Husbandry Department. The Animal Husbandry Department ducked their responsibility with the excuse that these are scheduled animals under the Wildlife Protection act and hence only the forest and wildlife department should take their responsibility.

In reality, it is the responsibility of humanity to care for them, it was the humans who captured them from the wild to train and make them the beasts of burden for the benefit of the society. Therefore, the society cannot escape from its responsibilities. The care of the magnificent creature must be taken to the extent possible; the society must make little sacrifice to make that happen.

## TUBERCULOSIS IN ELEPHANTS – THE HIDDEN ENEMY

*K. Vijayakumar*

Tuberculosis is an ancient scourge that continues to be an increasingly important public health problem world-wide. Over a decade, since the discovery of tubercle bacilli, there has been an increased understanding of the bacteriological and pathological characteristics of the disease. This along with the introduction of Bacille-de-Calmette Guerin (BCG) vaccination and chemotherapy during the second half of this century resulted in dramatic decline in morbidity and mortality. With the emergence of HIV infection in Indian scenario, the relative magnitude of contribution of innocuous mycobacteria and the emergence of multi drug resistant (MDR) tuberculosis appears to be frightening. Tuberculosis of animal origin has contributed substantially to human infections. With our socio-religious tradition of respect and reverence to elephants, along with the proven tuberculous environment imposes serious threat to the human health.

### **Etiology**

Ancient treatises suggest that tuberculosis may have been detected as early as 2000 years ago in Asian elephants. The first zoo elephant reportedly affected by TB was an Indian elephant that died at the London Zoo in 1875. Additional cases appeared in the literature in the early 20<sup>th</sup> century. The first case of mycobacterial infection in an African elephant was reported

in the 1960's. The important etiological agents responsible for tuberculosis in elephants are *Mycobacterium tuberculosis* complex (*M. tuberculosis*, *M. bovis*, *M. africanum*, *M. microti*), *Mycobacterium avium-intracellulare* complex (MAIC) along with less prevalent species like *Mycobacterium kansasii*, *Mycobacterium elephantis*, *Mycobacterium fortuitum* etc.

### **Source of infection and modes of transmission**

The main source of infection is the infected animal or a human being. Organisms are excreted in exhaled air, sputum, faeces, milk urine, vaginal and uterine discharges and discharges from open peripheral lymph nodes. The most common portals of entry of infection are inhalation and ingestion (Radostits *et al.*, 2003). Inhalation is the almost invariable mode of spread of tuberculosis in all species of animals including elephants and in human beings. The principal mode being droplet infection where in small micelle of exhaled air containing the contagion being inhaled by animals close by. The risk increases when large numbers of animals are housed in confinement. Infection by ingestion is possible at pasture or tethering grounds or when faeces contaminate common drinking water as well as feed troughs or common both ponds, but a large infective dose is required. Under natural conditions, stagnant drinking water can cause

infection up to 18 days after its last use by a tuberculous animal. Where as a running stream of water does not represent an important source of infection. Risk of transmission is more when large number of elephants is taken for bath in stagnant water tanks/ pools. The survival of the organism in the environment is influenced by temperature, moisture, exposure to desiccation by sunlight or ultraviolet light. Other routes include drinking infected milk or feeding infected cows milk to young animals with out proper pasteurization. Housing the animal in groups predisposes to infection, the closer the animals are in contact the greater is the chance of transmission.

### **Pathogenesis**

Tuberculosis spreads in the body by two stages, the primary complex and post-primary dissemination. The primary complex consists of lesion at the point of entry and in the local lymph node. A visible primary focus develops followed by necrosis and calcification surrounded by granulation tissue and cells to establish the pathognomonic 'tubercle'. Post-primary dissemination produces discrete nodular lesions in various organs. In later stages there can be generalization of lesion, which may affect all organs of the body.

### **Clinical signs**

Although the signs vary depending on the localization of infection to a particular organ, some general signs are also evident. Elephants usually suffer from tuberculosis affecting the respiratory tract. Chronic progressive emaciation unassociated with other signs occurs which arouses a suspicion of tuberculosis. A capricious appetite and fluctuating temperature are also noticed with this disease. Cough is not evident in elephants

suffering from tuberculosis and hence expectoration of sputum is not effective. Even in advanced cases of infection the symptoms simulates to that of acute bronchopneumonia. Discharge of sputum, which is colorless and odorless, though the trunk is one of the earliest symptoms. This is all the more evident when the animal is recumbent or when it is made to get up after lying down for some time. Copious discharge is noticed from trunk when the animal is made to lie down for giving bath in ponds or streams. At this stage respiratory distress is not usually noticed. During later stages the discharge may turn milky, thick and tenacious. An offensive odour may be noticed. The quantum of discharge increases and more so when the animal is made to walk long distance and made to work. The animal runs down in condition in spite of good nutrition and care. The animal becomes tired, muscles get reduced and the limbs become weak and animal unable to work or walk. On exertion animal starts panting and exhibit respiratory difficulty. Diarrhea, ascitis and anemia may be noticed but are not consistent clinical findings in elephants. In the terminal stages the animal becomes cachetic. Frank pus discharge, yellowish in colour or mixed with blood with offensive smell may be noticed from the trunk or from the mouth.

### **Necropsy**

A post-mortem examination should be performed on all elephants that die. The examination should include a thorough search for lesions of tuberculosis regardless of exposure status. An intense search for lesions of tuberculosis (TB) is recommended and should be performed in all elephant necropsies. This should include all elephants that die even though TB is not suspected. The owner and the animal attenders should be advised about the potential zoonotic threat

of this infection. Elephants that die naturally should have a post mortem trunk wash performed and serum should be harvested from post mortem blood for serological assays to confirm the diagnosis (Elephant Research and Tissue Request Protocol, 2003).

All elephants undergoing necropsies should have a careful examination of the tonsillar regions and submandibular lymph nodes for tuberculous appearing lesions. All lymph nodes should be carefully evaluated for lesions since other sites may also be infected (eg. reproductive or gastrointestinal tract). Collect any nodes that appear caseous or granulomatous for culture (freeze or ultrafreeze), and fixation (in buffered 10% formalin). In addition, search the thoracic organs carefully for early stages of TB as follows: After removal of the lungs and trachea, locate the bronchial nodes at the junction of the bronchi from the trachea. Use clean or sterile instruments to section the nodes. Freeze half of the lymph node and submit for TB culture to a laboratory experienced in mycobacterial culture and identification (even if lesions are not evident). Submit sections in formalin for histopathology. Carefully palpate the lobes of both lungs from the apices to the caudal borders to detect any firm nodular size lesions. Take sections of any suspicious lesions. Open the trachea and look for nodules or plaques. Regional thoracic and tracheal lymph nodes should also be examined and processed. Split the trunk from the tip to its insertion and take samples of any plaques, nodules or suspicious areas for TB diagnosis as above. Look for and collect possible extra-thoracic TB lesions, particularly if there is evidence of advanced pulmonary TB. Consider submitting cultures of liver, spleen, reproductive organs, and mesenteric lymph nodes for confirming TB,

especially if there are suspicious lesions (Elephant Necropsy Protocol, 2003). There is one reported case of an elephant diagnosed to have uterine TB infection.

### Diagnosis

Currently, the diagnosis of TB in elephants remains a dilemma. The sensitivity of trunk wash culture, the currently recommended test for diagnosis, is unknown. False negatives have been documented (trunk wash negative elephants that were subsequently found to be culture positive at necropsy). Although unlikely, false positive results may also occur due to incorrect handling of specimens at the time of collection. Cross contamination of specimens has been documented using older microbiologic growth systems but appears to be comparatively rare at present. Other non-culture techniques for TB diagnosis include ELISA, PCR, Gamma interferon assay and lymphocyte stimulation test. Serologic or other indirect assays (that detect antibodies but not the actual organism) may not be able to differentiate among 1) animals that are infected and shedding 2) animals that are infected and not shedding and 3) non-infected animals that were previously infected. Potential future diagnostic tests might utilize those being developed for human patients.

To adequately address the concerns of TB in the general elephant population, all captive elephants should be tested annually by culture under the direct supervision of a qualified veterinarian. If possible, elephants should be tested the same month each year so that annual test dates are 12 months apart. It is recommended that all elephants must be tested every calendar year (Elephant Tuberculosis Research Workshop, 2005).

A number of other ante-mortem tests are under investigation to diagnose TB. In

elephant researches done to date, has not demonstrated a correlation between the intradermal tuberculin test (skin test) and culture results. Therefore, intradermal skin testing cannot be deemed reliable for screening or diagnosis of tuberculosis in elephants and hence is not recommended. Preliminary investigations suggest ELISA testing of serum for the presence of antibodies against TB and Nucleic Acid Amplification tests to detect the presence of bacteria in sputum or other samples may be useful. However, additional data is needed to validate these tests.

Samples for culture should be collected under the direct visual supervision of a licensed veterinarian using the “triple sample method.” This method consists of obtaining three samples from the trunk on three separate days. If possible, collect samples within a seven-day period. Do not pool samples. Samples should be taken after water has been withheld for at least two hours to reduce sample dilution and contamination. Light exercise prior to collection may facilitate obtaining secretions from lower the respiratory tract, which is desirable. Of the following methods, the trunk wash with bag seems to provide the most effective way to collect samples at this time. Samples collected by swab are not acceptable. As there is a risk of human exposure to sputum produced during collection procedure, protective measures are recommended for personnel during sample collection.

A trunk wash can be performed with a bag (or other suitable container) using a catheter tip syringe. First, instill 60 ml sterile saline into the trunk. Immediately place a clean, one-gallon plastic bag over the end of the trunk and hold in place until the elephant exhales into the bag. Transfer at least 20 ml

of the sample to a sterile leak proof, screw cap container. (50-ml conical screw cap sterile centrifuge tubes are preferred). Do not expose samples to sunlight or heat. Freeze samples as soon as possible after collection and keep frozen until shipment.

### **TB Management groups**

Based upon the culture results and status of exposure to known culture positive animals, all elephants should fall into one of the following five management groups *viz.* A, B, C, D and E. (Guidelines for Control of Tuberculosis in Elephants, 2003). A culture positive elephant is defined as an elephant from which organism has been isolated from any body site or specimen.

**Group A (Negative culture; no exposure to culture positive animal in the last five years).** Monitor annually by triple sample method on separate days. Ancillary tests for data collection encouraged but not required. No treatment or travel restrictions. No elephant should move into a facility where there is an untested elephant.

**Group B (Negative culture; exposure to culture positive animal between one to five years age).** Monitor quarterly by the triple sample method for one year and then annually thereafter if all cultures remain negative. No treatment or travel restrictions. Ancillary tests are encouraged but not required. No elephant should move into a facility where there is an untested elephant.

**Group C (Negative culture; exposure to culture positive animal within last 12 months).** This group should be tested and then handled according to either *Option 1* (Prophylactic Treatment) or *Option 2* (Monitor by Culture).

**Group D (Current *M.tuberculosis* positive culture)**

Animals that have had *Mycobacterium tuberculosis* complex isolated from any sample (sputum, stool, tissue, etc.) are considered as culture positive. A culture positive elephant is considered positive until 1) it has completed six months of treatment with documentation that adequate TB drug serum levels have been achieved on two separate testing dates and 2) at least two consecutive months of negative culture results obtained as per standard procedures. These elephants should be separated from the public for the duration of the treatment period. Separation from previously non-exposed elephants is also recommended. It is recommended that precautions to safeguard personnel health and safety be instituted immediately (Elephants with cultures that yield non-tuberculous strains of mycobacteria are not considered infected and are not a risk to other animals or humans.

**Group E (Untested )**

If an elephant cannot be tested, it should not be permitted to have direct public contact or contact with other tested elephants (or their enclosures or equipment). Untested elephants should not be moved from their home facilities. A tested elephant should not move into a facility housing an untested elephant unless it can be demonstrated that there will be no direct contact with the untested elephant or with its enclosure or equipment.

**Treatment**

Similar to diagnostic issues, treatment parameters of tuberculosis in elephants are still under investigation. Effective drug levels for elephants have not been determined however, levels known to be effective in

humans have been achieved in elephants. Adverse drug effects have been a significant issue for some elephants. Long-term medication administration is challenging in this species, and currently there is no pre-mortem method to confirm a cure. However, there are a number of new anti-tuberculosis drugs being developed for humans that may be more effective or have fewer side effects. Other routes and treatment regimens (route and frequency) could also be explored for future treatment options.

