

**MANAGEMENT SYSTEMS AND UTILISATION
PATTERN OF CAPTIVE MALE ELEPHANTS
(*Elephas maximus*) IN KERALA**

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**Thesis submitted in partial fulfilment of the
requirement for the degree of**

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**Faculty of Veterinary and Animal Sciences
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2004

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DECLARATION

I hereby declare that the thesis entitled “**MANAGEMENT SYSTEMS AND UTILIZATION PATTERN OF CAPTIVE MALE ELEPHANTS (*Elephas maximus*) IN KERALA**” is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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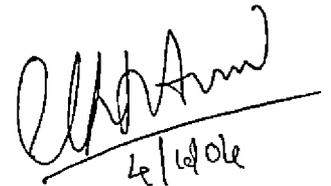


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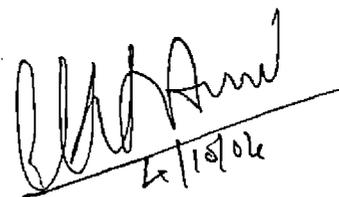
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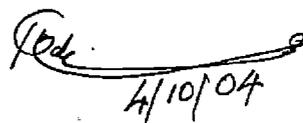
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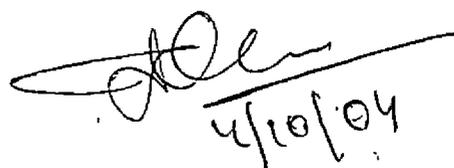
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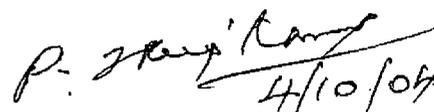
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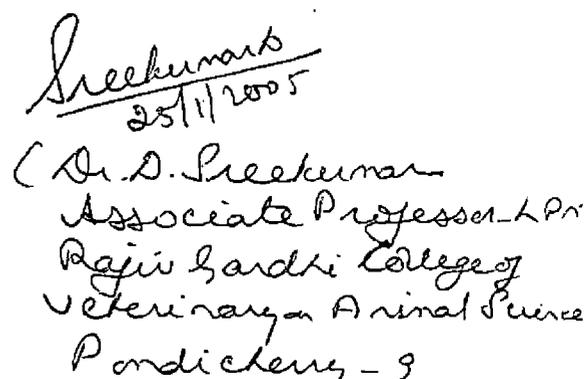
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Cijo.K. Joseph



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Introduction

1. INTRODUCTION

Kerala is a state of Indian union, covering an area of 38,864 sq. km., about 1.03 per cent of the country. It is located amidst the Western Ghats on the east and Arabian Sea in the west.

Kerala has a rich cultural heritage with festivals throughout the year. The major festival season is from November to April. Elephants form an integral part of these cultural festivals throughout the state.

Over and above their use in festivals these animals are used for draught purpose. The main use of their draught power was in the logging industry. Due to the recent ban on timber logging imposed by the central government, there is little or no work to captive elephants. Today, the main use of their draught power is in timber mills. They are also used for pulling heavy objects or vehicles, for tree felling in plantations, etc. The elephants of forest departments are used for elephant safaris too.

From the records of the Elephant Welfare Association and Kerala Forest Department, it is known that Kerala has approximately 700 captive elephants, out of which a great majority are tuskless. These elephants are owned by the Kerala Forest Department, temple trust, or by individuals.

The forest department owns about 24 elephants, of which ten are males. They are housed in four different camps across the state. Most of these animals tend to remain idle throughout the year.

The number of elephants owned by a single individual vary from one to more than a dozen. The utilization patterns of the elephants of this group vary considerably. It was seen that some owners used their elephants exclusively for work in timber mills, whereas some others used them exclusively to grace festivals.

The number of elephants owned by temple trusts varied drastically from one or two elephants to as much as 63 elephants kept by Guruvayoor Devaswam Board. The elephants reared by temple trusts are generally well fed and not used for work.

The elephants are controlled and managed by two mahouts. Some individual owners and temple trusts employ a third mahout during the festival season to assist the first and second mahouts.

It is known that the duration of musth, criteria for tying for musth, period of occurrence of musth, restraint during musth, management steps taken, type of feeding and its quality etc. vary from place to place and animal to animal.

The nutritional status, type of feed given and its quantity vary considerably among different groups and from place to place, even when the animal is idle. The number of functions attended by each elephant also varied considerably.

So, this study was intended to document

1. The utilization pattern of the elephants.
 - a) Their use for festivals, for work, idle days and day in musth in a year.
 - b) Month wise distribution of festivals, work, idle days and musth in a year.
 - c) Influence of type of ownership on utilization pattern.
2. Management of elephants
 - a) The routine management in terms of frequency and duration of bath, wash, rest, feeding, watering, type of housing provided, restraint during musth, non-musth, travel etc.

b) Influence of season and utilization pattern on the routine management procedures.

3. Nutrition of the elephant

a) Type of feed given and quantity.

b) Influence of season, month and utilization on the type and quantity of feed given.

4. History of diseases and vaccination.

Review of Literature

2. REVIEW OF LITERATURE

The captive elephant population of Kerala is increasing every year. Systematic studies on the utilization pattern, management and nutrition of these animals are scanty. So, an extensive study was conducted to document the prevailing utilization pattern, management and nutritional status of male elephants in the state.

The review of related studies is presented under the following headings.

- 2.1. Age and height of elephants
- 2.2. Management practices
 - a) Housing
 - b) Restrain
 - Restraining equipments
 - Restraining tools
 - Restrain during musth
 - Restrain during transportation
 - c) Bath
 - d) Musth
 - e) Transportation
 - f) Miscellaneous
- 2.3. Nutrition
 - a) Usual feeding
 - b) Restorative therapy
 - c) Feeding during musth
 - d) Watering
 - e) Feeding and its influence on musth
- 2.4. Utilization pattern
 - a) Festival
 - b) Work
 - c) Effect of utilization pattern on management

d) Effect of utilization pattern on Nutrition

2.5. Miscellaneous

2.1 AGE AND HEIGHT OF ELEPHANTS

Benedict (1936) reported that considerable variations were present in the measurement of height with respect to various body points at which the animal was measured, the muscle tone and the position of the body. Further, he opined that even the most experienced elephant men estimated the age of the elephant involving the data as to when the elephant was brought to the country, number of years the owner had possessed the elephant, physical configuration and the condition of the animal with special emphasis on the condition of feet and ears.

Johnson and Buss (1965) concluded that the height at the shoulders and body length were closely related to the body weight of the animal.

Mercy (2002) stated that the Asian elephants reached a height of 3.2 meters.

Anilkumar (2002) reported that the height of Indian elephants ranged from 2.5 meters to 3.5 meters.

Ashraf and Manikar (2003) studied the age and height wise distribution of the elephants that attended the Sonpur Mela of Bihar in the year 2002. They found that 60 percent of the elephants that attended the mela were between 15 and 40 years of age, and 54 percent were between 7 to 9 feet in height.

The studies by Ashraf and Singh (2004) revealed only 38 percent of the elephants that attended the Sonpur mela of Bihar in the year 2003 were above seven feet in height. They also found 29 percent of the elephants that attended the mela were below 5 years of age.

2.2 MANAGEMENT PRACTICE

Krishnamurthy(1998) classified the captive elephant management broadly into four systems namely.

- a) Elephants in logging camps maintained by the respective state forest departments
- b) Elephants in zoological parks.
- c) Elephants kept in temples.
- d) Elephants under private ownership

He found that the elephants of north and northeast India got a fixed quantity of grains consisting of rice, broken paddy and some lentils.

Survey by Project Elephant in December 2000 revealed that 75% of the total domesticated elephants in India were owned by individuals, 6% by temples, 2% by zoos, 3% by circuses and 14% by state forest departments.

Namboothiripad (1999) suggested that the length of the chain by which the elephant is tethered should be checked. He opined that the elephant should be approached from the back or side with shouting sound to wake the animal. Further, he suggested that the elephant should not be woken up abruptly.

Ratanakaran & Wongkalasin (2002) studied the management of domestic elephants and reported that the incidents of accidents during working were high especially during logging.

Mathew (2002) reported that the elephants of the West Bengal forest department were kept in specialized shelters called pikhnas.

Eswaran (2002) revealed that the elephants of Kerala forest department were managed systematically by scientific training, feeding and health care through mahouts having long-term experience.

a) **Housing**

Krishnamurthy(1998) found that almost all temple elephants of Tamilnadu had well maintained stables specially designed for elephant; whereas in Kerala, the animals are tethered under the shade of trees within the temple premises.

Namboothiripad (1999) opined that the tethering site of elephants should be free of slush and dirt as the microbes in it can cause disease on the legs such as foot rot. He suggested that the elephant should always be tied with its head in a slightly elevated position.

Krishnamoorthy (1999) observed that the elephants of Tamilnadu forest department were released overnight into the forest with a long trailing chain fastened to the hindleg and a bell tied around the neck.

Kaimal(1999) suggested that the tethering site must have a slight incline to facilitate drainage of urine & dung.

Cheeran (1999) reported that elephants are not usually let loose, but are tethered by one hind limb to a tree or strong pole made of Iron or concrete in Kerala. He recommended that the tethering site should have shade and proximity to water, and that the surface should not be too hard, and should be preferably muddy.

Bist (1999) reported that wild elephants – usually bulls visited the pikhanas - used to house captive elephants – to mate with a female in estrus, or to share fodder. He also reported cases of wild bulls assaulting captive elephants.

Sarma (2002) found that captive elephants of Northeastern India unlike their counterparts in the rest of the country enjoyed a near wild condition.

b) Restrain

- *Restraining equipments*

Ponnappan and Radhakrishnan (1999) mentioned about the precautions that should be taken while handling elephants. They suggested that the mahout must carry a restraining device while approaching the elephant.

Nayar (1999) recommended that elephants should be hobbled and body chains should be worn, with one end of the chain going around the left hind leg and the other around the body of the animal, during festivals.

Cheeran (1999) reported the use of body chain and double rope around the neck when the mahout is not confident about the animal, or when the animal is taken out.

- *Restraining tools*

Panicker (1999) described the restraining devices popularly used in Kerala, like cherukol, valiyakol, thotti, and chains, and their use.

Namboothiripad (1999) reported that the restraining tools commonly used by mahout of Kerala were stick, hook, long pole, and knife. He also recommended that a mahout must know the proper use of these tools; and that he should be armed with at least a knife while approaching an elephant.

Cheeran (1999) described the features and use of restraining tools and equipments like chains, rope, elephant hook, knife, long rod and short rod. He reported that the long rod was about 3-3½ meters long, and could be used to prod the elephant from a distance.

- *Restrain during musth*

Kaimal (1999) said that musth elephant must be chained by both fore and hind limbs; with chain or fetter with 7/8" diameter links. He recommended a gap of 2 feet or 60 cm between the tethering pole & elephant's hind limb.

Cheeran (1999) recommended the use of special heavy chains to tether the forelimb and hind limbs of the elephant during musth. He opined that this would help to clean the hind portion.

- *Restrain during riding*

Panicker (1999) opined that it was safer to use rope around the neck while riding an elephant, and that the rider must insert his feet between the ropes and the neck for better balance.

Cheeran (1999) reported the use of body chain and double rope around the neck when the animal is taken out by foot.

c) Bath

Ponnappan (1999) described the importance of bath to elephants; the points to be noted while giving a bath, the use of pumice stone, the sequential order of scrubbing while giving the bath, the precautions to be taken while bathing an elephant, etc. Further he cautioned that only the first mahout should wash the head and tusk because the elephant may attack the other mahouts. That apart, he suggested that timber elephants must be given a scrub bath with pumice stone at least once in a week with scrub lasting for 2-3 hours; and a normal scrub bath every evening.