The guidelines for the treatment of TB in elephants are based on the assumption that animals with known active disease are treated similarly to humans. Drugs commonly used for treatment of tuberculosis in elephants include isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), ethambutol (EMB) and streptomycin (SM). These are agents with the greatest activity and the best side effect profiles. Initial empirical therapy has usually included INH, RIF and PZA. Drug resistance has been identified to INH and RIF. This may necessitate treatment regimens with limited choices of remaining first line agents (PZA, EMB), inclusion of second line agents or the use of drugs for which there is significantly less clinical data (e.g. enrofloxacin or other quinolone antibiotics). Second line agents include those with less activity and/or greater side effects. Second line agents include amikacin, Para-aminosalicylic acid, capreomycin, ethionamide, cycloserine, thiacetazone, and the quinolones (ciprofloxacin, levofloxacin, moxifloxacin). Elephants can be discerning eaters and difficult to treat orally, especially long-term. Direct oral administration appears to achieve slightly higher blood levels than the rectal route, and oral administration over food fed ad lib is no longer recommended.



However, elephants can be trained to accept a bite block for oral administration with an equine dosing syringe. Some drugs, such as amikacin, can only be given by injection. Drug formulations with higher concentration may be used in order to decrease the volume injected intramuscularly. 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.

Isoniazid	5 mg/kg (Oral or rectal)
Rifampin	10 mg/kg (Oral only)
Pyrazinamide	30 mg/kg (Oral or rectal)
Ethambutol	30 mg/kg (Oral only)

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 hence some experimentation may be required to determine a workable regimen for each individual elephant. Target blood levels for anti-TB drugs in elephants have not been established. Until further studies can be conducted, target blood levels of anti-TB drugs for elephants must necessarily be based on human data.

### **Human safety**

All employees that are in contact with elephants should be skin-tested for TB

annually following established human testing guidelines. New employees should be tested prior to contact with elephants. Any employee with a positive skin test (i.e. a positive intradermal reaction to purified protein derivative (PPD), should be evaluated for the possibility of active TB. Employees with acid-fast positive (sputum/ smear positives) should be removed from animal contact until it is determined whether this represents infection with an organism of the *M.tuberculosis* complex. Measures to protect staff from infected animals include the use of respiratory HEPA (N95) filtered masks during all direct or indirect contact with infected animals, including cage cleaning, medication administration, feeding, watering, etc. The facility should contact local health agencies and should provide additional other protective gear such as gowns, gloves, etc. For moral and legal grounds the employee should be informed the potential hazards of infection and the public health significance.

The threat of global disaster due to tuberculosis looms large over the humanity especially in the wake of human AIDS epidemic. This is especially true in the developing tropics where the prevalence of tuberculosis is the highest. The epidemiology of elephant tuberculosis and its potential zoonotic significance has received little attention in our country. Hence a detailed epidemiological investigation on the occurrence, diagnosis and control of this infection among captive and wild elephants and its public health significance assumes paramount importance

## NECROPSY PROTOCOL WITH SPECIAL REFERENCE TO ELEPHANTS

*N.D. Nair and N.Vijayan*

Postmortem examination is the systematic and scientific examination of tissues and organs of a carcass to determine the cause of death, the extend of lesions or the nature of illness. Examination of gross lesions tell us what type of disease process has occurred and to what extent it has damaged specific organs systems. So postmortem examination is indispensable to an intelligent and scientific understanding of disease process. This is best accomplished by facts accurately recorded and objectively interpreted.

The elephant is conspicuous for its massive size. Constraints associated with the treatment of disease is also applicable to the autopsy examination. In the wild it may not be often possible to conduct an autopsy before autolytic changes set in. However, the autopsy should be conducted in a systematic way with the objective of making a disease diagnosis and learning the anatomical peculiarities of this species. It is very essential therefore that much attention must be paid to understand the methodology and interpretation of autopsy findings. A systematic procedure is the must and an unhurried technique must be followed to arrive at a correct diagnosis. For a thorough systematic examination, the methods and implements to be used must be standardized. So systematic procedure has so far been prescribed for elephants. Elephants being larger in size need special attention and

expertise in dissecting and it is better to follow a pattern which suits to all situations. Hence all attempts must be made to systematize the postmortem procedure for improving the efficacy of learning process to improve the knowledge regarding elephants. It is also indispensable to have a basic understanding of the special anatomical features of the elephants which will be discussed in the class.

### Postmortem equipment

Standard large animal autopsy set along with the following are required. Axe-small and big, Hand saws, Hammer and Chissel, Crowbar, Ropes, scissors, Sealpels, blades, metal detector to search bullets, emergency lamps, vehicle fitted with light focusing facilities and camera.

Tissue fixatives, sample collection bottles, culture tubes slides, blood and urine collection vials, labels, waterproof marking pens, gloves head and eye gear and first aid kits are the other requirements.

**Necropsy procedure:** As in any other case of autopsy collection of history is important followed by external examination. This includes examination of whole body, examination of skin for manmade, animal inflicted or accidental wounds, eruptions, swellings etc. A basic understanding of the features of wounds of varying types is a must. The wounds may be either closed or open and again it may be incised, penetrating,

lacerated, contused or gunshot wounds. Examine the temporal glands for musth, visible mucous membranes for pallor, cyanosis, congestion, icterus, natural orifices and extremities for lesions.

It is always advisable to designate a necropsy team in advance comprising veterinarians, anatomists, microbiologists and pathologists. It is essential to assign specific task to team members. A team consisting of two or three skilled assistants may be assigned the task of dissecting the head, forelimbs, hind limbs, thoracic region and abdominal region.

Dissect and remove the ears, trunk and tail. Decapitate the head by cutting through the atlanto-occipital joint. Dissect out the costly tusks. Expose the brain which needs several cuts to reach it. Large knives, long axe, chisels can be used to cut and crowbar for lifting the severed bones.

The forelimbs and hind limbs are cut and removed by disarticulating the various joints, tearing the tissues by crowbar and pulling out using crowbar.

Expose the thoracic cavity by dissecting out the skin, and S/c tissue along the vertebral column. Lift them up, passing a rope in the middle after incision, flap it by pulling. Separate and remove the structures by making deep incisions at the margins of the ribs at the cranial and abdominal ends of the thoracic wall and connecting them with a deep ventral midline incision. Cut the vertebral articulations with axe and expose the cavity by pulling as above and severing the costochondrol articulations of the sternum. Abnormal contents or other lesions present in the thoracic cavity should be noted down. The heart, lungs and associated structures are thus exposed and can be cut and separated.

Expose the abdominal cavity by dissecting the skin, S/c tissue and muscles by making deep incisions along the ventral midline from the xiphoid to the pubis and from this to the anterior border of the iliac crest and along the lumbar vertebrae. Slip off the omentum and pull out the intestine and stomach. Remove the liver and spleen separately. While opening the abdomen look for the presence of abnormal fluid as cases of impaction at the colorectal area leading to blockage, thinning, gangrene and rupture of intestine is common in elephants.

The kidneys, bladder and reproductive organs are removed by separating their attachments.

**Examination of organs:** All parts of an organ should be examined thoroughly. The size and shape of the organs, presence of abnormal fluid, odour emanating from the organs and nature of contents in a hollow organ have to be examined. Organs should be examined by palpation, making linear incision and look for deep seated lesions. Any lesion in the lung should be subjected to Mycobacterial examination. The bronchial lymph nodes even if appears normal have to be cultured to rule out TB as TB is on the increase among captive elephants and it poses threat to the mahouts.

**Collection of tissues:** For a specific diagnosis histopathological examination has to be done. Therefore tissues have to be collected and fixed immediately in 10% neutral formalin. While collecting part of the normal tissue should also be included. The size should not be more than 1 c.m. For vetero-legal cases the samples and tissues collected are preserved in rectified spirit. The collected materials are sealed in stoppered bottles and send to the chemical examiner.

A bottle containing the sample preservative should also be submitted for examination.

**Cultural examination:** Heart blood, spleen and mesenteric lymph nodes should be cultured. Organs where lesions are seen and suspected for infections should also be cultured.

**Autopsy report:** an accurate recording of the lesion encountered is essential. It must be written in the prescribed proforma. While

describing gross lesions, abnormalities and lesions should be recorded in precise scientific language. The points to be noted while describing the lesions are a) location b) colour, (c) size (d) shape of the lesions (e) consistency (f) surface on cross section and nature of the exudates. Assess the importance of the lesion before diagnosis is given. Special laboratory examination conducted if any and the results may be evaluated for etiopathological diagnosis.

## COLLECTION AND PRESERVATION OF CLINICAL MATERIALS FOR LABORATORY EXAMINATION AND INTERPRETATION OF HAEMATOLOGICAL FINDINGS

*P.C. Alex*

In the field of veterinary medicine accurate diagnosis is highly essential for providing efficient treatment and to take preventive measures. The clinician has to seek the help of laboratories for the confirmation of his diagnosis. A laboratory provides means for achieving a diagnosis as quickly as possible. In many cases the success of diagnosis depends on the skill and care with which the clinician selects, collects, and transports the material to the laboratory. A good clinical history of the case should always accompany the material as the clinical history is frequently the key to accurate diagnosis.

Common clinical materials collected

- Blood
- Urine
- Milk
- Faecal matter
- Skin scrapings
- Discharge from natural orifices
- Pus
- Cerebrospinal fluid
- Transudate
- Exudate
- Biopsy materials
- Autopsy materials
- Feeds or fodder

Common methods of preservation

- By adding chemical preservatives
- Refrigeration
- Freezing

The following points should be kept in mind

1. A detailed case history should accompany the specimens
2. Collect specimens before starting the therapy.
3. Collect from proper sites.
4. Obtain the materials free from contamination.
5. Make smears that are neither too thin nor too thick.
6. Specify the source of material and whenever possible the kind of examination to be made.
7. Use cotton tipped swabs; the exceptions are body fluids and sputum which should be collected in sterile glass containers.
8. Avoid contamination of the swab or container after collection.
9. Deliver the specimens to the laboratory as promptly as possible. Swabs must be kept moist by the addition of a few drops of cultured broth. An alternative procedure is immediate inoculation of culture media.
10. Select a proper specimen with due regard to nature of disease, duration of illness and etiology.

11. In the laboratory, it is important to
- Read the request slip carefully, noting the source of specimen, tentative diagnosis and type of examination requested.
  - Make stained smears of all specimens except swab of the faeces, gums and throat.
  - Preserve all the specimens in the refrigerator until cultured.

### Blood

Equipments for collection of blood:

A clean dry syringe, needle, sterile vials, test tube, cover slips, slides, cotton, antiseptics, anticoagulants.

Site of collection:

Elephant - Ear vein

Containers used

- For clotted blood

Chemically clean and dry containers/test tube

- For whole blood

Glass vials fitted with rubber or poly ethylene stoppers are recommended

- Vacutainers

Vacuum tubes, with a special holder and needle are available in a variety of sizes from 2 to 50 ml, either plain or containing anticoagulants.

### Blood sampling techniques

Reliable interpretation of haematological parameters depends upon the blood sample reaching the laboratory in a suitable state for the test to be carried out. High environmental temperature and ageing result in haemolysis which in turn may result in a reduction in packed cell volume, MCV, total RBC count and an increase in MCHC.

### Collection and preservation of clinical materials

Materials	Preservatives used	Quantity of preservatives
1. Faeces	10% Formalin	1:4
2. Urine	1. Toluene	Cover the surface of urine
	2. Thymol	Small crystal
	3. Formalin (40% formaldehyde)	One drop/30 ml urine
	4. Chloroform	
	5. Boric acid	
3. Milk	Refrigeration	
4. Blood sample	1. EDTA	1-2 mg/ml
	2. Heparin	0.1-0.2 mg/ml
	3. Smear, fix it with 95% ethanol	
5. Tissue sample	1. Phosphate buffered 10%Formalin	1:10
	2. 3-4% buffered gluteraldehyde for electron microscopy study	
Tissue for toxicology (if in doubt consult the laboratory)	1. Fresh samples preferred 2. Freezing 3. Dry ice 4. 95% ethanol	1 ml/g of sample

**Normal values**

**Interpretation**

**I. PCV** : Interpretation must be made in the light of hydration status of the animal.

- (a) PCV less than normal : Anaemia
- PCV more than normal: Haemoconcentration
- (b) Colour of plasma layer is also diagnostic under certain pathological conditions

Normal - straw coloured

Deep yellow -Jaundice

Colourless / pale plasma -blood loss/bone marrow depression

Hazy appearance -lipemic

**II. ESR** : Method – Wintrobe tube and Westergren tube method

Morphological classification of anaemia

Normal ESR does not exclude the possibility of disease process and is a guide to prognosis.

Increased ESR – general and local conditions like

- (i) peritonitis
- (ii) pleuritis
- (iii) pericarditis
- (iv) pregnancy
- (v) malignant tumours

**III. Erythrocyte indices**

$$MCV (fl) = \frac{PCV \times 10}{RBC}$$

$$MCHC (\%) = \frac{Hb \times 100}{PCV\%}$$

$$MCH (pg/dl) = \frac{Hb \times 10}{RBC}$$

Parameter	MCV normal	Increased MCV	Decreased MCV
Normal MCHC	Normocytic normochromic	Macrocytic normochromic	Microcytic normochromic
Decreased MCHC	Normocytic hypochromic	Macrocytic hypochromic	Microcytic hypochromic

**IV. Interpretation of leukogram**

Leukogram consists of total leukocyte count, differential leukocyte count and morphologic evaluation of blood leukocytes.

**1). Leukopenia** : decrease in the total number of circulating leukocytes.

Associated with

- a. Infection-viral origin (not all), early stages of bacterial infection/localized severe infection
- b. Sequestration of leukocytes into the capillaries of lung, liver, spleen. eg. Shock
- c. Affections of bone marrow

d. Chemicals (lead, mercury)

e. Drugs (Streptomycin, aspirin, phenylbutazone)

**2). Leukocytosis:** Increase in the total number of circulating leukocytes above the accepted normal range.

Physiologic - due to release of epinephrine and exercise, convulsions, excitement, pain, pregnancy.

Pathologic – localized/generalized infection, intoxications, tissue necrosis.

**Response of individual cell types**

1. Neutrophil response

Functions - 1. Phagocytosis

## 2. Digestion of foreign materials

The neutrophil release from bone marrow is regulated by leukocytosis inducing factor.

### **Neutrophilia without a left shift**

Increase in the number of neutrophils without increase in immature cells in the peripheral blood.

Physiologic – release of epinephrine, exercise, increased heart rate, stress.

Pathologic – mild inflammatory disorders.

### **Neutrophilia with a left shift**

Increase in number of neutrophils with increase in the number of immature cells of granulocytic series – eg. Local inflammation and increased tissue demand for neutrophils.

Normal neutrophil count with a left shift/ normal leukocyte count with increased number of immature cells in the peripheral blood (degenerative shift to left).

Eg. Bacterial sepsis, Septicemia

### **Neutropenia with or without left shift**

1. Excessive tissue consumption of cells, peritonitis, acute metritis, aspiration pneumonia.
2. Sequestration of circulating neutrophils by endotoxins and mediators of anaphylaxis (pseudoneutropenia).
3. Drugs, chronic infections, deficiency of Vit. B<sub>12</sub> and folic acid.

### **Immune mediated neutropenia**

Persistent neutropenia with monocytosis  
M/N ratio is high.

### **Lymphocyte response**

T cells – Thymus derived – cell mediated immune response

B cells – Bursa derived – humoral antibodies

Lymphopenia

1. Tissue redistribution of cells (Stress, hyperadrenocorticism)
2. Lysis of lymphocytes – Radiation, immuno suppressive drugs.

Lymphocytosis

1. Hypoadreno - corticism
2. Lymphocytic leukemia
3. Fear/excitement

### **Eosinophil response**

Eosinophilia – More than 750 cells/ $\mu$ l

1. Skin allergies
2. Food allergies
3. Anaphylactic reactions
4. Parasitism

Eosinopenia

1. Stress
2. Administration of ACTH or corticosteroids

### **Basophil response**

Basophilia

1. Hyper adreno corticism
2. Basophilic leukemia
3. Hypothyroidism

### **Monocyte response**

Monocytosis

1. Stress conditions
2. Pyometra, Retained placenta
3. Granulomatous inflammation (TB, mycotic infections)



## TRAINING THE MAHOUTS

*P. J. Rajkamal and T. S. Rajeev*

The captive elephant is the symbolic image of a secularist culture at least in Kerala. The elephant is Lord Ganapathi to Hindus and hence its importance in temple rituals and festivals. Nevertheless, the caparisoned elephant has become an important item in Muslim and Christian festivals as well.

The number of festivals or livelihood activities involving elephants are comparatively more in the central districts of Kerala, namely Thrissur, Ernakulam and Palakkad. Their population hence tends to be more in these parts of the state. Though the elephant is in domesticity and looked after by mahouts for whom it is the source of livelihood, it is only considered as a wild animal unlike other livestock species obviously due to rigorous wildlife protection policies.



Fig. 1. Elephant with mahout

It has been a pleasure as well as displeasure keeping elephants. It is undoubtedly a pleasure to experience a docile one but displeasure to experience a dare-devil. However, we tend to forget dare-devilry whatsoever accidents and sorrow that has brought. It raises chicken or egg problem when we also consider the part that torturing these companions is too common. Have lack of know how and do how apart from right attitude been many a times the precedents of dare devilry?

Recent observations by the authors reveal that there was a serious lack of know how as evident from some least known practices to mahouts. These were methods to be adopted while taking elephant in hot weather, water requirement per day, precautions to be taken while experts make use of capture gun, signs of water deficiency, techniques of first aid for wounds, right methods of mounting on elephants and sitting etc. Similarly, elephant owners were found to be seriously lacking know how regarding causes of impaction, maximum weight that can be lifted by an elephant, minimum quantity of drinking water required for an adult elephant per day, maximum walkable distance with maximum bearable weight, normal thickness of restraining chains, normal length of neck rope etc.

Further, there were many practices least adopted by mahouts which indicated lack of right attitude apart from lack of do how and know how. For instance, procedures to be adopted while the elephant is made to walk a long time during hot weather, making the elephant to carry only less than 500 kg at a stretch, usage of chains of thickness 1/2",

5/8" or 3/4", making to walk below 6 km with the maximum weight it can bear, properly restraining during festival performance, providing at least 250 lit of drinking water per day, precautionary measures while caning the hind limbs, methods used to correct small mistakes and mischieves of elephants, precautionary measure while using ankush, methods to be adopted to reduce the degree of seriousness of impaction once its symptoms are noticed etc.

It was known from the proportionate random sample of 50 each of owners, first and second mahouts studied that none of the elephant owners had undergone a formal training on elephant management. Only a first mahout and three second mahouts had attended a formal training programme organized by the elephant welfare association of Kerala perhaps only one of its kind in the country. To compound the issue further 30 and 26 percentages of the first and second mahouts respectively were illiterates.

R.C. Lair in his famous book "Gene Astray, the care and management of Asian elephants in domesticity" published by FAO wrote that poor mahoutship was the most frightening problem faced by the domesticated elephants in Thailand, India and Sri Lanka. Mahouts themselves have admitted this. For instance, Ponnappan a known mahout of Kerala had admitted that most of the injuries to elephants were caused due to ignorance and uncontrolled use of restraining devices by the mahouts as recorded in the book "Gajaparipalanam-prasnangalum, pariharangalum".

There is legal recom-mendation too in this regard. The Government of Kerala had laid out the rules regarding captive elephant management vide provisions under section 64 of Wild Life Protection Act 1972. Some of the relevant rules read as follows:

1. All the mahouts in service and newly recruited shall undergo inservice/pre

service training by Forest Department and obtain license.

2. The Chief Wildlife Warden/authorized officer will issue license based on his performance in training.
3. The license should be renewed every two years.

Similarly, the rules insist proper housing, ownership, care of elephants, feeding practices, work load, timber hauling, acts of cruelty to elephants, norms and standards of transportation, retirement of elephants, care of old elephants, record keeping, breeding policy, cutting tusks and remuneration to mahouts.

There has always been a strong public feeling regarding the importance of training the mahouts and owners and inculcating a right attitude in them. The disdain with which we ignored this might explain most of the accidents involving loss of precious lives. We are yet to learn the lesson. This costly neglect nonetheless should not continue.

Mahouts have been trained in 'the traditional ways. This traditional system of learning i.e., learning informally from the predecessor involves transfer of irrational know how as well that may include brutal practices. This system should be replaced by the modern one so that scientism and human practices find a place. Empathy, compassion and right attitude are to be inculcated through appropriate curriculum and instructional methods.

Therefore, it is high time that we realized the importance of formal training. Perhaps a functional literacy programme is the foremost priority to the mahouts. Experts of elephant management, experienced and renowned mahouts and nonformal educationists can jointly formulate the curriculum and lesson plans for such a functional literacy programme.

## MEDIA AND ELEPHANT WELFARE

*T. P. Sethumadhavan*

Ever since the beginning of planned development in the country, the role of the media in the process of development has been recognized. Information is an important resource input in the process of gradual and orderly change in the tradition bound rural areas. This emphasizes the need for evolving a new and effective communication strategy. Therefore, the media strategies for elephant welfare will have to be geared to the ethos and relevance of the people and should highlight the dissemination of scientific information and practices. The media strategies for elephant welfare include the press, local radio stations, programmes on television and reinforcement through extension agencies, so as to facilitate and reinforce the adoption process through interpersonal and face-to-face communication process.

Over the years our forest cover has shrunken. Now elephant is an endangered species. Asian elephant is also no exception. Asian range countries like India, Sri Lanka, Myanmar, Thailand, etc. have a fascinating history of domesticating elephants. Historical evidence revealed that they were domesticated around 4000 years ago. Today the press plays an effective role in the dissemination of information on elephants. Several innovative concepts have to be put into practice for creating awareness among millions of people so as to provide information and confidence to adopt modern technologies. Very little research work has been done in the elephant welfare sector to assess the coverage, readability, accuracy and

relevancy of articles. The study to understand coverage of news on elephants published in selected dailies and to assess its readability by the author revealed that dailies provided 2.9 per cent pages for publishing information related to elephants. Of the three modes of presentation news articles occupied maximum column length in all dailies studied. Frequency of occurrence of news article was found to be more when compared to other modes of presentation. Reading easiness of news articles was found to be good with an average readability as indicated by Fog index of 5.28. In Kerala with regard to captive elephants, reports on Human-elephant conflicts are getting more media coverage.



*Fig.1. Caparisoned elephant*

Human elephant conflict and sustainable elephant welfare measures are some of the recent issues of media concern. Frequent media reports acts as an eye opener and helps to monitor and correct some of the unscientific practices and imminent issues. Human elephant conflict varies with captive and wild Asian elephants. These issues have to be tackled in a participatory and time bound manner. At the same time it should be self-sustaining also. Kerala, which occupies less than 1.18 per cent geographical area of the country, has more than 20 per cent of the captive Asian elephant population. Cost of elephant rearing is increasing day by day. As part of mechanization elephants are rarely used for work in the timber mills. Elephant owners are getting income through festivals and processions that too limited to certain seasons of the year. As a result they are compelled to work more during festive seasons. Over work, absence of trained mahouts, poor feeding and management, diseases, cruelty coupled with restriction for breeding cause stress and hormonal imbalance that may ultimately lead to musth and human elephant conflict. In Myanmar elephants are not allowed to enter within the urban limits. During pre-musth period they are allowed to mate with wild elephants. Similar semi-intensive breeding strategies are followed in the Mudumalai range of Tamilnadu. Moreover in Tamilnadu female elephants are used for festivals. In Thailand elephants are mainly used for tourist rides.