Ponnappan and Radhakrishnan (1999) reported that elephants love to spray mud on themselves and may do so after the mahouts have spend hours scrubbing and cleaning the elephant for some functions. They suggested that the

head and tusk of an elephant should be washed by the first mahout because the elephant may attack the other mahouts.

Namboothiripad (1999) reported the practice of scrubbing the elephants with pumice stone while bathing.

d) **Musth**

McGaughey (1963) made a detailed study on musth in captive elephants of Sri Lanka and its control and treatment. He reported that the duration of musth might vary from a few days to months. Further, he reported that some mahouts of Sri Lanka fed pumpkin for abating the excitement.

Fernando et. al. (1963) noticed slight change in the temperament of elephant as early as 3 months prior to musth. They also reported that accomplishment of successful mating during this period would arrest the subsequent enlargement & hyper secretion by temporal gland.

Sarma and Dutta (1996) described musth and its management in Asian elephants. He found that winter season was the time of occurrence of musth in Asian bulls. He associated three conditions with the occurrence of musth. They were prime age (Young adult), period of rest (at least 10-15 days) and full ration.

Lincoln & Ratnasooriya (1996) reported that periodic increase in testosterone secretion during gonadal cycle induces the development of musth. Further, he suggested that androgen withdrawal following a period of hyper secretion may be the cause of some aspects of musth behavior that make the bull elephant very difficult to manage in captivity.

Ponnappan (1999) described the general handling of musth elephants and some general symptoms of musth like loss of appetite, swelling of temporal gland, staring viciously at objects, release of penis from the sheath-especially in the cool hours, etc. He also reported that the mahouts cool their elephants in

musth by spraying water on its body to help the musth fluid to flow easily and quickly. He suggested that the elephant can be fed with a mixture of Gingili and Jaggery during musth.

Kaimal (1999) suggested that a water tank with constant supply of water must be placed at a distance reachable to trunk of the elephant in musth. He suggested that the elephant must be showered with water at least once a day to cool it.

Prasad *et.al.* (2000) analyzed the data on musth episode of Asian elephants collected from Punnathoor Kotta of Guruvayoor and found that the average duration of musth was 99 ± 36 days, and that it increased as the age advanced. They also reported that the number of elephants that come to musth showed peaks in the months of January & August, which were post monsoon periods in Kerala.

Cheeran *et.al.* (2002) divided musth into three different phases and described the physical and physiological changes occurring in each of these stages. He reported that a large number of elephants of Myanmar came to musth in the month of April.

- *Musth management using sedatives and antiandrogenic drugs*

Thakuria & Barthakur (1994) reported the use of chemical sedatives like Diazepam and Lorezepam for the management of musth in male African elephants.

Valandikar & Raju (1996) reported the use of xylazine, haloperidol & Lasix, and special diet to control musth.

Chandrasekharan & Cheeran (1996) reported the use of antiandrogens like flutamide and haloperidole to control musth in captive elephants.

- *Effect of utilization pattern on musth*

Ponnappan (1999) reported that the elephants that were over worked did not go into musth.

- *Other reports on musth management*

Anonymous (2000) reported that there was a significant reduction in the musth duration of young males after the introduction of some older males in Pilanes berg, South Africa.

e) Transportation

Krishnamurthy (1999) reported that until a few years ago elephants were transported on foot only and that now they are being transported by vehicles also. He enlisted the important points to be considered for transporting elephants by foot and by vehicles. He suggested that the elephants should not be made to walk for more than 25 kms a day. Further, he recommended that the vehicle transporting the elephant should not be driven at a speed above 30 km per hour.

f) Training

Poole and Taylor (1999) reported that many zoos, especially those that discouraged the formation of bond of affection between the keeper and the animal, had inadequate facilities for training.

Ponnappan (1999) reported that elephants were trained for timber hauling from their calf hood onwards, and that the elephants brought from other states like Karnataka, Assam, Bihar etc. had to be re-trained for vakka method of timber hauling.

Ponnappan (1999) attempted to divide the different procedures involved in training of newly captured elephants into five different steps. He reported that

the elephants were trained for timber hauling and for festivals, and that the entire training period took about 1-2 years.

Cheeran (1999) opined that the secret of successful training lies in understanding the basic principles of training, which involved the understanding of the animal's biology and psychology. He suggested that like humans and other animals, elephants learned by trial and error, and that the lessons were set in firmly with repetition and practice.

Sarma (2002) reported that the freshly captured elephants were subjected to domestication and obedience training as soon as possible. He pointed out that the calves born in captivity were also subjected to training during 4-5 years of age. He said that the training methods of the Assamese phandis and mahouts were the most humane in approach.

- *Use of intoxicants*

Bist(1999) recorded the use of opium and other intoxicants to suppress musth & keep bull elephant under control.

3. NUTRITION

Nair and Ananthasubramaniam (1979) studied the nutritional requirements of elephants using palm leaves at Kodanad in Kerala.

a) Usual feeding

Ananthasubramaniam (1979) analyzed the proximate principles present in the palm leaves fed to elephants of Kodanad elephant camp. He also calculated the DCP and TDN requirement of young and adult elephants of Kodanad elephant camp.

Sukumar (1989) suggested that elephants were highly adaptable in their feed requirement. He observed that they met up to 90% of their requirement in some areas with grass, and in some other areas by browsing depending on the nutritive value of the vegetation. His study revealed that the wild elephants of south India fed on 112 plant species of which, 25 species made up to 85% of the bulk of their food.

Ponnappan and Radhakrishnan (1999) reported that the staple foods for captive elephants in Kerala were palm leaves and coconut palm leaves. He reported that elephants are given concentrate feed once in a day in most captive establishments, and that the feed in the forest department was a mixture of wheat, ragi and horse gram mixed and powdered together.

Namboothiripad (1999) suggested that elephants must not be overfed as it might cause impaction and other abdominal ailments, and that mud eating should be discouraged.

Krishnamurthy (1999) observed that the working elephant of Tamilnadu forest department were fed with concentrate feed in the morning before work.

Cheeran (1999) reported that the main cut fodder fed to captive elephants in Kerala were Palm leaves and coconut palm leaves. He found that the elephant's capacity to digest food was poor and only 40%; and that the standard practice was to supply fodder at a rate of 5% of their body weight. He suggested that if sufficient greens were available the concentrate was unnecessary unless the animal was put to heavy work like timber hauling.

Mercy (2002) opined that elephants under natural habitat were continuous feeders, spending about 12 to 20 hours in a day feeding on a wide variety of plants ranging from grasses, tree leaves, twigs, bark of trees, roots, fruits and flowers.

b) Restorative therapy

Joseph and Ananth (2002) assessed the weight gain in a group of elephants belonging to the Guruvayoor Devaswom after the administration of restorative treatment. They found that the elephants gained significant amount of weight due to restorative therapy.

c) Feeding during musth

Nayar (1999) recommended that the elephant should be given special foods like cucumber and curd mixed with rice during musth.

Kaimal (1999) reported that some elephants had lack of appetite and were offered palatable foods like banana and curd rice during the mid phase of violent musth.

Malhotra & Manoj (2003) reported that the elephants would calm down if curd was given at a rate of 2 kg per animal per day during musth period.

d) Watering

According to the study conducted by Ananthasubramaniam (1979), an adult elephant requires on an average about 250 litres of drinking water a day.

e) Feeding and its influence on musth

Ponnappan (1999) reported that the practice of maintaining some elephants in a perpetual state of weakness to prevent them from going into musth was common in Kerala.

Nayar (1999) documented the use of a mixture of rice, black gram, green gram and milk to induce musth in elephants.

4. UTILISATION PATTERN

The survey by Project Elephant in December 2000 found out that 43% of the elephants were primarily used for logging, 10% for transportation, 6% for tourism, 5% for entertainment (eg: circus and zoo) 12% for ceremonial purposes, 2% for agriculture (mainly in Arunachal Pradesh), 4% for elephant capturing (as Kunkis) and 7% for begging. The remaining 11% (mostly calves, sub-adults and old ones) were not put to any work.

Eswaran (2002) reported that the adult elephants in the camps of Kerala forest and wildlife department were used for timber hauling, religious ceremonies, tourism and for driving problematic wild elephants.

Chawla (2002) reported that elephants of Jaipur were originally used by the Maharajas for various purposes including hunting, wars & ceremonial processions. He also reported that the elephants were being used for carrying tourists, for wedding processions and for festival at present.

a) **Festival**

Nayar (1999) reported the precautions to be taken while using an elephant for Ezhunnallippu or Festival parade. He suggested that the elephants should be hobbled during ezhunnallippu.

Dangolla *et.al.* (2002) studied the sleep patterns of captive elephants while participating in festivals. He found out that the number of elephants that slept during the day increased during the three-day period.

b) **Work**

Ponnappan (1999) reported that elephants were used in timber mills for transporting logs over short distance, stacking & forming neat piles and also for loading and unloading from vehicles. He found that the elephants in most of the

mills in Kerala were made to work for more than 7-8 hrs per day. He reported the use of elephants for felling of trees and transporting big logs from felling sites to dumping sites or depots.

Ponnappan (1999) documented that tuskers, Makhnas and cow elephants belonging to private owners and the forest department were used for timber hauling and those belonging to temple trusts were not usually used for this purpose.

Namboothiripad (1999) suggested that nylon vakkas should not be used for timber hauling operations as they injure the elephant's mouth. He recommended that tuskers should not be made to carry extremely heavy logs on their tusks.

Mohandas (1999) reported that according to the guidelines of Kerala forest department, the elephants of the department were made to work only for six hours a day, and that the schedule was adjusted according to the climate and the temperature. The working schedule for a normal day was from 8.00am – 11.00am and 3.00pm – 6.00pm and that the schedule might be altered to 7.00am – 10.00am and 4.00pm – 7.00pm on hot days. He also reported that the elephants were not used for work during the months of April and May, and on weekends and on state and national holidays.

Krishanmoorthy (1999) reported that the elephants of Tamilnadu forest department were worked for only six hours a day between 8-11am and 2-5pm. He also reported that the elephants used for pleasure ride works were used only for 1-1½ in the morning and afternoon.

Bist (1999) reported that the elephants of West Bengal forest department were used for patrolling by forest staff, for carrying tourists to the sanctuaries and national parks for watching wildlife, for conducting census of wild animal if needed.

Saseendran *et.al.* (2002) studied draught capacity of captive elephants for timber logging operation. They found out that the mean weight of the log carried by an elephant in a timber mill to be 9.6 percent of their body weight, and the maximum weight to be 23 percent of their body weight.

Mathew (2002) reported that the captive elephants of West Bengal were not put to work between 10.00am and 4.00pm in summer and 11.00am and 3.00pm in winter.

c) Effect of utilization pattern on management

Ponnappan (1999) suggested that elephants used in timber mills should be given a scrub bath with pumice stone at least once a week with scrub lasting for 2-3 hours; and a normal scrub bath every evening. He also suggested that these elephants must be allowed to rest at least for a day in a week.

d) Effect of utilization pattern on Nutrition

Cheeran (1999) suggested that concentrates should be given to elephants used for heavy work like timber hauling.

5. MISCELLANEOUS

Kannan *et.al.* (2002) reported that the incidence of impaction was maximum in the monsoon season and minimum in the post monsoon season.

Chāndrasekharan (2002) conducted a study on the various specific diseases that occurred in Asian elephants.

The study by Ashraf and Manikar (2003) revealed that out of the 77 elephants that attended the Sonpur Mela in 2002, 40 suffered from some ailment. The most common ailments were abscess, sub-mandibular odema, toe nail crack, opacity of eye, cutaneous miasis and pododermatitis.

Materials and Methods

3. MATERIALS AND METHODS

The methods of research followed are presented in this chapter under the following headings.