Recently the term sustainability is widely used. Sustainable elephant welfare is still a controversial issue. Management practices with regard to wild and captive Asian elephants are entirely different. Captive elephants may exhibit their wild character, which is another proven issue. Awareness

about different elephant rearing practices like feeding, management, housing, reproduction, constraints, problems and strategies pertaining to conservation, animal welfare measures, geographic imaging system and human elephant conflicts need adequate attention. As part of the extension strategies public awareness programmes and meaningful communication have to be given enough emphasis to project the elephant welfare measures. Sound conservation strategies will yield sustainable development to the present generation and maintenance of its potential will meet the aspirations of the future generations.

In order to reduce human-elephant conflict and to develop better human-elephant relationship, encourage scientific management practices and adopt sound land-use strategies. To minimize the likelihood of conflicts occurring in captive Asian elephants, awareness programs for the public, animal welfare organizations, research workers, etc. play a key role. Print and electronic media play a major role in reporting news related to human-elephant conflicts and relationships. Poaching for ivory, which is only found in male Asian elephants, is severely affecting the sex ratio in some areas, notably South India, Cambodia and Vietnam.

Asian elephants live in the region of the world with the densest human population, which is growing about three per cent a year. Clearance of forests for settlement and agriculture is disrupting traditional elephant migration routes and leading to violent clashes between humans and animals when hungry elephants raid crops. The Asian elephant specialist group of the IUCN describes the current distribution of elephants in North, South, East and Northeastern forest divisions.

Estimated population of elephants in the country according to Karnataka Forest Department (Census 2001) is around 28729, of which more than 50 per cent elephants are in South India. About 20 per cent of the world's human population lives in or near the present range of the Asian elephant.

Elephants frequently move outside the borders of even the largest conservation areas; almost 70 per cent of the Asian elephant's range is now outside national parks and reserves. Meanwhile, human populations in Asia are increasing at a rate of 2.5-3 per cent a year. Human-elephant conflicts have become widespread, and unless innovative measures are adopted to address the concerns of the rural poor, Asian elephants will disappear in the wild throughout most of their range.

Many protected areas are surrounded by a landscape dominated by people and wildlife authorities must pay attention to the concerns of the human population. Conservationists in Asia must adapt their strategies so as to improve people's livelihoods because programmes designed for elephants will only

succeed if they recognize the concerns and needs of people who compete with the elephants for resources. The emphasis, therefore, must be on accommodating both elephants and human beings.

The key to reduce human-elephant conflict in Asia is, first and foremost, to encourage the adoption of sound land-use strategies that would make it more difficult for elephants to stray into human settlements. It will be important to develop mechanisms to predict where human-elephant conflicts are likely to occur and to enlist the support of governments and local communities to undertake land-use planning in order to minimize the likelihood of such conflicts occurring. Regulations of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) banning trade in Asian elephant products should be strongly enforced. Through WWF-supported projects in India, Thailand, Vietnam, Cambodia, China, Indonesia, Bhutan, Nepal and Malaysia this problem is being assessed and solutions are being sought. People living in elephant areas could be assisted in protecting their homes so that they do not turn hostile towards elephants.

# APPENDIX - 1

## TIPS FOR LABORATORY INVESTIGATIONS

### LABORATORY SPECIMEN FORM

Please examine the specimen for: .....

.....

Specimen No	:	.....	Species	:	.....
Specimen type	:	.....	Sex	:	.....
Preservative used	:	.....	Age	:	.....
Collection date	:	.....	Weight	:	.....
Place	:	.....			

Disease suspected : .....

History of ailment / death / outbreak .....

.....

.....

Time lag between death & collection : .....

Time lag between collection & preservation : .....

Mode of despatch : Post / rail / air / bus / messenger / .....

Time of despatch : .....

Investigator's name: ..... Signature: .....

Sender's address	Laboratory address
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**DISEASES THAT CAN BE DIAGNOSED FROM MATERIALS  
IN DIFFERENT PRESERVATIVES**

**(A) From faeces:**

<i>Preservation</i>	<i>Species</i>	<i>Disease</i>
1. 10% Formalin	All species	Helminthic diseases
2. 2.5% Pot. dichromate	All species	Coccidiosis
3. Refrigeration	All mammals Ruminants, primates Birds All species  Carnivores Bovids	Listeriosis Paratuberculosis Ornithosis (Psittacosis) Coccidiosis, Poisoning Salmonellosis, Q Fever Canine parvovirus Bovine coronavirus, E. coli,

**(B) From body fluids:**

<i>Fluid type</i>	<i>Preservation</i>	<i>Species</i>	<i>Disease</i>
Uterine fluid, milk & semen	Refrigeration	All mammals Bovids Ungulates	Listeriosis, Brucellosis, Vibriosis Trichomonosis
Vesicular fluid of i. Foot and mouth lesions ii. Pox lesions	50% buffered glycerine	Ruminants, Pigs, Elephant All species	FMD Pox
Urine	Refrigeration	All species Carnivores All mammals	Capture myopathy Ova of kidney worm Leptospirosis, Poisoning Q Fever
Cervical, vaginal/ preputial secretions	Refrigeration	Bovids Ungulates	Vibriosis Trichomonosis
Crop, throat fluid	Refrigeration	Birds	Trichomonosis
Effusion fluid (lung)	Refrigeration	Bovids	Pleuropneumonia
Oedema fluid	Refrigeration	All mammals	Pseudorabies
Nasal discharge	Refrigeration	Ruminants Ungulates Bovids, pigs	Schistosomosis Rhinosporidiosis Rhinothacheitis
Tears	50% buffered glycerine	Ruminants, Pig	Rinderpest
Pleural fluid	Refrigeration	All mammals	Leptospirosis

**(C) From stomach/intestinal contents:**

<i>Preservation</i>	<i>Species</i>	<i>Disease</i>
Refrigeration	All species	Botulism
0.5% chloroform		Enterotoxaemia (Clostridial)
(No preservative)	All species	Poisoning
Refrigeration	Foetal stomach contents of mammals	Brucellosis, Aspergillosis Trichomonosis, Vibriosis Listeriosis, Mycotic abortion

**(D) From blood:**

<i>Material type</i>	<i>Preservation</i>	<i>Species</i>	<i>Disease</i>
Whole blood (in anticoagulant)	a) Refrigeration	Ungulates All species  Primates Equines  Ruminants,  Pig Carnivores	Blue tongue Leptospirosis, Botulism Q Fever KFD African Horse Sickness Rinderpest, Black quarter Hog cholera Feline panleukopenia
Thin blood smear	-----	All species  Birds All species  Primates	Protozoan diseases, Haemofilarids Anaplasmosis, Fowl cholera Anthrax Trypanosomosis Pasteurellosis KFD
Serum	Refrigeration/ Freezing/ 0.5% Phenol	All species	All infectious diseases



**(E) By impression and / or smears:**

<i>Specimen Type</i>	<i>Species</i>	<i>Disease</i>
Lung tissue and lymph node	All mammals	Coccidiomycosis, Theileriosis
Lesions of affected organs	All species Ruminants	<i>Tuberculosis</i> , Protozoan diseases Actinomycosis, Actinobacillosis
Brain	All mammals	Rabies, Listeriosis
Foot lesions	Ruminants	Necrobacillosis
Pus, fluid, exudates	Ruminants	Black quarter, Actinobacillosis, Actinomycosis
Intestinal scrapings	All species Ruminants, Primates	Salmonellosis, Paratuberculosis
Fluid of pox-like lesions	All species	Pox
Faecal smear	Ruminants, Primates All mammals	Paratuberculosis <i>Clostridium perfringens</i> (Type B,C), Cryptosporidiosis,
Placenta-cotyledon, foetal stomach contents	All mammals	Aspergillosis

**(F) From cotton swabs preserved under refrigeration**

<i>Materials</i>	<i>Species</i>	<i>Disease</i>
Throat swabs	All species	Pasteurellosis (HS)
Swabs of blood	All species	Pasteurellosis, Anthrax
Cut surface of lymph nodes	All species	Anthrax, Paratuberculosis
Pus/exudates from tissues	Ruminants, pigs	Black quarter, Actinobacillosis, Actinomycosis
Body fluids	All species	Listeriosis
Foot, mouth, throat lesions	Ruminants	Necrobacillosis
Rectal swabs	All species Ruminants	Salmonellosis Paratuberculosis
Nasal swabs	Bovids, pigs, felids Ruminants, Ungulates	Rhinotracheitis Schistosomosis Rhinosporidiosis
Vaginal, ocular, preputial swabs	Bovids, pigs	Rhinotracheitis
Tear swabs (in 50% GB)	Ruminants, pigs	Rinderpest
Cervical swabs	All mammals	Trichomoniasis
Nasal, ocular, tonsillar swabs	Bovids	Bovine adenovirus

**(G) By preserving in 50% buffered glycerine:**

<i>Specimen type</i>	<i>Species</i>	<i>Disease</i>
Vesicular fluid of tongue/gums, epithelium of tongue/gums/mouth Foot lesions	Ruminants Pigs, elephant All ungulates Primates Ungulates	FMD Vesicular stomatitis Simian herpes virus FMD
One half of brain	All mammals	Rabies, Pseudorabies
Liver, spleen, heart, lung	Equines Primates Swine	Afr. Horse sickness KFD, Virus B, Herpes Hog cholera
Tear swab	Ruminants, Pigs	Rinderpest

**(H) By preserving in 10% formalin:**

<i>Specimens</i>	<i>Species</i>	<i>Disease</i>
Affected tissues	All species  Ruminants Sheep/goat	Pox, Tuberculosis, Tumour Aspergillosis Actinobacillosis, Actinomycosis Contagious ecthyma
Urinary bladder, lung, liver, kidney, heart, trachea	Carnivores  All species	Canine distemper, Canine hepatitis Leptospirosis, Toxoplasmosis
Liver, spleen, brain, oral lesions	Primates	KFD, Virus B infection, Simian Herpes infection
Heart (muscle)	Ruminants, Elephant, Pig	FMD
One half of brain	All mammals	Listeriosis, Rabies, Pseudorabies
Mesenteric lymph nodes, small intestines (SI)	All mammals Carnivores Ruminants	Listeriosis Feline enteritis Paratuberculosis
Spleen, SI	Carnivores	Feline enteritis
Affected muscles	All species	Capture myopathy
Liver, spleen, lung, lymph nodes	All species	Histoplasmosis, Coccidiomycosis
Lungs	Elephants	Herpes virus infection
Trachea & turbinates	Bovids	Rhinotracheitis
Faeces (5-10 gm)	All species	(Parasite ova detection)

**(I) Preserved under refrigeration/freezer:**

<i>Specimen</i>	<i>Preservation</i>	<i>Species</i>	<i>Disease</i>
Affected muscle, liver	Refrigeration	Ruminant, Pig	Black quarter
Affected tissues	Refrig/Freez Refrigeration	All species Ruminants	Pox, Tularaemia, Tuberculosis Actinobacillosis, Actinomycosis
Liver, lung, rumen	Refrigeration	Ruminants	Necrobacillosis
Mesenteric lymph nodes	Refrigeration	All species	Salmonellosis
Ileo-caecal portion	Refrigeration	Ruminants All mammal	Paratuberculosis Pseudotuberculosis
Blood, spleen, liver	Refrigeration Refrig/Freez Refrigeration	Ruminants All species Primates Rodents, Hare	Blue tongue Erysipelas Virus B infection Chlamydiosis
Spleen, pre-femoral and pre-scapular LN	Refrigeration Refrig/Freez	Pigs Ruminant, Pig	Hog cholera Rinderpest
Liver	Refrigeration	All species Ruminant, Pig Primates	Botulism Black quarter Virus B infection
Placenta, foetus	Refrigeration	Bovids  All mammals	Rhinotracheitis, Aspergillosis, Listeriosis, Mycotic abortion
Placenta-cotyledons, milk, semen, testes, cervical mucus	Refrigeration	All mammals  Bovids	Trichomonosis, Brucellosis, Q Fever Vibriosis
Epithelium of gum/ tongue vesicles	Refrigeration	Ruminant, Pig, Elephant	FMD
Blood (heart, venous), lung, spleen, heart, kidney, trachea	Refrigeration  Freez/Refrig.	All mammals   Carnivores Birds Pigs Equines	Leptospirosis, Listeriosis, Toxoplasmosis, Pasteurellosis, Histoplasmosis, Pseudotuberculosis Canine hepatitis Ornithosis African swine fever African horse sickness
One half of brain, spinal cord	Refrigeration	All mammals  Primates	Leptospirosis, Rabies, Listeriosis, Pseudorabies, Virus B infection

Lung and adjacent lymph node	Refrigeration	Elephants Ruminants	Herpes virus infection Pleuropneumonia
Oesophagus, crop	Refrigeration	Birds	Trichomoniosis
Spleen	Refrig/Freeze	Rodents	Q Fever
Lung, urinary bladder, cerebellum	Freeze	Carnivores	Canine distemper
Trachea, lung, kidney	Freeze	Bovids	Bovine rhinotracheitis
		Equids	Equine rhinotracheitis
		Felids	Feline rhinotracheitis
Small intestine	Refrigeration	Carnivores	Canine parvovirus

### Preparation of Some Important Preservatives

No	Name of the preservative	Constituents required	Method of preparation
1.	50% Buffered glycerol	Citric acid (CA), double distilled water (DDW)  Disodium phosphate (DSP), glycerine	<ol style="list-style-type: none"> <li>1. Prepare a CA solution of 21 gm/1000 ml of DDW Take 2.15 ml of this.</li> <li>2. Prepare a DSP solution of 28.4 gm/1000 ml of DDW. Take 97.85 ml of this</li> <li>3. Mix both solutions to make 100 ml.</li> <li>4. Add 100 ml of glycerine Autoclave the mixture at 15 lbs for 30 mts.</li> </ol>
2.	10% formalin	Clean water & commercial (40%) formalin	Add to one part of commercial formalin, 9 parts of water.
3.	70% Alcohol	Alcohol, distilled water	Add to 7 parts of rectified spirit (alcohol), 3 parts of distilled water.
4.	2.5% Potassium dichromate (PD)	PD & distilled water	<ol style="list-style-type: none"> <li>1. Take 2.5 gm of PD</li> <li>2. Make up the volume to 100 ml with distilled water</li> </ol>
5.	0.5% Phenol	Phenol, distilled water	Take 0.5 ml of phenol and make up the volume to 100 ml with distilled water.

## **APPENDIX - 2**

### **KERALA CAPTIVE ELEPHANTS (MANAGEMENT AND MAINTENANCE) RULES, 2003.**

#### **Forest and Wildlife (F) Department**

#### NOTIFICATION

G.O.(P) No.12/2003/F&WLD. Dated, Thiruvananthapuram, 26<sup>th</sup> February, 2003.

*1. Short title and commencement –*

- (1) These rules may be called the Kerala Captive Elephants(Management and Maintenance)Rules, 2003.
- (2) They shall come into force at once.

*2. Definitions –*

- (1) In these rules, unless the context otherwise requires,-
  - (a) “Act” means the Wildlife (Protection) Act, 1972 (Central Act 53 of 1972);
  - (b) “Cavady” means a person engaged to assist the mahout;
  - (c) “Chief Wildlife Warden” means the person appointed as such under section 4 of the Act;
  - (d) “Department” means the Kerala Forest Department;
  - (e) “Elephant” means any elephant, captured or kept or bred in captivity;
  - (f) “Mahout” means the person who manages the captive elephants;
  - (g) “Owner” means a person who owns an elephant as per the provisions of the Act and the Rules made thereunder;
  - (h) “Ownership Certificate” means the certificate of ownership issued as per the provisions of the Act and the Rules made thereunder;
  - (i) “Veterinary Doctor” means a registered Veterinary Doctor or an experienced Ayurvedic elephant expert;
- (2) Words and expressions used and not defined in these rules but defined in the Act shall have the meanings respectively assigned to them in the Act.

*3. Mahouts -*

- (1) For taking care of each elephant, the owner thereof shall engage a mahout having at least 3 years experience in managing an elephant.
- (2) The experience of the mahout shall be certified by the officer authorised for the purpose by the Chief Wildlife Warden;
- (3) Every mahout shall attend training programmes in elephant care as and when called for by the Forest Department and it shall be the responsibility of the owner to facilitate the above training by relieving the mahout after making suitable arrangements.

(4) The owner shall engage the cavady to assist the mahout.

4. *Housing of Elephants* –

(1) The owner shall provide a stable (tethering place) in a clean and healthy environment with sufficient shade to keep elephants during its rest period;

(2) Each elephant must be ensured a minimum floor area as specified below:-

(i) Weaned Calf (height below 1.50 m) .. 5 m x 2.5 m

(ii) Sub-adult elephant (height 1.50 m to 2.25 m) .. 7 m x 3.5 m

(iii) Adult elephant (height above 2.25 m) and  
Cow elephant with unweaned calf .. 9 m x 6 m

(3) In the case of covered sheds, the height of the structure shall not be less than 5.5 m;

(4) Corrugated iron sheets or asbestos when used for roofing of elephant stables shall be covered with cooling materials like gunny bags, grass, cadjan leaves etc.

5. *Care of Elephant* -

(1) The mahout shall ensure that the elephant gets a thorough bath every day;

(2) If the elephant is found sick, injured, unduly stressed or pregnant, the mahout shall report the condition to the owner, who in turn shall consult a Veterinary Doctor for providing treatment expeditiously;

(3) Routine examination including parasitic checks shall be carried out regularly and preventive medicines including vaccination be administered at such intervals as may be prescribed by the Veterinary Doctor;

(4) The owner shall arrange for medical check-up of the mahout responsible for upkeep of the elephant at least once in two years to ensure that they do not have any diseases, which may infect the elephant;

(5) The organizers of festivals where elephants are used shall submit in writing the programmes with details to the station house officer and the Range Officer having jurisdiction over the area, who in turn shall ensure the implementation of the provisions in these rules;

(6) The owner shall inform within 24 hours, to the Chief Wildlife Warden or the nearest forest office, the cases of attack of anthrax, rinderpest, hemorrhagic septicemia, surra or any other contagious diseases and shall follow the instructions issued by the authorities regarding the treatment of the animal or disposal of the carcass. The Chief Wildlife Warden or an officer authorized by him shall ensure proper veterinary assistance and advice;

(7) The owner shall obtain prior permission of the Chief Wildlife Warden or the officer authorized by him before undertaking sterilization, vasectomy, tubectomy or any other population control measures for the elephant and shall ensure the assistance of a competent veterinary doctor for these measures;

- (8) The elephant showing symptoms of musth shall be got examined by a Veterinary Doctor;
- (9) No drugs or intoxicants shall be used to suppress musth except on a written prescription by a Veterinary Doctor;
- (10) The owner of the elephant shall ensure that in case of musth, the elephant is secured properly and does not become a hazard to the public at large;
- (11) An elephant in musth shall not be put to any work;
- (12) No owner shall put to work, any elephant having pregnancy of 12 months or above, or any cow elephant having a suckling calf of age below 6 months, or any elephant of height below 5 feet;
- (13) No owner shall permit the use of nylon ropes or chains/hobbles with spikes or sharp edges for tying the elephants;
- (14) Weight of the chains and hobbles shall commensurate with age and health of the elephant;
- (15) No owner shall permit any type of harness which may expose the back or other sensitive organs of the elephant to pain and injury;
- (16) No owner shall permit his elephant to be trained by a trainer who is not approved by the Chief Wildlife Warden or the Officer authorized by him for the purpose;
- (17) The owner shall report within 24 hours, to the Chief Wildlife Warden or to the officer authorized by him, the death of an elephant and the tusks, if any, shall be declared within one week to the Chief Wildlife Warden for obtaining Ownership Certificate;
- (18) The owner shall get the postmortem examination of the elephant done by a Veterinary Doctor and shall submit the report to the Chief Wildlife Warden or the Officer authorised by him within 15 days of the death.

6. *Feeding of Elephants -*

- (1) The owner or the person who is managing the elephant on contract or the person who has taken the elephant for own purpose shall ensure timely supply of wholesome feed with variety in required quantity to each elephant. Green fodder shall be supplemented by ration as prescribed by Veterinary Doctor;
- (2) The minimum feed supply for elephant shall be as follows:-
 

Height of elephant	Feed
Below 1.50 m (weaned calf)	Not less than 100 kg.
1.50 m to 1.80 m	Not less than 150 kg.
1.81 m to 2.25 m	Not less than 200 kg.
Above 2.25 m	Not less than 250 kg. (or 5% of its body weight)
- (3) Supply of sufficient quantity of succulent food to the elephant shall be ensured during hot climate;
- (4) The owner or contractor or hirer of the elephant shall provide sufficient potable drinking water to the elephant, preferably from a river or any other source of running water.



7. *Work Load of Elephant –*

- (1) The scale of load including gears, riders and materials for the elephant shall be as follows:-

Height of elephant	Load
Below 1.50 m	Not to be used for carrying load
1.50 m to 1.80 m	Not exceeding 150 kg (To carry only fodder and trainer)
1.81 m to 2.25 m	Not exceeding 200 kg.
2.26 m to 2.55 m	Not exceeding 300 kg.
Above 2.55 m	Not exceeding 400 kg.

- (2) The load scale shall be reduced by 50% in hilly or other difficult terrain;
- (3) The elephants of height below 2.10 m shall not be deployed for logging operations.
- (4) The elephants of height from 2.10 m to 2.25 m shall not be used for dragging timber logs exceeding 750 kg in weight;
- (5) The elephants of height above 2.25 m shall not be engaged for dragging logs exceeding 1000 kg in weight;
- (6) Ill-designed logging harness such as exposing elephants backbone and chest to extreme strain and injuries, using tusks and jaws regularly for dragging timber logs, timber hauling over steep areas or rocky areas etc. shall not be done.

8. *Norms and Standards for Transportation –*

- (1) For transportation of the elephant, necessary permission from the Chief Wildlife Warden or any other officer authorized by the Government in this behalf shall be obtained as provided under section 48 A of the Act;
- (2) A valid health certificate from a veterinary doctor 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 shall be obtained in the form given in Appendix I;
- (3) In the absence of such a certificate, the carrier shall refuse to accept the consignment for transport;
- (4) The elephant shall be properly fed and given water before loading;
- (5) Necessary arrangements shall be made for feeding and watering the elephant *en route*;
- (6) No elephant shall be made to walk for more than three hours at a stretch;
- (7) While transporting elephants by walk during nights, two prominent reflectors shall be placed at the front and hind portion of the elephant;

- (8) No elephant shall be made to walk more than 30 kms a day and any transportation for more than 50 kms shall be carried out in a vehicle;
- (9) Trucks with length less than 12 feet shall not be used for carrying elephants except calves (height below 1.50 m);
- (10) One truck shall not be used to carry more than two weaned calves (height below 1.50 m) or one elephant with one unweaned calf or one adult/sub-adult elephant (height above 1.51 m);
- (11) At least 12 hour rest should be allowed to elephants for every 12 hours of journey by trucks;
- (12) Cow elephants in advanced stage of pregnancy should not be transported by trucks;
- (13) While transporting elephants by rail, an ordinary goods wagon should not carry more than three adult elephants or six calves on broad gauge, or 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.
- (14) While transporting elephants by truck or train, care shall be taken to maintain constant speed avoiding jerks and sudden stops and reducing effects of shocks and jolts to the minimum;
- (15) Each truck or wagon carrying elephant should have at least two attendant mahouts;
- (16) Sedatives, if necessary, shall be used to control nervous or temperamental elephants only as prescribed by the Veterinary Doctor.

9. *Retirement of Elephants -*

- (1) An elephant shall normally be allowed to retire from its work on attaining an age of 65 years;
  - (2) Healthy elephants above 65 years of age shall be allowed to be put to light work under proper health certificate from the veterinary doctor.
10. Records to be kept - Every owner shall maintain the following records and registers in respect of the elephant in the form given in appendix-II and such records and registers shall be produced before the officers authorised by Government in this behalf for inspection at such time as may be called for.
- (a) Vaccination record
  - (b) Disease and treatment record
  - (c) Movement register
  - (d) Feeding register
  - (e) Work register

*11. Cutting Tusks -*

- (1) The owner of the tusker shall apply for permission of the Chief Wildlife Warden or the officer authorized by him in this behalf, for cutting or shaping the tusk through a letter sent by registered post, indicating the location where it will be done and the name of the competent person who would perform the operation at least one month in advance;
- (2) The Chief Wildlife Warden shall give the permission within three weeks to carry out the operation in the presence of an officer not below the rank of Forest Range Officer or Forest Veterinary Officer or Assistant Forest Veterinary Officer as instructed by the Chief Wildlife Warden;
- (3) The authorized officer shall report to the Chief Wildlife Warden, the details of the cut portion such as, length and weight of the tusk;
- (4) In case permission is not granted, the owner shall be intimated of the reason for rejecting the request in writing;
- (5) The Chief Wildlife Warden, based on a written request with the details shall issue a permit to the owner for keeping the cut tusks in accordance with the provisions of the Act.