- 3.1) Sampling design
- 3.2) Selection of variables and their measurement
- 3.3) Data collection
- 3.4) Statistical Analysis

3.1 SAMPLING DESIGN

Sampling, several units consisting of one or more elephants owned by individuals, temple trusts and the state forest department were identified and purposively selected from nine districts of Kerala viz. Kollam, Pathanamthitta, Kottayam, Alapuzha, Ernakulam, Thrissur, Palakkad, Malapuram and Wayanad. The sample was then divided on the basis of type of ownership into five different groups namely,

- 1) Individual owner with one elephant
- 2) Individual owner with more than one elephant
- 3) Temple trust with one elephant
- 4) Temple trust with more than one elephant
- 5) The male elephants belonging to the forest department formed another group where individual animals were considered as separate units.

3.2 SELECTION OF VARIABLES AND THEIR MEASUREMENT

3.2.1 Type of Ownership

- *1 Ownership status
- *2 Number of elephants

3.2.2 Details About the Animal

- *3 Age
- *4 Height

3.2.3 General Management Steps

- *5 Frequency of bath
- *6 Duration of each bath
- *7 Frequency of washing in summer
- *8 Frequency of washing in rainy season
- *9 Frequency of watering
- *10 Duration of rest/sleep
- *11 Feeding
- *12 Restraint

3.2.4 Month-Wise Utilization Pattern in a Year

- *13 Festival season
- *14 Work
- *15 Musth
- *16 Idle

3.2.5 Influence of Utilisation Pattern on Routine Management

*17 Festivals

*18 Work

*19 Musth

*20 Idle

2.6 Type of housing provided

2.7 Vaccination if any

2.8 History of diseases

3.2.1.1 Type of Ownership was further subdivided into

a) Individual owner

b) Temple trusts

c) Government elephants

a) Individual owners included people who own one or more elephants

b) Temple trusts included temple trusts and other trusts governed by a group of individuals.

b) Government elephants included elephants reared by the Kerala forest department.

3.2.1.2 Number of Elephants

Number of elephants meant the number of elephants owned by the individual or the trust. It was further subdivided into owners with one elephant and owners with more than one elephant.

3.2.2.3 Age

The age of the animal was recorded either by verifying the records and certificates issued by the forest department, or by asking the owner / mahout.

3.2.2.4 Height

The height of the animal was ascertained by one of the following procedures namely, measuring, referring the official records or by asking the mahout or the owner. In all cases, the height at the shoulder of the animal was recorded as the height of the animal.

3.2.3.5 Frequency of Bath

Bath referred to the process of thorough scrubbing and cleaning the animal in a natural or an artificial water body like tank, pond, lake, river, etc. with special attention paid to each and every part of the animal's body.

Frequency of bath indicated the number of baths given to the animal per week when the animal was idle, and not in musth.

3.2.3.6 Duration of Bath

Duration of bath is the time in hours required to give a routine bath to the animal. It includes two mahouts scrubbing and cleaning the animal for the specified period of time. So the total man hours spent will be twice the duration of bath.

3.2.3.7 Frequency of Wetting in Summer

Wetting is the process of making the elephant wet with water. It does not include any laborious process like scrubbing. It can be done either by spraying the body of the animal with water using a hose or by making the animal spray the water on its body.

Frequency of wetting in summer refers to the number of times the animal is wetted using water in summer.

3.2.3.8 Frequency of Wetting in Rainy Season

It refers to the number of times the animal is wetted by pouring water/sprinkling water. This does not include wetting by rain, or while bathing.

3.2.3.9 Frequency of Watering

Watering refers to the process of giving drinking water to the animal. It can be done by using a hose, or by providing water in a bucket or any container, or by providing ad libitum supply of water in a nearby tank.

3.2.3.10 Duration of Rest/Sleep

As it was impractical to calculate the duration of rest or sleep directly, it was calculated as the time in hours for which the animal is neither working, nor attending festivals, nor traveling.

i.e. Duration of rest or sleep in hours = 24 hrs - (hrs of festival + hrs of work + hrs of travel)

3.2.3.11 Feeding

Feed included the different feeds and fodder fed to the animal during different periods of the year. It was further subdivided into concentrates and roughages.

Concentrates included feed items that contained less than 10% of fiber on dry matter basis. Roughages included all feed items that are not included in the list of concentrates. In general, they had more than 10% crude fiber content, and formed the bulk of the total food that was consumed by the animal.

Both the concentrates and roughages were further subdivided into the component items in the feed. The quantity of each item was estimated.

3.2.3.12 Restrain

Restrain included the equipments and tools used for restraining the animal, the type of restrain used during musth, while working, while attending festivals, the restrain used during transportation, etc.

3.2.4 Month-Wise Utilization Pattern in a Year

The month-wise utilization of the animal refers to month-wise distribution of various activities for which the animal was utilized in the year viz., functions, work, etc. It also included the number of days the animal is in musth in a particular month. The remaining days were designated as the idle days.

3.2.5 Influence of Utilisation Pattern on Routine Management

It refers to the change in routine managerial procedures and their duration due to different types of utilization. This includes changes during festival season, changes when the animal is used for work, changes when the animal is traveling either by foot or by a vehicle and the changes when the animal is in musth.

3.2.6 Type of Housing Provided

The type of housing provided was considered as a qualitative trait and it was evaluated based on certain fixed parameters like type of flooring, type of roofing, type of wall if present, etc.

3.2.7 Vaccination

The data on vaccination against diseases were collected by asking the owner \ mahout.

3.2.8 History of Diseases

History of diseases included the diseases that the animal has suffered during the past one year.

3.3 DATA COLLECTION

The data was collected using survey method, where the information was collected from the owner, the mahout, and also by physical verification of the claims in most of the cases. The credibility of the information so collected was checked using triangulation method.

The data was collected from the elephant owners and the mahouts in the period between June –2003 and July-2004. The interview was conducted at various locations like the rest room of mahouts during festival seasons, the site where the animal was tethered in case of some animals which were in musth, in the houses and offices of the owners, etc.

The feed samples were collected from all possible sources and proximate analysis was conducted to ascertain the percentage of various proximate principles in each of the feed constituent.

The group wise data on the average feed consumed was then multiplied with the amount of proximate principle present in each feed item to find out the average quantity of each proximate principle consumed by the animal. The data so obtained was then compared with the results of the study of Ananthasubramaniam (1979) to assess whether the nutrient requirement recommended in the above study was met or not.

3.4 STATISTICAL ANALYSIS

The information so obtained was further analyzed using various statistical techniques like mean, percentage, frequency, standard deviation, standard error, etc.

Results



COLLECTION OF DATA

4. RESULTS

The animals surveyed under this study were divided into five groups on the basis of their type of ownership as,

Group – 1 :- Elephants of private owners with one elephant.

Group – 2 :- Elephants of private owners with more than one elephant

Group – 3 :- Elephants of temple trusts with one elephant

Group – 4 :- Elephants of temple trusts with more than one elephant

Group – 5 :- Elephants of forest department

The groups indicated hereafter in this chapter indicate these groups.

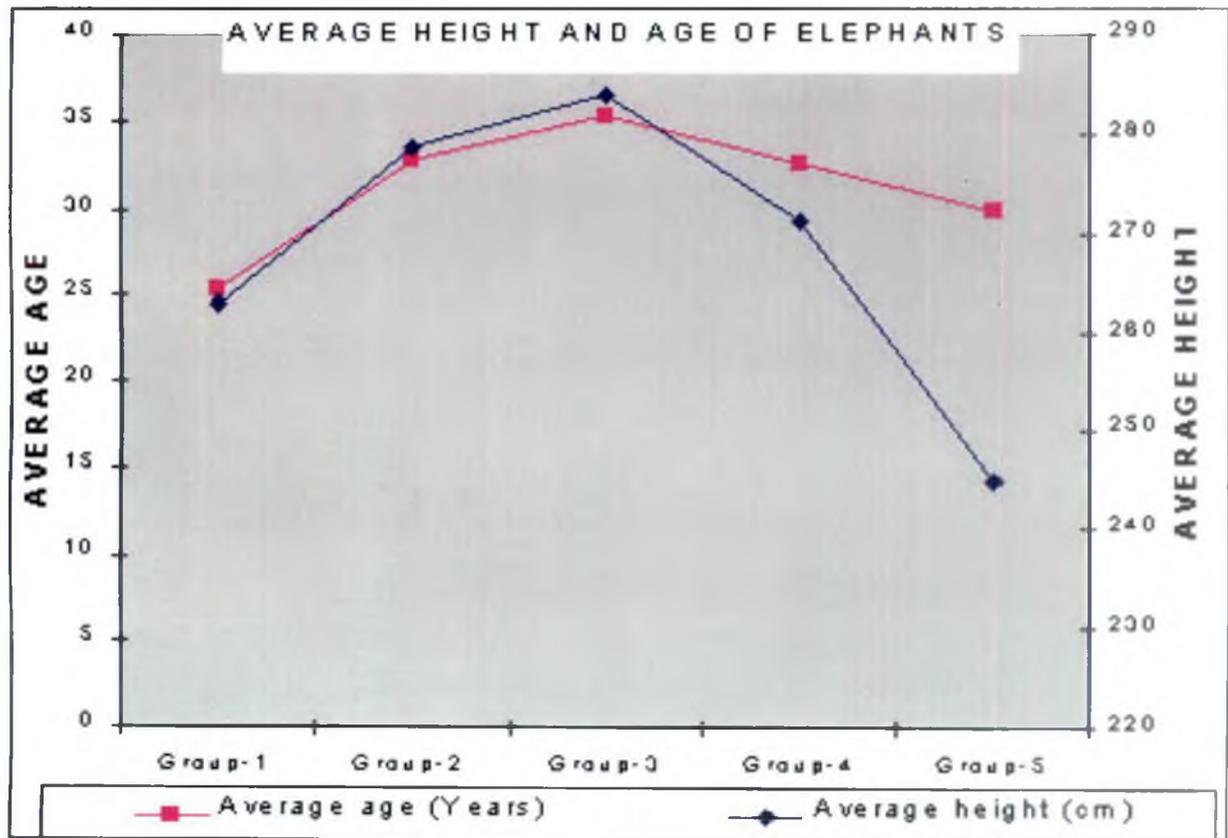
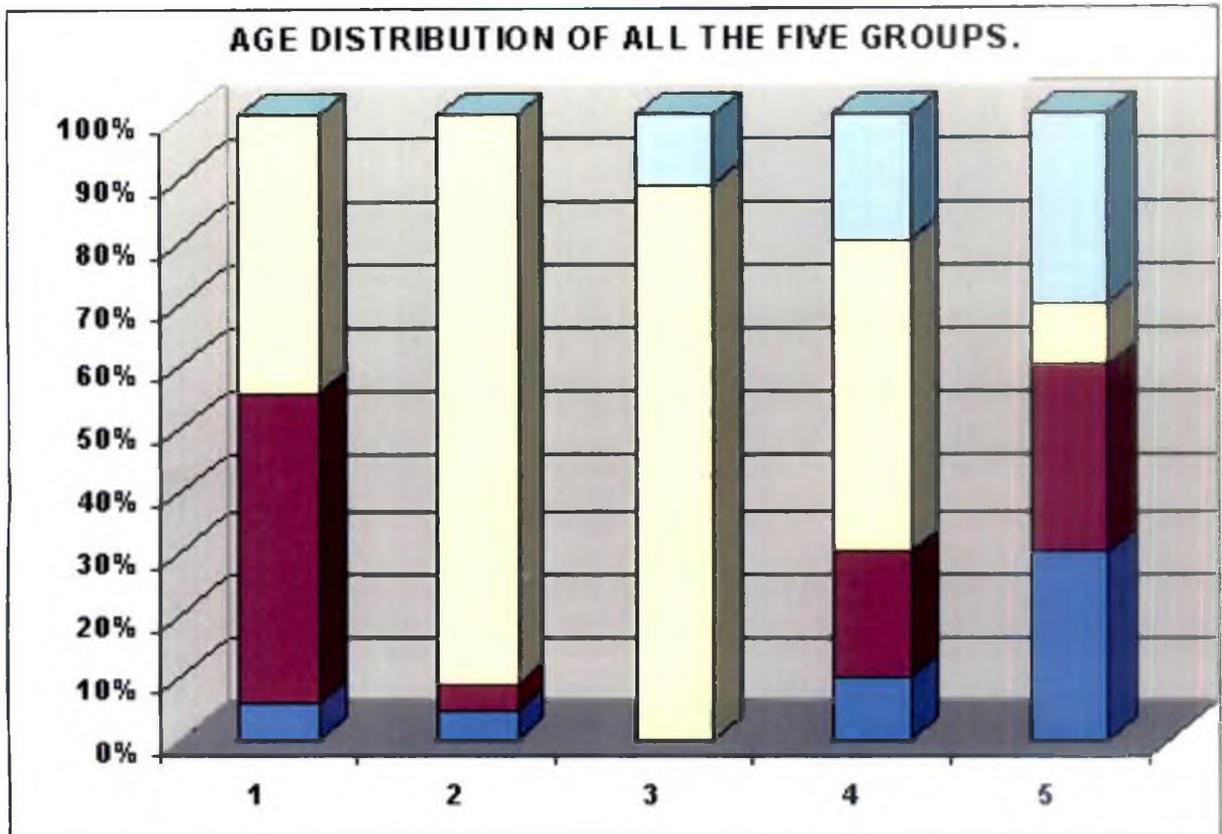
1. DETAILS ABOUT THE ANIMAL

1.1 Age and height of elephants

Table 1. Average age and height of elephants belonging to all the five groups

	Group - 1	Group - 2	Group - 3	Group - 4	Group - 5
Average age (Years)	25.2	32.7	35.4	32.6	29.9
Average height (cm)	262.8	278.7	283.9	271.4	245

The data in Table1 revealed that the average age of elephants belonging to temples with one elephant was the maximum and that with private owners having one elephant the minimum. It can also be seen that the average height of the animals in temples with one elephant was the highest. The elephants belonging to the forest department had the least average height.



1.2 Age distribution

Table 2. The age distribution of elephants in each group

Age in Years	Group - 1	Group - 2	Group - 3	Group - 4	Group - 5
<10YEARS	1 (5.6)	1 (4.5)	0 (0.0)	1 (10.0)	3 (30.0)
10 and <25	9 (50.0)	1 (4.5)	0 (0.0)	2 (20.0)	3 (30.0)
25 and <45	8 (44.4)	20 (91.0)	8 (88.9)	5 (50.0)	1 (10.0)
45 & above	0 (0.0)	0 (0.0)	1 (11.1)	2 (20.0)	3 (30.0)

Figures in parenthesis indicate percentage

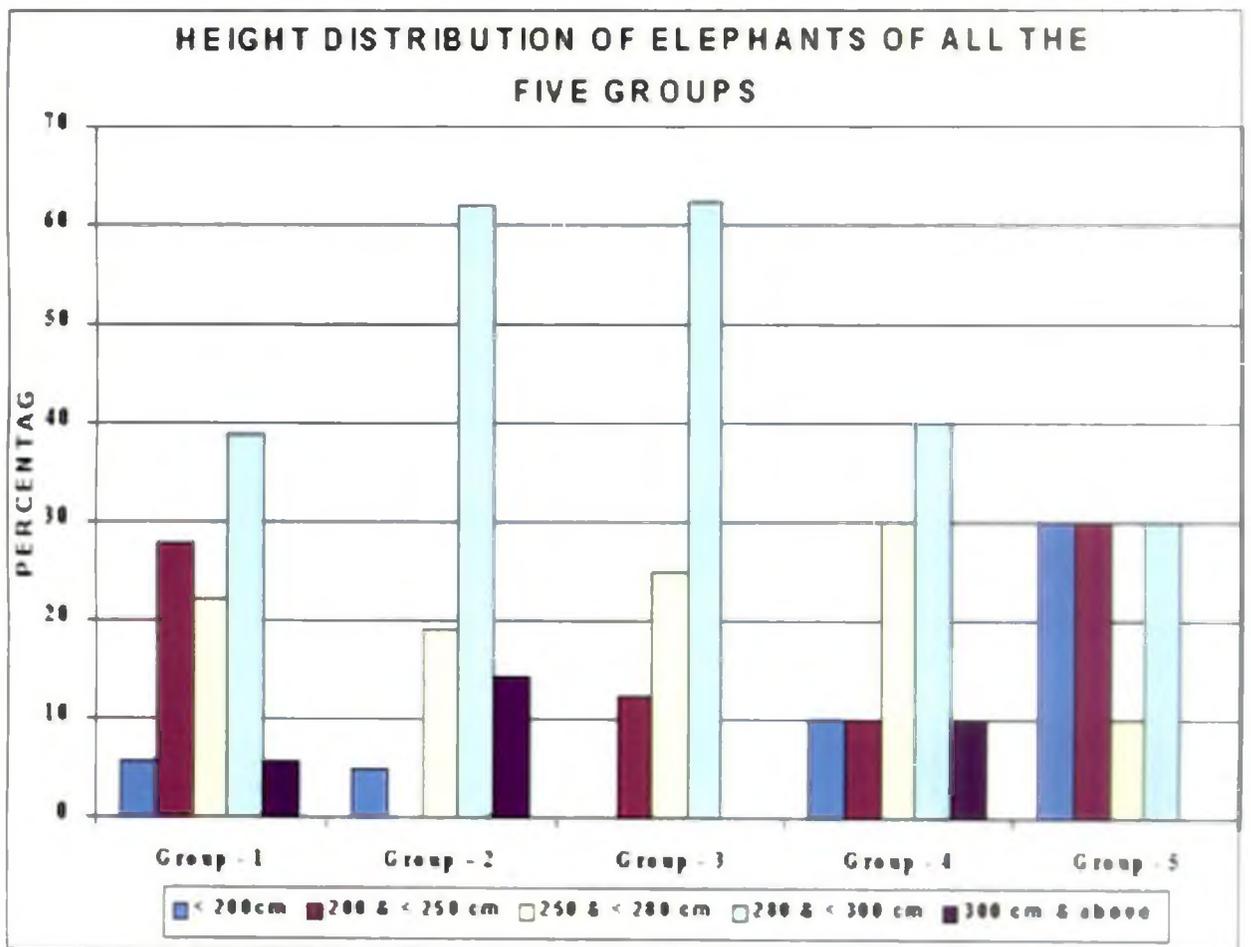
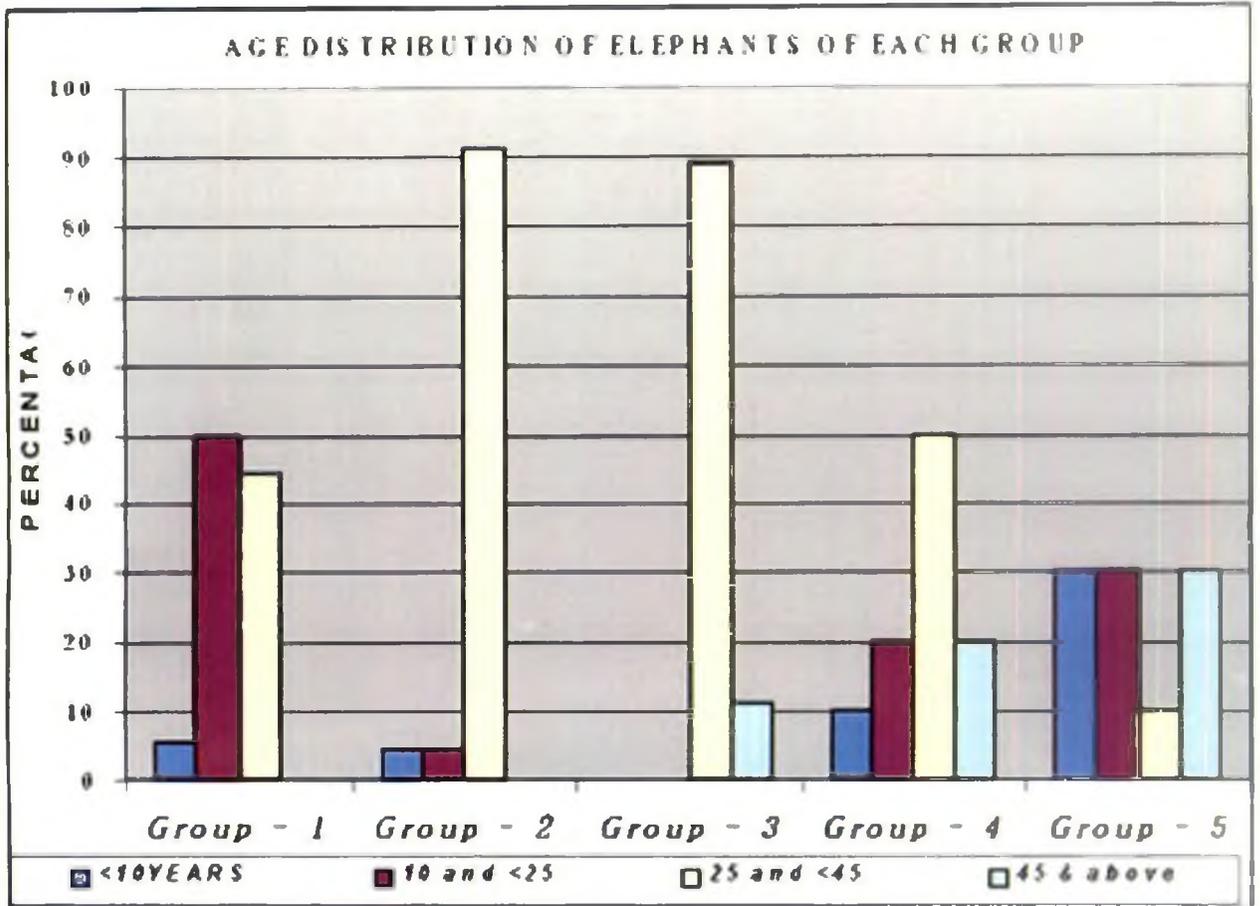
Table 2 showed that a majority of the private owners with one elephant (55.6%) preferred to keep young elephants below 25 years of age. It can also be seen that the majority (91.0%) of the elephants belonging to private owners having more than one elephant fell in the middle age group. The table also shows that the forest department has a very high percentage of very young and very old animals.

1.3 Height distribution

Table 3. The height distribution of elephants in each group

Height of the elephant (centimeters)	Group - 1	Group - 2	Group - 3	Group - 4	Group - 5
< 200cm	1 (5.6)	1 (4.8)	0 (0.0)	1 (10.0)	3 (30.0)
200 & < 250 cm	5 (27.8)	0 (0.0)	1 (12.5)	1 (10.0)	3 (30.0)
250 & < 280 cm	4 (22.2)	4 (19.0)	2 (25.0)	3 (30.0)	1 (10.0)
280 & < 300 cm	7 (38.9)	13 (61.9)	5 (62.5)	4 (40.0)	3 (30.0)
300 cm & above	1 (5.6)	3 (14.3)	0 (0.0)	1 (10.0)	0 (0.0)

Figures in parenthesis indicate percentage



The data in Table 3 reveals that a large number of the elephants in all the five groups ranged from 280 cm to 300 cm in height. The table also shows that the height of a considerably high number of elephants of group-1 and group-5 were below 250 centimeters.