*12. Acts which are tantamount to cruelty to elephants -*

The following acts shall be considered as acts of cruelty to elephant and is prohibited:-

- (a) beating, kicking, over-riding, over-driving, over-loading, torturing or treating any elephant so as to subject to it to unnecessary pain or suffering, or being an owner permitting, any elephant to be so treated;
- (b) employing in any work or labour or for any purpose, any elephant, which by reason of its age or disease, infirmity, wound, sore or other cause, if unfit to be so employed, or being owner permitting any such elephant to be employed;
- (c) willfully and unreasonably administering any injurious drug or injurious substance to an elephant or uses drugs or intoxicants to control elephants particularly to suppress musth without proper veterinary advice;
- (d) conveying or carrying whether in or upon any vehicle or not, an elephant, in such a manner or position as to subject it to unnecessary pain or suffering or cause accident;
- (e) keeping or confining an elephant, in any cage or receptacle, which does not measure the specifications given in rule 4;
- (f) keeping for unreasonable time, an elephant chained or tethered upon an unreasonable short or unreasonably heavy chain or cord;
- (g) using an elephant for drawing any vehicle or carrying any load, more than nine hours a day or for more than five hours continuously without a break or rest for the elephant or exposes the elephant to hot climatic conditions without ensuring enough succulent food and electrolytes;

- (h) failing to provide an elephant, with sufficient food, drinking water or shelter;
- (i) abandoning an elephant in circumstances, which will render it to suffer pain by reason of starvation or thirst;
- (j) offering for sale any elephant, which is suffering from pain by reason of mutilation, starvation, thirst, over-crowding or other ill treatment;
- (k) not providing adequate veterinary care to a sick, injured or pregnant elephant;
- (l) cutting the tusks of a bull elephant too short so as to expose horn core/pulp;
- (m) forcibly weaning away an elephant calf below 2 years of age from its mother;
- (n) using heavy chains and hobbles with spikes or sharp edges or barbed wires for tying elephants;
- (o) using “peti” (belly band) on cow elephants in advanced stage of pregnancy;
- (p) using pad and Nundah of improper size on working elephant exposing its spinal cord to injuries;
- (q) marching a sick, injured or pregnant elephant or a young calf over very long distances or for a long duration at a stretch;
- (r) marching an elephant over tarred roads or otherwise, during hottest period of the day and for a long duration at a stretch without rest for religious or any other purpose;
- (s) transporting elephants on trucks of inadequate size or trucks with uneven floor, or tying them in an improper manner – subjecting them to severe jerks during journey by truck;
- (t) transporting elephants in trucks for over 12 hours at a stretch;
- (u) transporting elephants through any conveyance without making arrangement for adequate fodder and drinking water during the journey;
- (v) carrying load on an elephant without proper pad;
- (w) making an elephant carry load unevenly balanced on its back;
- (x) making the elephant to stand in scorching sun for long duration, or put the ceremonial gears or decoration for unreasonably long duration or bursts crackers from or near the elephants for ceremonial purposes;
- (y) using an elephant in such a manner so as to cause any injury, over-stress or strain to the elephant for tourism purposes;
- (z) using an elephant for sports and games such as tug-of-war, foot ball etc. in such a manner so as to cause over stress or strain to the elephant.

**Appendix I**  
**(See Rule 8)**

**FORM FOR CERTIFICATE OF FITNESS TO TRAVEL ELEPHANTS**

(This certificate should be completed and signed by a Veterinary Doctor)

Date and Time of Examination .....  
Number of Elephant .....  
Name of Elephants.....  
Age/Sex .....  
Number of Cages .....

I hereby certify that I have read rule 8 of the Kerala Captive Elephants (Management and Maintenance) Rules, 2003.

1. That, at the request of (consignor) ..... I examined the above mentioned elephants in their travelling cages not more than 12 hours before their departure.
2. That each elephant appeared to be in a fit condition to travel from the ..... area to ..... by road/rail and is not showing any signs of infections or contagious diseases.
3. That no cow elephant appeared to be under advanced stage of pregnancy.
4. That the elephants were adequately fed and watered for the purpose of the journey.
5. That the elephants have been vaccinated.

- (a) Type of vaccine/s
- (b) Date of vaccination/s

Signed .....  
Address .....  
.....  
.....  
Qualifications .....

Place: .....

Date : .....

**Appendix II**  
**FORMS OF RECORDS AND REGISTERS TO BE KEPT**  
 (See Rule 10)

**1. Vaccination Record**

- (a) Name of the Elephant :  
 (b) Sex :  
 (c) Age :

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<i>Date of Vaccination</i>	<i>Name of Disease</i>	<i>Due date for next Vaccination</i>	<i>Signature of the Veterinary Surgeon</i>
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**2. Disease and Treatment Record**

- (a) Name of the Elephant :  
 (b) Sex :  
 (c) Age :

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<i>Date of Treatment</i>	<i>History</i>	<i>Description by Veterinary Surgeon</i>	<i>Diagnosis</i>	<i>Treatment</i>	<i>Preventive Measures</i>	<i>Signature of the Veterinary Surgeon</i>
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**3. Movement Register**

- (a) Name of the Elephant :  
 (b) Sex :  
 (c) Age :

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<i>Date</i>	<i>Place to Move</i>		<i>Time</i>		<i>Signature of the Mahout</i>
	<i>Starting</i>	<i>Ending</i>	<i>Starting</i>	<i>Ending</i>	

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**4. Feeding Register**

- (a) Name of the Elephant :  
 (b) Sex :  
 (c) Age :  
 (d) Ration prescribed by the :  
 Veterinary Surgeon

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<i>Date</i>	<i>Type of Food</i>	<i>Quantity given</i>	<i>Signature of the Mahout</i>
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**5. Work Register**

- (a) Name of the Elephant :  
 (b) Sex :  
 (c) Age :  
 (d) Admissible quantum :  
 of work

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<i>Date and Weather</i>	<i>Type of Work</i>	<i>Duration</i>		<i>Signature of the Mahout</i>
		<i>From</i>	<i>To</i>	

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By order of the Governor,  
 E.K. BHARAT BHUSHAN,  
 Secretary to Government.

**Explanatory Note**

(This does not form part of this notification, but is intended to indicate its general purport).

The Wildlife (Protection) Act, 1972 does not provide for the management of captive elephants, except for issuing of Certificates of Ownership to those who possess the captive elephants and for issuing permits for the transportation of the elephants. There are many complaints about the ill treatment of captive elephants such as beating, overriding, over-driving or otherwise torturing so as to cause unnecessary pain to the animal. The number of captive elephants in the state is also on the increase. Therefore, it is necessary to prescribe rules and procedures for the effective and proper management of the captive elephants. This notification is intended to achieve the above object.

## APPENDIX - 3

### PACKAGE OF PRACTICES – 2001

*Kerala Agricultural University*  
**ELEPHANT**

#### **Types of Elephants**

The elephant is the largest living land mammal with an evolutionary background of more than 50 million years. They belong to the family Elephantidae under the order Proboscidea. There are two types of elephants under two separate genus *Loxodonta* (African elephants) and *Elephas* (Asian elephants). The African elephants *Loxodonta africana* include two races as *Loxodonta africana africana* and *Loxodonta africana cyclotis*. The Asian elephant *Elephas maximus* is sub-divided into five races viz., *Elephas maximus ceylonicus* (Ceylon elephants), *Elephas maximus sumatranus* (Sumatra elephants), *Elephas maximus hirsutus* (Malayan elephants), *Elephas maximus burmanicus* (Burma elephants) and *Elephas maximus indicus* (Indian elephants). The African elephants are distinct with large body size, more height, large ears, tallest point at the shoulder, small trunk with two finger like lips at the tip, large tusks in both males and females, marked dip on the back between the fore and hind quarters, elongated and narrow face with flat forehead. The distinguishing features of Asian elephants are comparatively smaller size, lesser height, highest point at the middle of the back, comparatively smaller ears, large and long trunk with one lip at its tip, tusks only in males, unbroken, convex curved back, bull dogged face with twin domed forehead.

#### **Capturing of elephants**

The following methods can be employed to capture elephants

1. Making elephants fall into pits prepared for the purpose
2. Driving elephants into stockades and noosing individually (keddah method).
3. Lasso method or noosing elephants from back of trained elephants (Koonkies) Melasikar.
4. Placing nooses concealed on the pathways of elephants.
5. Employing female decoys to attract tuskers.
6. Using tranquilisers in syringe rifle.

Pit method was well adopted in Kerala

Pits with a measurement of 4 m square at top and 2 m at the bottom with 4 m depth are dug in a triangular fashion of three each at a distance of 16 m apart on the pathways of elephants. Usually 40-50 pits are dug in a forest area. Pit is filled to 2m with twigs and grass and is covered with split bamboo, earth, grass and leaves. When elephants fall into pits, they are retrieved with the help of koonkies and marched off to krall under proper restraint. Training in krall lasts for 3-6 months.

#### **Anatomical peculiarities**

Trunk, the amazing nose, is the elongation of the upper lip and is the most distinctive feature of the elephant. It is composed of longitudinal and circular muscle fibres.



Incisor teeth of the upper jaw transform into the tusks and its one-third portion is embedded within the skull. Tusks are composed of dentine (ivory) with a conical cap of smooth enamel at their tip in the initial stages and grow continuously throughout the animal's life. Tuskless male elephant is known as Makhana.

#### Dental formula

$$2 \left( I \frac{1}{0} (\text{tusk}), C \frac{0}{0}, PM \frac{0}{0}, M \frac{6}{6} \right)$$

How ever there will be only one set of molars in the buccal cavity at any one time. Molar progression and fragmentation will take place five times in the life span of elephant. Hence total molars are 24 in number.

Temporal glands are located on either side of head just beneath the skin, above the zygomatic arch, at a point about half-way between the lateral canthus of the eye and external opening of the auditory canal. Its duct opens at the temporal fossa close to the lateral canthus of each eye. Histologically, the gland is compound, tubuloalveolar and apocrine in nature. Temporal glands become engorged and secrete discharge during the period of musth in male elephants.

The vertebral formula is

C7, T19, L4, S4, Cy30.

There are 19 to 20 pairs of ribs.

Heart has twin apices and there is only one coronary artery. Gall bladder is absent. Pleural cavities although present in young ones are obliterated in adults. The large and small intestines are about 35 to 45 feet and 65 to 75 feet in length respectively. Ovaries are slightly lobulated and placed in bursa as in canines. Placenta is incompletely annular and zonary and it occupies the equator of an ovoid chorio-allantoic sac. In males papiniform plexus, cremastor muscle and inguinal canal are absent. Testes are intraabdominal. Epididymis is indistinct or absent. Wolffian duct is highly convoluted.

#### Ageing the elephant

It is difficult to calculate exact age of an elephant from its external appearance. Curling of upper border of ears, narrowing of limbs, sunken cheek, depigmentation of skin etc. may give some indication of ageing.

The number of ridges present on the molar teeth give an indication of age, as tabulated below.

Molar	Plates/ridges	Appearance age	Replacement age
1	4	4 months	2 to 2½ years
2	8	6 months	6 years
3	12	3 years	9 years
4	12	6 years	25 years
5	16	20 years	45-50 years
6	24	40 years	Lasts upto 80 years

**Physiological parameters**

Respiration	10/minute while standing 5/minute on recumbency
Pulse	28/minute while standing 35/minute on recumbency
Rectal temperature	35.9°C (96.6°F)
Urine	Urine is turbid and alkaline. Usually excretes 50-54 litres per day.