2. General management steps

2.1 Frequency and duration of bath

Table 4. Average frequency and the duration of each bath

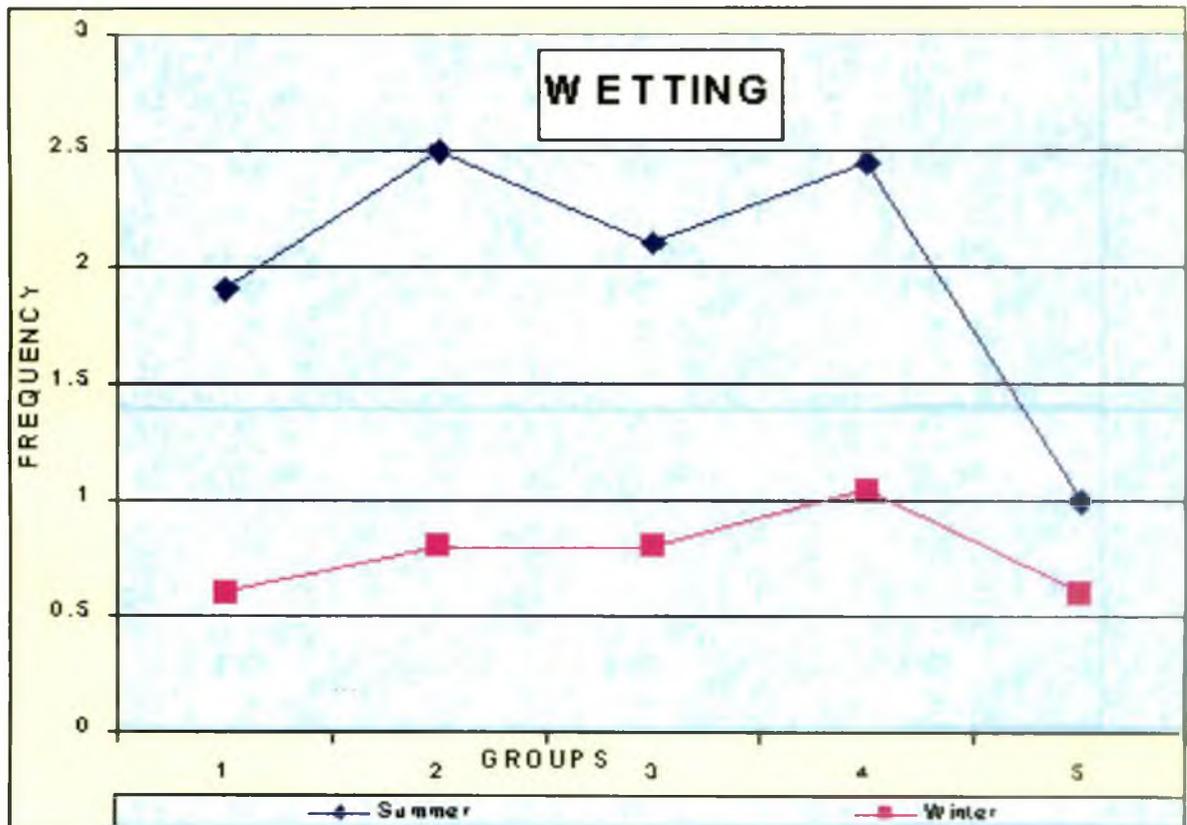
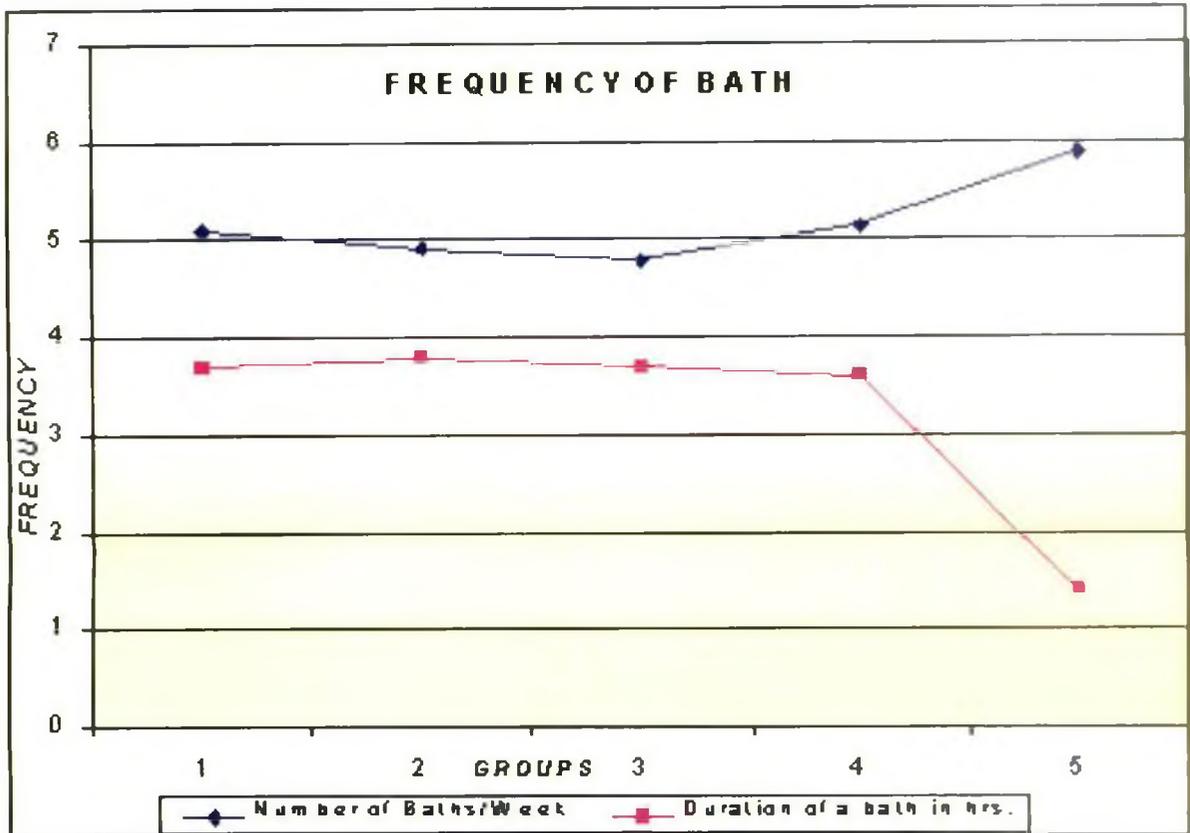
	Group - 1	Group - 2	Group - 3	Group - 4	Group - 5
Number of Baths/Week	5.1	4.9	4.8	5.15	5.89
Duration of a bath in hrs.	3.7	3.8	3.7	3.6	1.4

The figures shown in Table 4 reveal that the elephants in the first four groups are given almost five baths a week, and the elephants belonging to the forest department were given almost six baths (5.9) in a week. It can also be seen that the average time taken for bath in hours in the first four groups is almost 3.7; compared to 1.4 in case of elephants belonging to the forest department.

2.2 Frequency of wetting

Table 5. Average number of wetting done per day in each group in summer and winter

	Group - 1	Group - 2	Group - 3	Group - 4	Group - 5
Summer	1.9	2.5	2.1	2.45	1.0
Winter	0.6	0.8	0.8	1.05	0.6





BATHING ELEPHANTS IN A TANK



TWO ELEPHANTS BEING GIVEN A SCRUB BATH IN A POND



PART OF THE SCRUBBING OPERATION IS BEING DONE ON LAND



WETTING AN ELEPHANT BY MAKING IT POUR WATER ON ITSELF

It is evident from Table 5 that the average frequency of wetting was more in summer than in winter and that the average frequency of wetting was highest in summer for the elephants belonging to private owners with more than one elephant. The number of wettings was the least in winter in the case of elephants belonging to private owners with one elephant and elephants of forest department.

2.3 Frequency of watering and feeding

It was observed that the frequency of watering varied with season, and was highest in summer and the least in winter in all the groups. The study revealed that the frequency of watering varied from twice to four times in hot summer months and once to twice in rainy season. Though there were marked differences between individual animals or owners, there was no much difference between different groups in this regard.

It was seen that the elephants were fed with palm leaves continuously during the daytime when they were idle. It was perceived that in addition to the green fodder mentioned above, the owners usually fed their elephants with some easily digestible feed items, like rice, dates, jaggery etc. and traditional medicinal preparations like ajamamsa rasayanam, chavanaprasham, etc.

2.4 Type of housing provided

Table 6 The type of housing provided to the elephants of each group

	Group-1	Group-2	Group-3	Group-4	Group-5
Full concrete floor with no wall & roof	2	3	6	0	0
Permanent solid brick walls	0	0	0	0	0
Permanent roof	0	0	0	2	2
Temporary roof in rainy season	1	0	0	0	0
Tied under a tree – sand flooring	9	19	4	8	8

The above table reveals that almost all the elephants surveyed were tethered under trees. Most of these animals were tethered on elevated sand or soil beds. It can also be seen that very few animals, belonging to temples with more than one elephant and the forest department, were housed under a permanent roof.

2.5 Restrain

The animals were usually controlled using restraining equipments and tools like chains, ropes, stick, hook, long pole, knives, etc. The chains used in normal animals were found to have links of ½ to 5/8-inch in diameter. It was also seen that the mahouts of Kerala usually carried a knife, a hook and a short stick while they were attending their elephants.

HOUSING UNDER A TREE



2.5.1 Restrain during riding

The mahouts were seen using body chain and double rope around the neck when the animal was taken out by walk. One end of the body chain was usually tied on one hind limb and the other went around the body of the animal.

2.5.2 Restrain during musth

All the owners and mahouts irrespective of the ownership condition, age, and height of the animal, reported that the animal was tied during musth using big chains of 7/8" links. Most of the mahouts also reported swapping of chain between the two hind limbs during musth.

2.5.3 Restrain at night

It was seen that all the elephants irrespective of the type of ownership, age, physical condition and physiological stage were restrained using certain methods. The most popular one was tethering. In this method, the hind limb of the elephant was tethered to a tree, or any other strong structure like a concrete pillar. In some cases one of the forelimbs of the animal were also secured to restrict the movement of the elephant. Two elephant calves belonging to the forest department were housed in wooden enclosures.

2.5.4 Control during festivals

The mahouts reported that the forelimbs of the elephants were hobbled together while attending festivals. This was done to restrict the movement of the elephants during festivals. It was observed that the body chains was worn during festivals with one end of the chain going around the left hind leg and the other around the body of the animal.

MUSTH



3. Utilization pattern of elephants belonging to all the five groups

Table-7. The group wise annual utilization of elephants for various activities in days

Activity	Group-1	Group-2	Group-3	Group-4	Group-5
Festival	71.1 (19.5)	82.9 (22.7)	72.9 (20.0)	44.3 (12.1)	2.7 (0.7)
Work	39.7 (10.9)	18.6 (5.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Musth	16.1 (4.4)	63.2 (17.3)	72.2 (19.8)	98.1 (26.9)	40.0 (11.0)
Idle	238.1 (65.2)	200.3 (54.9)	219.9 (60.2)	222.6 (61.0)	322.3 (88.3)

Figures in parenthesis indicate percentage

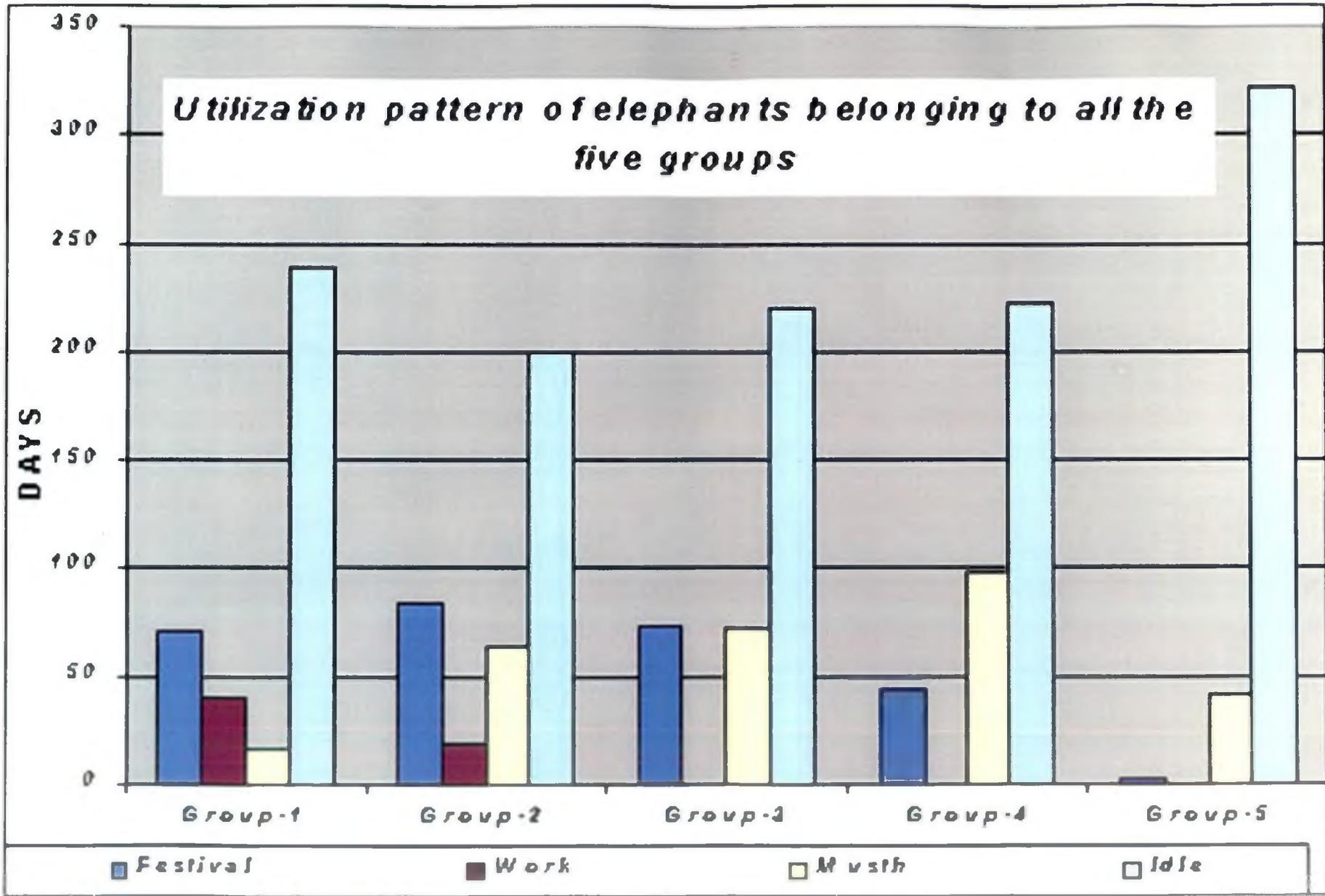
The data in Table-7 reveal that the elephants irrespective of their type of ownership were idle for most part of the year. It can also be seen that the elephants of the forest department were idle for almost ninety percent of the year and were in musth for the best part of the remaining period.

3.1 Average month wise utilization of elephants belonging to all the five groups

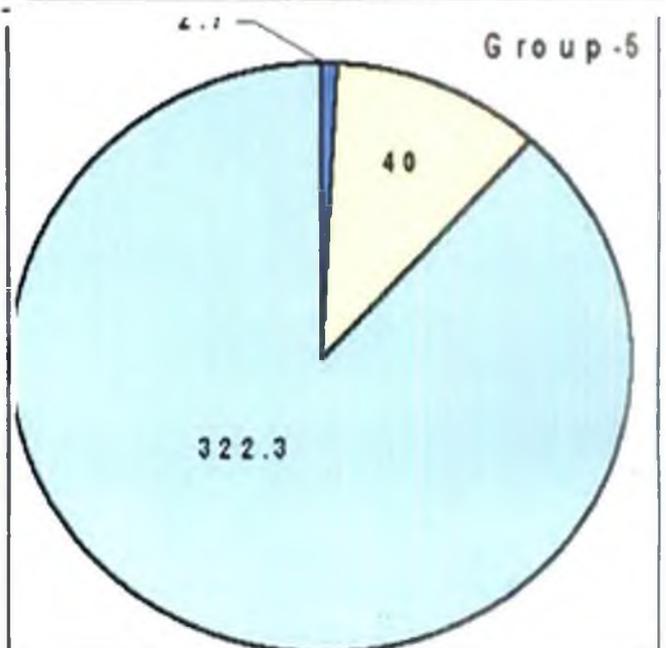
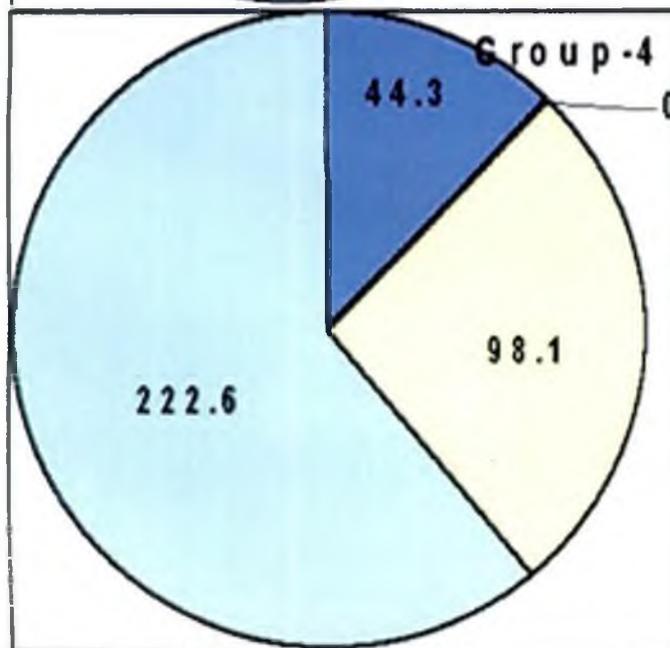
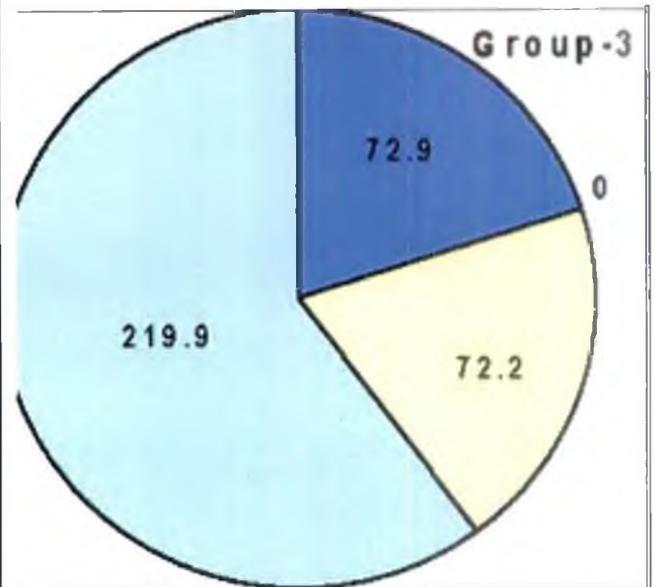
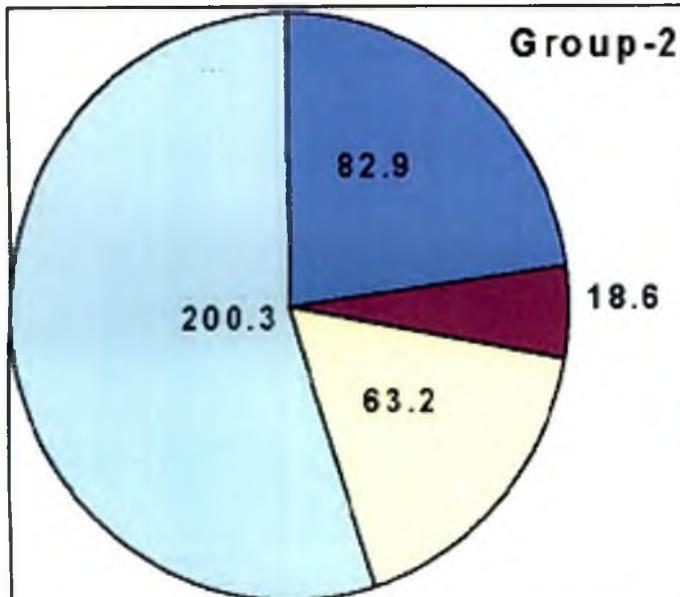
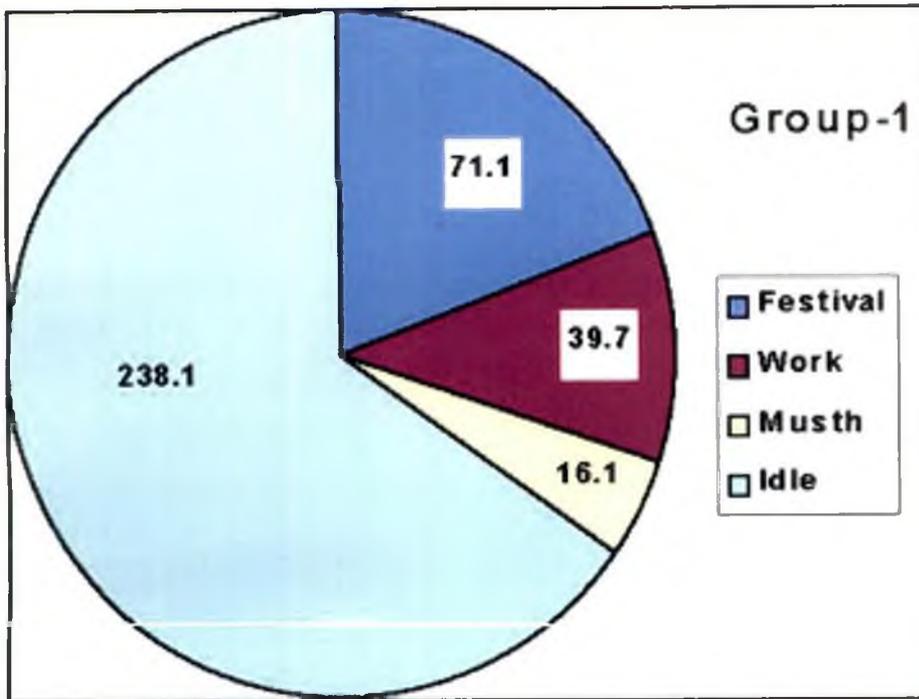
Group – 1 Elephants of private owners with one elephant

The average month wise utilization pattern of elephants of Group-1 for various activities in days and its percentage in that month is presented in Table-8

The data in Table-8 show the elephants of this group were idle for the majority of time. It can be seen that the elephants were idle for more than 65 percent of days in the year. It was also seen that the average time spent in musth was just 4.4 percent of the total time. Further it could be seen that the elephants of this group worked for almost 40 days in a year, and that the average number of festivals attended were about 71.