Haemogram	Tuskers	Adult non-pregnant non-lactating females (Mean ± SE)	Pregnant Elephants Mean ± S.E.	Lactating Elephants (Mean ± S.E)
Total leukocytes ( $10^3/m^3$ )	8.8 ± 0.54	9.8 ± 1.20	12.4 ± 3.7	8.9 ± 0.65
Neutrophil(%)	34.2 ± 0.94	32.3 ± 1.63	44.1 ± 0.90	35 ± 0.01
Eosinophil(%)	6.2 ± 0.75	6.6 ± 0.92	1.9 ± 0.62	4.0 ± 1.00
Basophil(%)	0.7 ± 0.27	0.9 ± 0.24	0.5 ± 0.38	1.0 ± 1.06
Lymphocyte(%)	52.8 ± 1.42	56.2 ± 1.33	50.6 ± 2.06	54.0 ± 0.01
Monocyte(%)	6.1 ± 0.86	3.9 ± 1.09	2.9 ± 1.19	6.0 ± 2.0

**Erythrocyte sedimentation rate (mm) of Indian elephants**

Time in minutes	Tuskers (Mean ± S.E)	Adult non-pregnant non lactating females (Mean ± S.E)
05	3.79 ± 0.66	3.25 ± 0.59
10	10.12 ± 1.55	13.38 ± 3.32
15	26.47 ± 2.77	33.00 ± 5.37
20	38.89 ± 2.74	46.71 ± 4.37
25	46.29 ± 2.80	50.13 ± 3.19
30	49.75 ± 2.32	53.00 ± 2.88
45	55.60 ± 1.21	56.00 ± 2.21
60	56.74 ± 0.96	58.63 ± 1.71

## Feeding

Captive elephants are generally fed with palm leaves or coconut leaves and grains like rice, ragi, horsegram, greengram, wheat etc. Elephants maintained by the forest department are given roughage in the form of bamboo leaves, grass, ficus twig and grain rations. A medium sized elephant weighing about 3000 kg requires a minimum of 150 to 200 kg palm leaves per day.

Regarding basal energy expenditure and nutrient requirements of the elephant in

Nutrient requirement per unit Metabolic body size (73kg ) per day

Item	For growing elephants	For adult idle elephant
Dry matter (g)	142	108
DCP (g)	7	6
TDN (g)	70	58
DE (K cal)	335	278
ME (K cal)	279	237
Calcium (g)	0.6	0.5

The data obtained during the course of the balance studies also revealed the following.

1. Whenever palm leaves form the sole source of feed for the elephant, a phosphorous supplement should be provided.
2. Cereals can be safely omitted in the ration of adult idle elephants when they are fed with sufficient quantities of palm leaves to meet their dry matter requirements.

relation to body size, the information available is meager. However, investigations undertaken under the auspices of the Kerala Agricultural University involving digestion and balance studies have yielded sufficient data for the formulation of feeding standards pertaining to maintenance and growth of domesticated elephant. The following feeding standards may be used as general guidelines in formulating rations for the elephant.

The dry matter intake varies from 1.2 to 2.1 percent of their body weight. Palm leaves can be fed at the rate of 5 percent of their body weight (wet basis). As regards the nutrient requirements for supporting the most important physiological function of the elephant viz. work, recommendations based on systematic investigations are not readily available. However, based on experience with working elephants maintained by the Forest department and by private individuals, the following feeding schedule can be suggested for working adult elephants with a body weight of 3000 kg.

## Ration

a) Roughage 150-200 Kg

(Palm leaves, bamboo leaves, coconut leaves, grass, ficus twigs etc.)

b) Concentrate

Horsegram	5 kg
Ragi	7 kg
Rice	3 kg
Salt	100 g
Mineral mixture	100 g
Jaggery	50 g

c) Drinking water *ad lib*. (Elephants usually drink on an average 250 litres of water/day)

Elephants in their natural habitat consume fruits, grasses, shrubs, leafy browse and bark of trees in the order of preference and the average weight of an elephant mouthful of food, irrespective of type is around 150 g although it is around 190 g when they consume palm leaves. Palm is the preferred food plant for the elephant.

**Orphan Calf**

The care and management of orphan calves of elephants are comparatively tedious. Most of them, especially young ones, usually die for want of sufficient nutrients and congenial atmosphere. A mixture containing diluted cow's milk (1:1), fine ragi powder, glucose, vitamins and minerals is found to be useful. Another mixture containing milk powder 500 g, cooked rice 500 g, sugar 200 g and water 8½ litres is also recommended. Grain ration is usually recommended after 6 months of age.

Elephants defecate 14 to 18 times in a day passing 5 to 6 boli of 1 to 1.5 kg, each time.

The passage time of food materials through the gastrointestinal tract ranges from 18 to 24 hours.

## Standard ration for young calves

Feeds	6 months to 1 year	1 to 3 years	3 to 6 years
Ragi	4 kg	4 kg	6 kg
Horse gram	-	1 kg	1 kg
Salt	30 gm	50 gm	50 gm
Jaggery	100 gm	100 gm	199 gm
Green fodder	15-25 kg	25-50 kg	50-90 kg

The average walking speed of an elephant is about 6 km per hour. While running, it can attain a maximum speed of about 30 km an hour, but this can be kept up only for a short time. It can be allowed to walk 30 to 45 kms a day in favourable weather. Elephant can swim at the rate of about 2-2½ km per hour.

Elephants upto a height of 2 m can be air lifted. They can be transported to distant places either by lorry, train or ship.

### Work

Calves are first trained in timber logging at the age of 5 years. Elephants are allowed to work 6 hours in a day (morning 3 hrs and evening 3 hrs) for 6 days in a week and 8 to 9 months in a year. A fully grown elephant can lift and carry a load upto 500 to 550 kg for short distance. Wood dragging capacity is about 3 to 4.5 m<sup>3</sup> (105 to 157½ cft). Elephants should not be made to carry loads for more than 5 to 6 km a day and they should be well protected from hot sun.

### Estimation of body weight

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

$$W = 12.8 (Cg + ng) - 4281 \quad \text{or} \\ 4152.47 + 14.76 Cg + 8.84 ng$$

where W – weight in kg, Cg – chest girth in cm, ng – neck girth in cm.

### Estimation of height

$$H = 21.04 + 1.77 CF$$

H – height in cm, CF – circumference of front foot in cm.

or

Double the circumference of front foot

### Age at maturity

Female – 12 to 14 years

Male – 14 to 15 years

### Oestrus

Elephants do not have a breeding season. Cow elephants have an oestrous cycle of 14 to 16 weeks with a mean of 15 weeks and oestrus usually last for 4 to 8 days. Oestrus sign are not prominent in elephant as compared to other animals except the exhibition of willingness to be mounted by a

male. But some elephants may show frequent micturition, enlarged clitoris, swollen vulval lips, slimy mucus discharge from vagina, twisting of tail etc. A courting period is noticed in elephants and it may last for about 30 minutes to one hour prior to coitus.

Gestation period : an average of 22 months

Inter-calving interval – 2½ to 3½ years.

Weight of new born calf – 90 to 110 kg

### Weaning

Weaning is done at the age of 2 to 2½ years. The calf will suck the milk of the mother even beyond 4 years of age unless it is weaned. It may also suck other lactating females (wet nurse) of the herd.

### Musth

Male elephants in captivity or wild state show periodically the phenomenon of musth which is characterized by engorgement of temporal glands and discharge, excessive bulging at perineal region, frequent erection of penis, dribbling of urine etc. The temperament is highly unpredictable and musth elephants will be easily provoked by slight irritation. Typical musth will be exhibited by most of the healthy males over 20-25 years of age. Annual periodicity is noticed and the musth period ranges from 3 weeks to 3 months. Most of the elephants come into musth in winter season. Proper restraint and careful handling and management are essential during the musth period. Prolonged musth can be a problem for elephant owners.

Aggressiveness during musth is due to excessive androgens and hence anti androgens can be tried. This is found to be good at the last phase of the musth especially when the musth is of prolonged nature. Along with anti androgens, sedatives and Pot.iodide can be given.

1) *Antiandrogen*

Flutamide (Drogenil) 2500 – 7500 mg

Haloperidol (Serenace) 100 mg

Pot.iodide 20 gm

(per animal per day for 3 days)

**Trimming of tusk**

Tusks are modified incisors the ever-growing structure of the elephants. 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 tusks of the respective side. Maximum of distal 1/3<sup>rd</sup> of the length of the tusk seen outside can be cut and removed.

**Diseases**

The important diseases of captive Asian elephants are Gastro-intestinal helminthiasis, Cutaneous filariasis, Surra, Anthrax, Tuberculosis, Haemorrhagic septicemia, Salmonellosis, Tetanus, Foot and Mouth disease, Pox, Rabies, Necrotic foot rot, Impaction of colon, Corneal opacity etc.

**Injection site**

Intravenous - ear veins

Intramuscular – Gluteal/Rump region

Subcutaneous – tail fold at base of tail and on the neck anterior to scapula.

**Treatment****Crystalluria**

- (1) Citralka/Metalka (alkaline citrate mixture) – 150-300 ml/day
- (2) Diuretic – Frusamide - 40-60 tabs/day
- (3) Sodium citrate/acetate - 200-250 g/day
- (4) Special care to provide water *ad lib.*
- (5) Tender coconut water.

**Summer stress**

Elephants, especially working ones, may be given oral electrolytes (ORS packets) @ of 200-250 gms per day.

**Digestive stimulants**

Commercial herbal preparation given for cattle may be administered in case of indigestion, anorexia, liver toxicity – 10-12 times the dose of cattle.

**Tuberculosis**

Clinically suspected to be suffering from T.B. can be administered with

Rifampicin & INH –30-50 tabs/day for 6-9 months

Review after 6-9 months and repeat if necessary.

**Gastro-intestinal helminthosis**

Helminthosis are more common and serious in captive elephants – Species of helminths recorded in Kerala are (1) the flukes – *Pfendarius papillatus*, *Pseudodiscus collinsi*, *P. hawkesi*, *Gastrodiscus secundus*, *Fasciola jacksoni* and *Bivitellobilharzia nairi* (2) the tape worm– *Anoplocephala manubriata* and (3) round worms – *Murshidia indica*, *M. murshida*, *M. falcifera*, *Quilonia travencra*, *Q. renniei*, *Amira pileata*, *Bathmostomum sangeri*, *Grammocephalus varedatus*, *G. clathratus*, *Parabronema indicum*, *P. smithi*, *Indofilaria elephantis* and *I. pattabhiramani*.

**Treatment for helminthosis***Flukes*

Oxyclozanide 5-7.5 mg/kg

Rafoxanide 5 mg/kg

*Bilharziasis*

Lithium Antimony Thiomalate (Anthiomaline) inj – 50 ml/2000 kg deep IM  
Total of six injections at weekly intervals.

#### *Tapeworms*

Praziquantel (Droncit) 2.5-4 mg/kg weight orally

Oxyclozanide – 3.4 mg/kg body weight orally

#### *Round worms*

Thiophanate (Nemafex) 14 mg/kg body weight orally

Albendazole 3-5 mg/kg

Fenbendazole 3-5 mg/kg

Mebendazole (Mebex, Mebazole, Wormin etc.) 3-5 mg/kg body weight orally

Levamisole 2.5 to 3 mg/kg body weight.

#### *Cutaneous filariosis*

The filarid nematode *Indofilaria patabhiramani* is responsible for cutaneous haemorrhagic nodules. Lithium Antimony Thiomalate 50 ml/2000 kg IM 6-10 injections at weekly interval.

*Surra* – *Trypanosoma evansi* is the causative organism

Antricide methyl sulphate - 2-4 mg/kg body weight as 10% solution s/c

Berenil - 5-8 mg/kg i/m

Louse infestation – *Haematomyzus elephantis* is the common louse of elephants Butox/Ticktox as prescribed by the manufacturer.

#### **Impaction of colon**

Very commonly seen in captive elephants which are irregularly fed with coarse roughages and not given proper exercise.

#### *Drugs recommended are*

Calcium pantothenate 60-100 ml/animal i/m or i/v

Novalgin or Baralgin 60-90 ml/animal i/v or i/m

Calcium boro gluconate 1000 to 1200 ml/animal i/v

Chlorpheniramine

Prostigmine 3-5 mg, Neostigmine 3-5 mg.