GROUPWISE ANNUAL UTILISATION OF ELEPHANTS FOR VARIOUS ACTIVITIES





A



B



C



D

ELEPHANTS IN FESTIVALS

- A ADULT ELEPHANTS
- B YOUNG ELEPHANTS
- C TYPICAL TEMPLE FESTIVAL OF KERALA
- D YOUNG ELEPHANT USED FOR ADVERTISEMENT



A



B



C



D



E AN ELEPHANT CARRYING PEOPLE WHILE ATTENDING A FESTIVAL

USE OF ELEPHANTS FOR WORK

THE ELEPHANTS IN PICTURES A,B,C AND D ARE BEING USED FOR TIMBER HAULING OPERATION

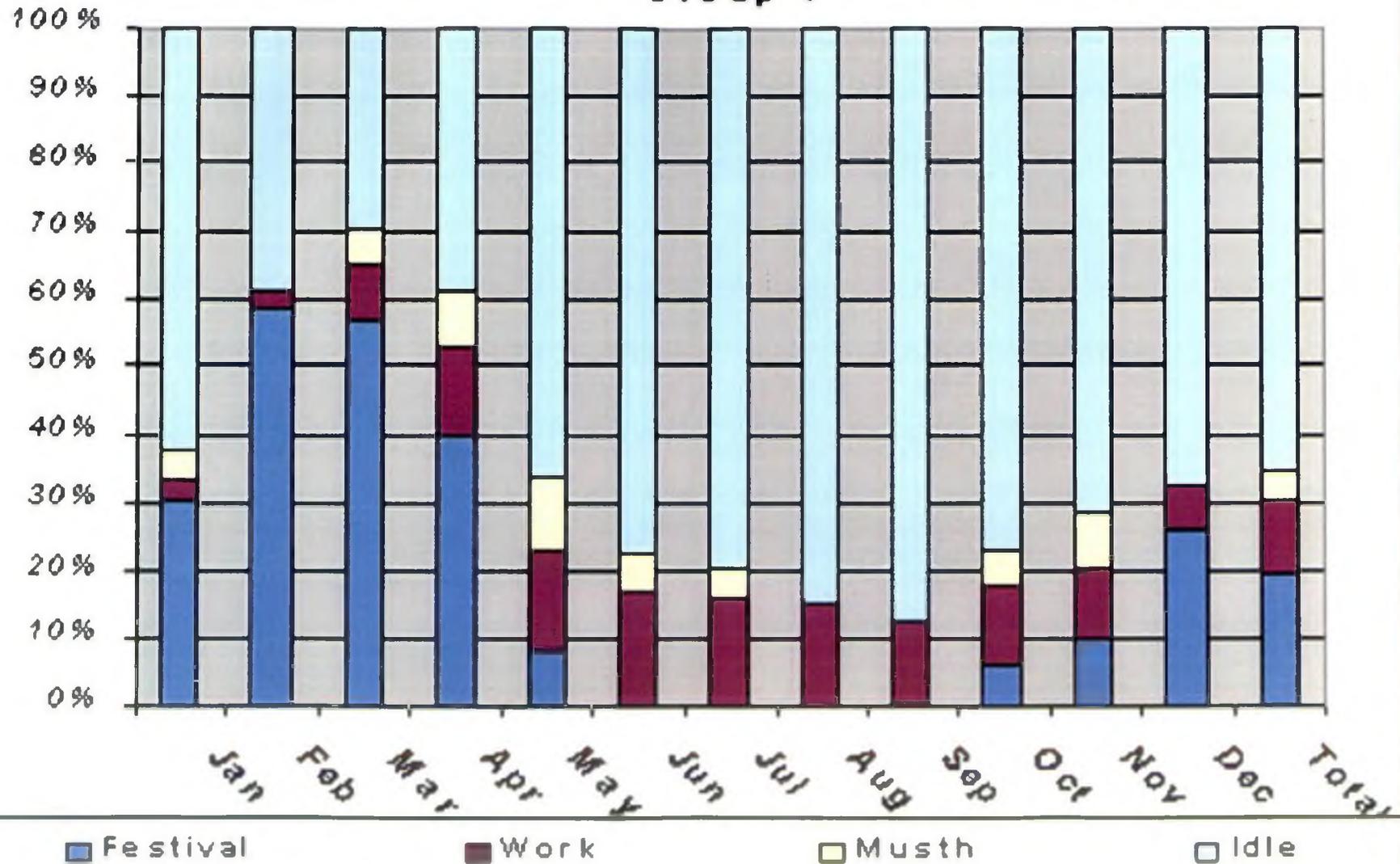
Table-8. Average month wise utilization pattern of elephants of Group-1 for various activities in days and its percentage in that month

Activity	Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	Days	9.5	16.4	17.6	12	2.5	0.00	0	0	0	2	3	8.1	71.1
	Percentage	30.6	58.6	56.8	40.0	8.1	0.00	0.0	0.0	0.0	6.5	10.0	26.1	19.5
Work	Days	0.8	0.8	2.6	3.9	4.7	5.10	4.9	4.6	3.7	3.5	3.1	1.9	39.7
	Percentage	2.6	2.9	8.4	13.0	15.2	17.0	15.8	14.8	12.3	11.3	10.3	6.1	10.9
Musth	Days	1.4	0.0	1.7	2.5	3.3	1.7	1.4	0.0	0.0	1.7	2.5	0.0	16.1
	Percentage	4.5	0.0	5.5	8.3	10.6	5.7	4.5	0.0	0.0	5.5	8.3	0.0	4.4
Idle	Days	19.3	10.8	9.1	11.6	20.5	23.2	24.7	26.4	26.3	23.8	21.4	21.0	238.1
	Percentage	62.3	38.6	29.4	38.7	66.1	77.3	79.7	85.2	87.7	76.8	71.3	67.7	65.2

Table-9. Month wise distribution of various activities in percentage – in Group - 1

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	13.4	23.1	24.8	16.9	3.5	0.0	0.0	0.0	0.0	2.8	4.2	11.4	100.0
Work	2.0	2.0	6.5	9.8	11.8	12.8	12.3	11.6	9.3	8.8	7.8	4.8	100.0
Musth	8.7	0.0	10.6	15.5	20.5	10.6	8.7	0.0	0.0	10.6	15.5	0.0	100.0
Idle	8.1	4.5	3.8	4.9	8.6	9.7	10.4	11.1	11.0	10.0	9.0	8.8	100.0

**Month wise utilization pattern of Elephants of
Group -1**



The Table.8 also shows the average number of days for which an animal belonging to Group-1 was used for various activities in each month of the year and the total split-up of various activities in a year.

The average number of days for which an animal belonging to a group was used for various activities in a month of the year was arrived at by dividing the total number of that activity of the animals in that month with the total number of animals in that group.

ie, Average utilization for festivals in a month =

$$= \frac{\text{(Sum of the numbers of days each elephants of that group spend for attending festivals in that month)}}{\text{Total number of elephants in that group}}$$

So, the above data says that an elephant of this group attended festivals for an average of 17.6 days in the month of March.

It is clear from the above table that the animals of this group attended the maximum number of festivals in the month of March (17.6 days), and did not attend any festival in the months from June, July, August and September.

The month wise distribution of average percentage of days for which an animal belonging to a group was used for various activities in a year was arrived at by dividing the average number of days spend doing a particular activity in a month by the total number of days in that month and multiplying with hundred.

ie, Percentage utilization for festivals in a month =

$$= \frac{\text{Average numbers of days spend for attending festivals in that month}}{\text{Total number of days in that month}} * 100$$

It can be seen from the above table that the elephants of Group-1 spend the majority of their time attending festivals in the months of February and March (58.6 and 56.8 percent respectively) whereas, they remained idle for more than 85 percent

of time during the months of August and September. The table also shows that the elephants of this group remained idle for more than 65 percent of the days in a year, and festivals constituted for less than 20% of their annual routine only.

Table-9 shows the month wise distribution of various activities that the elephants of Group-1 have undertaken in a percentage scale.

It was calculated as the percentage of a particular activity that was undertaken in a month.

$$\text{ie, percentage of a particular activity in a month} = \frac{\text{Total number of that particular activity in that month}}{\text{Total number of that activity in the year}} * 100$$

It is clear from the above table that the elephants of this group attended the maximum number of festivals in February and March (23.1% and 24.8% respectively). It can be seen that almost 50% of the total festivals attended by the elephants of this group were in the months of February and March. The table also indicates that almost 90% of the festivals attended by the elephants of this group fell between December and April.

Group – 2 Elephants of private owners with more than one elephant

The data in Table-10 shows the elephants of this group were idle for the majority of time. It can be seen that the elephants were idle for more than 50 percent of days in the year. It was also seen that the average time spent in musth was 17.3 percent of the total time. Further it could be seen that the elephants of this group worked for almost 19 days in a year, and that the average number of festivals attended were about 83.

The data in Table-10 shows the average number of days for which the animals belonging to Group-2 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

It is clear from the above table that the animals of Group-2 attended the maximum number of festivals in the month of January (17.0 days), and did not attend any festival in June & July. It can also be seen that out of the 82.9 (average) festivals attended by the animals in this group in a year, 68.7 were in the months of December to April. It can also be seen that the maximum number of animals in this group came to musth in the in the months of August and September.

The data in Table-10 also shows the average percentage of days for which the animals belonging to Group-2 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

It can be seen from Table-10 that the animals of this group attended festivals for more than half the days during the months of January and February, and did not attend even a single festival during the months of June and July. It could also be seen that the animals were idle for the maximum period in the month of July (almost 75% of their time).

Table-11 shows the month wise distribution of various activities that the elephants of Group-2 have undertaken in percentage scale. It was calculated using the same procedure as in Table-9.

The data from Table-11 reveals that more than eighty percent of the functions attended by the animals of this group fell in five months between December and April. It also showed that a large number of the animals in this group were in musth between June and October, with a peak in August – September. The data in the table also reveals that almost one fourth of the total works undertaken by the elephants of this group in a year were in the month of June.

Table-10. Average month wise utilization of elephants of Group - 2 for various activities and its percentage in that month

Activity	Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	Days	17.0	16.1	13.0	12.1	2.9	0.0	0.0	1.3	1.6	2.0	6.5	10.5	82.9
	Percentage	54.8	57.5	41.9	40.3	9.4	0.0	0.0	4.2	5.3	6.5	21.7	33.9	22.7
Work	Days	0.0	0.2	0.2	1.3	2.8	4.6	0.6	3.4	2.0	1.3	1.6	0.5	18.6
	Percentage	0.0	0.7	0.6	4.3	9.0	15.3	1.9	11.0	6.7	4.2	5.3	1.6	5.1
Musth	Days	2.7	0.0	0.0	2.6	5.3	6.1	7.4	12.0	10.9	6.1	5.2	5.0	63.2
	Percentage	8.7	0.0	0.0	8.7	17.1	20.3	23.9	38.7	36.3	19.7	17.3	16.1	17.3
Idle	Days	11.3	11.7	17.8	14.0	20.0	19.3	23.0	14.3	15.5	21.6	16.7	15.0	200.3
	Percentage	36.5	41.8	57.4	46.7	64.5	64.3	74.2	46.1	51.7	69.7	55.7	48.4	54.9