Electrolytes and nutrients 15-20 litres i/v

Liquid paraffin oral may also give good results.

#### *Anthrax*

Penicillin 10000 units/kg body weight i/m.

Preventive vaccination with spore vaccine s/c at the root of tail as follows.

Elephants irrespective of age:

Initial dose: 1 ml

Booster after 1 month: 3 ml

#### *Haemorrhagic septicaemia*

Sulphadimidine 200 to 250 g orally followed by half the dose daily for three consecutive days.

Sulphadimidine sodium 33%, 800 ml i/v, followed by half the dose for three consecutive days.

#### *Tetanus*

Tetanus toxoid – 6-10 ml/animal i/m prophylactic

#### *Treatment*

ATS 4-6 lakh IU i/v

Crystalline penicillin – 400 lakhs IU i/v

Diazepam – 200-300 mg i/v or xylazine 400-500 mg i/m.

**Rabies**

1. B.P.L. inactivated vaccine – 30 ml s/c for 10 days.
2. Killed vaccine (approved for horses) - 2 ml i/m

**Foot rot**

Formalin foot bath 1% solution/Hypertonic saline foot bath.

Dress with Castellani's paint/crystal violet paint/gentian violet/antifungal/ antibacterial ointments.

**Control of elephants**

For sedation and premedication.

Triflupromazine (Siquil) 0.15 to 0.2 mg/kg i/m.

Xylazine hydrochloride 0.08 to 0.1 mg/kg i/m

**Immobilization using dart syringe for captive elephants**

1. Xylazine hydrochloride 80-120 mg/ton

**Sedation:** Minor surgery, Examination of trunk

Xylazine 80-100 mg/Ton.

**Surgery** Xylazine 80-120 mg/MT. Supported with local anaesthetics.

Administer the drug after recumbency if the surgery indicates such a posture.

**Antidote:** Yohimbine preparation

Doxapram (Dopram)

**Restraint materials**

1. Chain

Cross chain for forelegs (Eda or Hobbles)

Length – 11 feet – Thickness of rings 1/2 to 5/8 inch

Belly chain: Length 21 feet – thickness of rings 5/8 to 3/4 inch

2. Goad with hook - Ankush or thotti

3. Long pole – (Proding pole)

4. Cane – (Cherukol – short stick)

**Restraint methods:**

During March:

- (1) Belly chain with connection to one hind leg

- (2) Cross chain secured on one fore leg.

During festivals/exhibition/show:

- (1) Cross chain securing the two fore limbs

- (2) Belly chain connected to one hind leg.



## **APPENDIX - 4**

### **GUIDELINES FOR EUTHANASIA IN ELEPHANTS**

Euthanasia is an act of inducing humane death in an animal with minimal pain and distress. It should result in rapid loss of consciousness followed by cardiac or respiratory arrest and the ultimate loss of brain function. It is important that the death of the animal is verified after euthanasia and before disposal of the animal.

#### **Procedure to be followed for ordering euthanasia by Chief Wildlife Warden**

It is proposed that euthanasia of elephants may be carried out only in the specific circumstances when the elephant is in such agony or pain that it is cruel to keep it alive. The animal should not be euthanised without getting it examined by a team comprising of at least two veterinarians from the expert's panel; a member of the Society for Prevention of Cruelty to Animal, wherever applicable; one Senior Veterinarian preferably a Professor in the neighbouring veterinary college/agricultural university/ recognized zoo and a member of the Animal Welfare Board, wherever it is possible.

#### **Euthanasia in elephants:**

The use of injectable euthanasia agents is the most rapid and reliable method of performing euthanasia. It is important to ensure that all the procedures involved in the entire operation are carried out following proper review and in the most efficient, ethical and professional manner. Two procedures are recommended for euthanasia in elephant.

#### ***Procedure 1.***

Euthanasia in elephants can be primarily carried out as a two stage process involving heavy sedation on anaesthesia followed by intravenous injectable pharmaceutical (lethal agent) It includes administration of sufficient sedative or anesthetic agent (Xylazine hydrochloride/ Etorphine hydrochloride/Carfentanyl) to induce recumbency and unconsciousness. Once the animal is recumbent, 40-60 mg/kg of potassium chloride can be administered intravenously, to induce cardiac arrest.

Potassium chloride is an acceptable euthanasia substance only when administered to deeply anaesthetized animal intravenously or intracardially. The potassium ions are cardiotoxic and rapid intravenous or intracardiac administration causes cardiac arrest. The advantage of using potassium chloride is that it can be easily acquired, transported and mixed in the field.

#### ***Procedure 2.***

Euthanasia may also be achieved using barbiturate overdose. Barbituric acid derivatives usually sodium pentobarbital in combination with local anesthetic agents is an effective euthanasia agent. It induces rapid euthanasia when given intravenously/intracardially and leads to death by severely depressing the medullary respiratory and vasomotor center, when administered at high doses.

A primary advantage of barbiturate is the speed of action as well as it induces euthanasia smoothly with minimal discomfort to the animals. As these drugs have to be necessarily administered intravenously, each animal needs to be restrained prior to administration of drug and requires trained personnel.

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Plate 1. Asian and African elephants

*Photo by: V.V. Krishnan*



Plate 2. Tooth of elephant

A. Asian B. African





Plate 3. Field of vision of elephant and danger zones

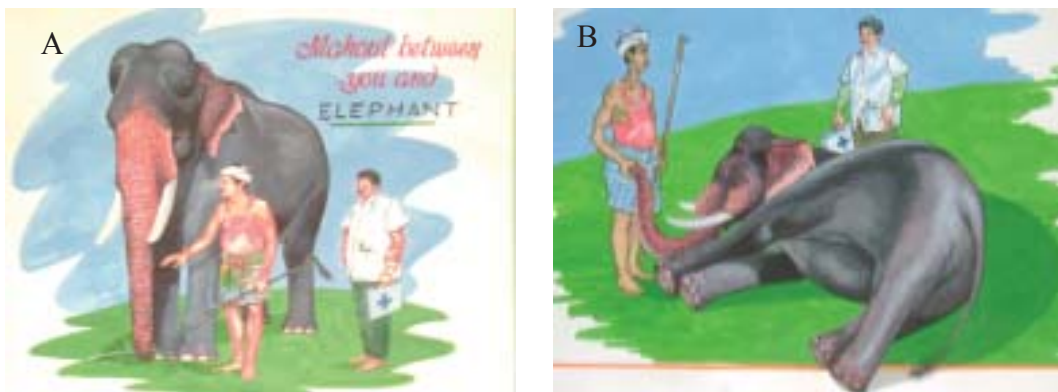


Plate 4. Safe position for the veterinarian  
A. While standing B. While recumbent



Plate 5. Mahout to the top



Plate 6. Uterus of a young elephant



Plate 7. Ovary of an elephant  
A. Ovarian tissue  
B. Corpus luteum

*Photos : G.Ajitkumar*

# TRIMMING OF TUSK

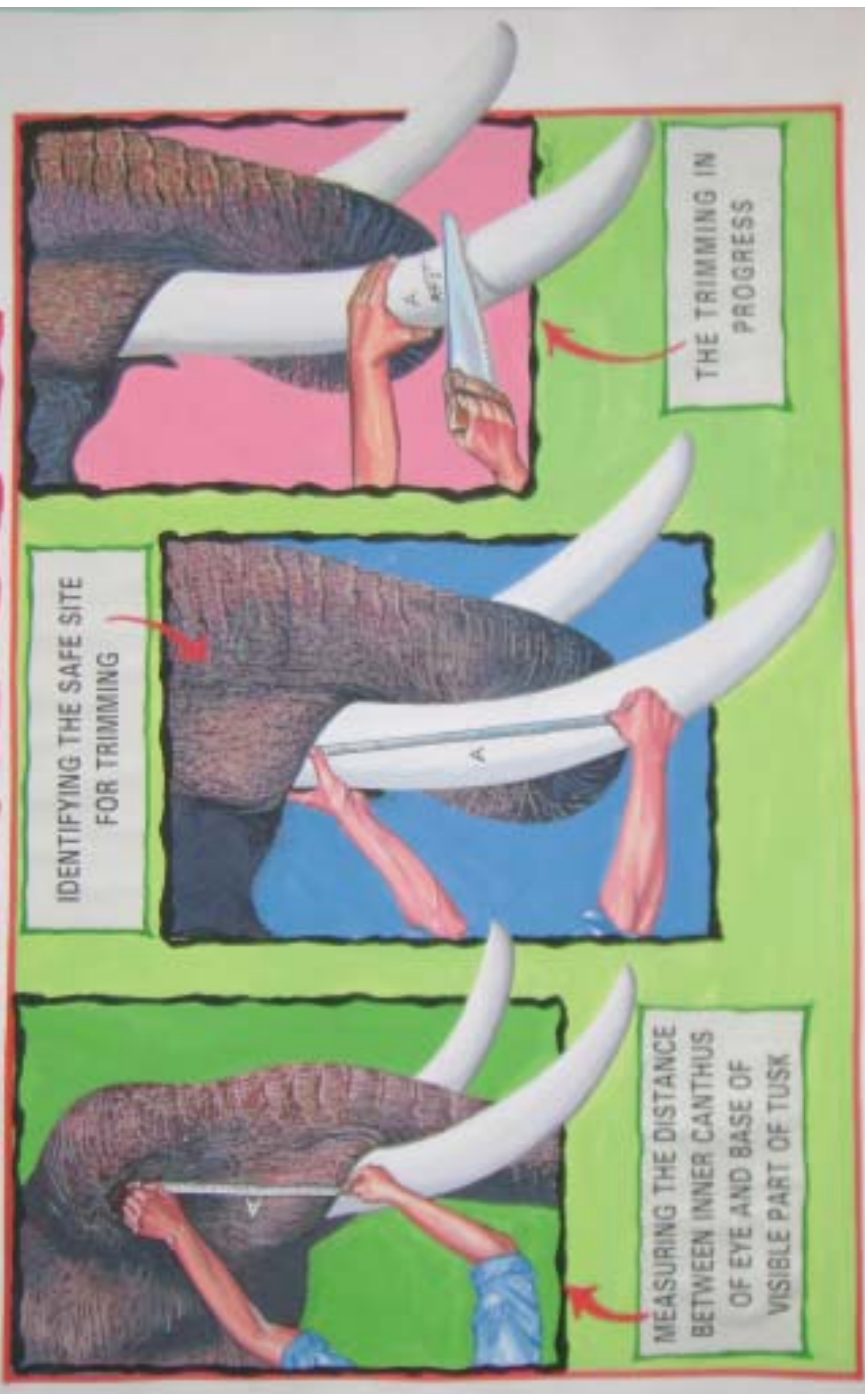


Plate 8. Trimming of tusk



Cracked sole



Overworn sole



Overgrown sole



Cracked heel



Split nail and  
overgrown cuticle



Pododermatitis



Foot rot



Evulsion of nail



Interdigital vegetative  
dermatitis

Plate 9. Foot disorders of captive Asian elephants in Kerala

*Photos : David Abraham*



Opacity of cornea



Cataract



Suppurative conjunctivitis

Plate 10. Eye lesions in elephants



Plate 11. Temporal adenitis

*Photos : David Abraham*



Plate 12. A debilitated captive elephant



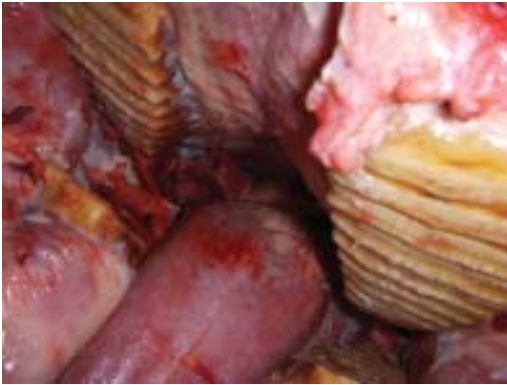
Plate 13. Sagittal section-Lung-Tuberculosis

*Photo : T.S.Rajeev*



Plate 14. Elephant calf died of Herpes

*Photo : Arun Zacharia*



A. Lingual cyanosis



B. Intestine- extensive serosal  
haemorrhage

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