Month wise utilization of Elephants of Group.2

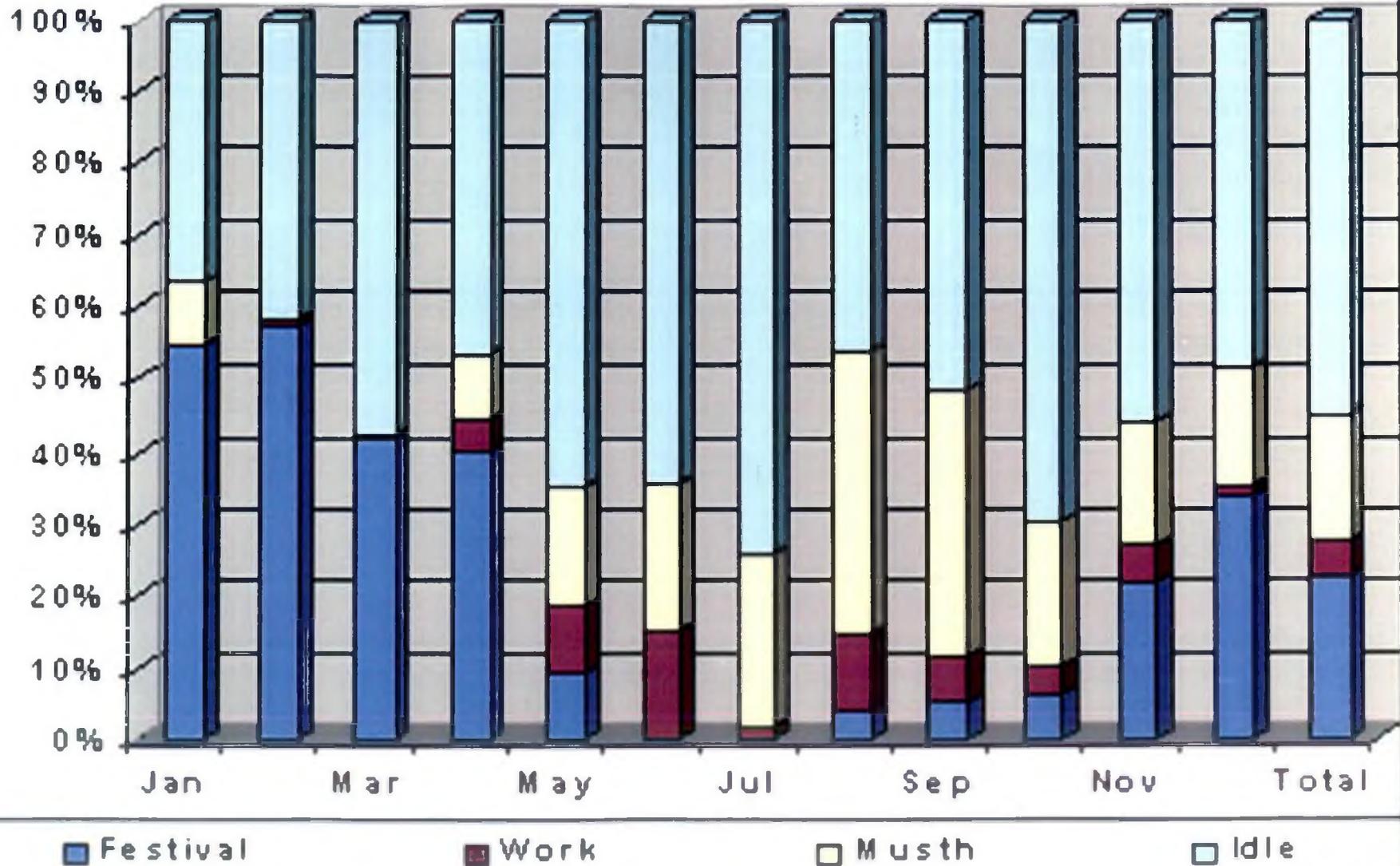


Table-11. Month wise percentage distribution of various activities in a year in Group-2

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	20.5	19.4	15.7	14.6	3.5	0.0	0.0	1.6	1.9	2.4	7.8	12.7	100.0
Work	0.0	1.1	1.1	7.0	15.1	24.7	3.2	18.3	10.8	7.0	8.6	2.7	100.0
Musth	4.3	0.0	0.0	4.1	8.4	9.7	11.7	19.0	17.2	9.7	8.2	7.9	100.0
Idle	5.6	5.8	8.9	7.0	10.0	9.6	11.5	7.1	7.7	10.8	8.3	7.5	100.0

Group – 3 Elephants of temple trusts with one elephant

The data in Table-12 shows the elephants of this group were idle for the majority of time. It can be seen that the elephants were idle for more than 60 percent of days in the year. It was also seen that the elephants were in musth for almost 20 percent of the total days in the year. Further it could be seen that the elephants of this group were not used for work in that year, and the average number of festivals attended were about 73.

The data in Table-12 shows the average number of days for which the animals belonging to Group-3 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

From the above table it can be comprehended that the animals of Group-3 attended the maximum number of festivals in the month of March (16.1 nos.), and that they did not attend any festival from June to October. Further, the elephants of this group were not used for any work round the year. Apart from that the maximum numbers of elephants were in musth during the months of January, June and July. Furthermore the table shows that the elephants of this group were idle for the maximum number of days in the month of October (29.3 days).

The data in Table-12 also shows the average percentage of days for which the animals belonging to Group-3 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

Table-12 reveals that the animals of this group were idle for almost 95% of days in the month of October and attended festivals for almost 50% of days in the months of February and March.

Table-13 shows the month wise distribution of various activities that the elephants of Group-3 have undertaken in percentage scale. It was calculated using the same procedure as in Table-9.

Table-12. Average month wise utilization of elephants of Group - 3 for various activities and its percentage in a month

Activity	Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	Days	11.3	14.0	16.1	10.4	6.6	0.0	0.0	0.0	0.0	0.0	6.3	8.2	72.9
	Percentage	36.5	50.0	51.9	34.7	21.3	0.0	0.0	0.0	0.0	0.0	21.0	26.5	20.0
	Days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Percentage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Musth	Days	10	6.7	3.3	3.3	6.7	10.0	12.2	6.7	5.0	1.7	3.3	3.3	72.2
	Percentage	32.3	23.9	10.6	11.0	21.6	33.3	39.4	21.6	16.7	5.5	11.0	10.6	19.8
	Days	9.7	7.3	11.6	16.3	17.7	20.0	18.8	24.3	25.0	29.3	20.4	19.5	219.9
	Percentage	31.3	26.1	37.4	54.3	57.1	66.7	60.6	78.4	83.3	94.5	68.0	62.9	60.2

Month wise utilization of Elephants of Group.3

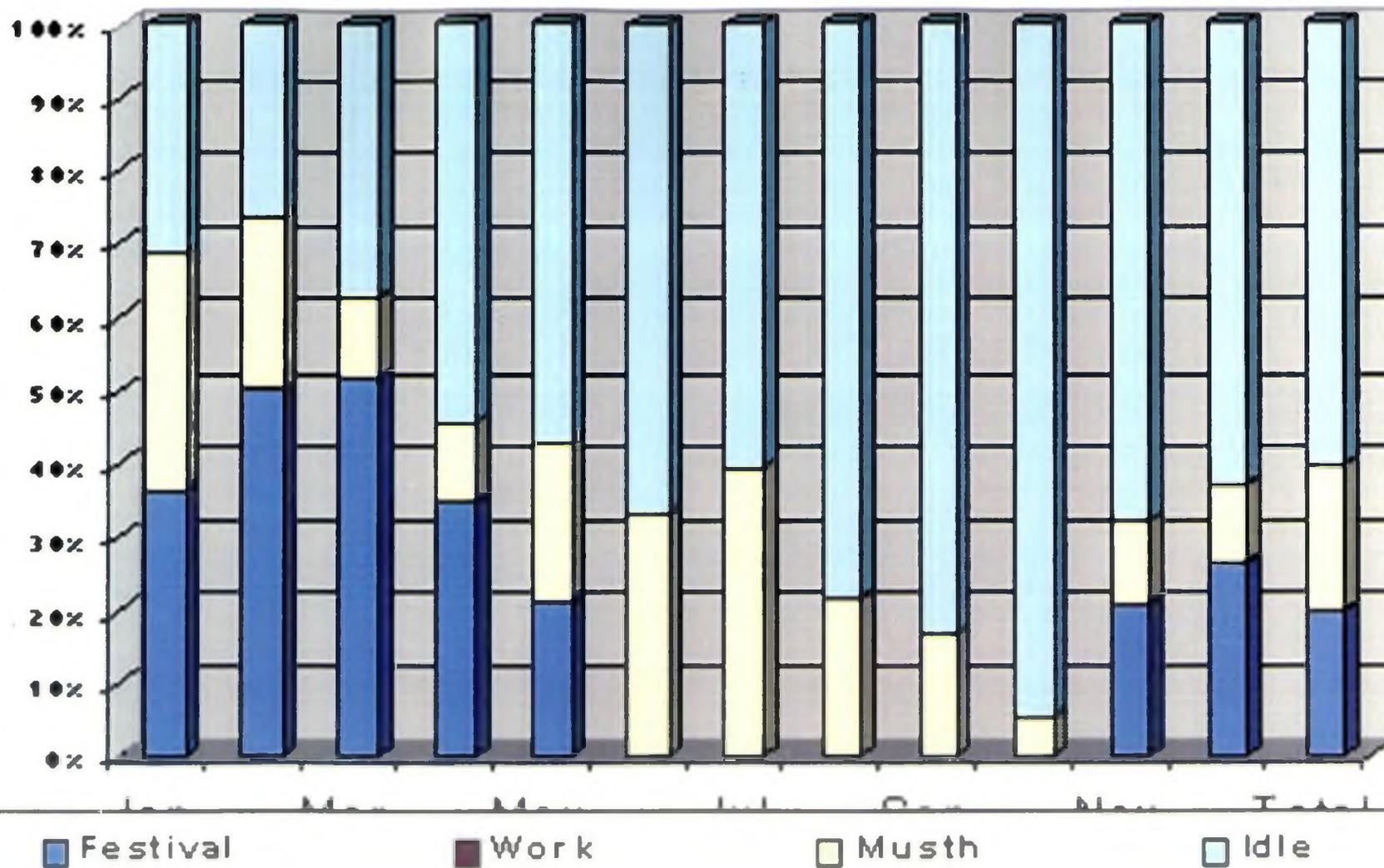


Table-13. Month wise percentage distribution of various activities in a year in Group-3

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	15.5	19.2	22.1	14.3	9.1	0.0	0.0	0.0	0.0	0.0	8.6	11.2	100.0
Work	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Musth	13.9	9.3	4.6	4.6	9.3	13.9	16.9	9.3	6.9	2.4	4.6	4.6	100.0
Idle	4.4	3.3	5.3	7.4	8.0	9.1	8.5	11.1	11.4	13.3	9.3	8.9	100.0

It can be inferred from the data in Table-13 that elephants of this group did not attend any function between the months of June and October. It can also be seen that they attended the maximum number of functions in the months of February and March – 19.2 and 22.1 percent of the total functions respectively. Two seasonal peaks were seen in the average percentage of animals that showed musth. They were in the months of January and July with 13.9 and 16.9 percentage of total cases respectively.

Group – 4 Elephants of temple trusts with more than one elephant

The data in Table-14 shows the elephants of this group were idle for the majority of time. It can be seen that the elephants were idle for more than 60 percent of days in the year. It was also seen that the elephants were in musth for more than 25 percent of the total days in the year. Further it could be seen that the elephants of this group were not used for work in that year, and the average number of festivals attended were about 44.3.

The data in Table-14 shows the average number of days for which the animals belonging to Group-4 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

Table-14 shows that the elephants of Group-4 were mainly used for festivals during the months of January, February and March. They were not used for festivals in June and July. Furthermore, the animals of this group were not used for any work. Besides the data in Table-14 shows the average percentage of days for which the animals belonging to Group-4 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

Table-14. Average month wise utilization of elephants of Group - 4 for various activities and its percentage in that month

Activity	Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	Days	8.7	9.9	9.9	4.9	1.0	0.0	0.0	0.7	1.0	1.0	2.2	4.9	44.3
	Percentage	28.1	35.4	31.9	16.3	3.2	0.0	0.0	2.3	3.3	3.2	7.3	15.8	12.1
Work	Days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Percentage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Musth	Days	19.4	13.2	2.3	0.0	19.4	40.0	58.1	50.6	34.7	19.4	30.0	33.9	26.9
	Percentage	6.0	3.7	0.7	0.0	6.0	12.0	18.0	15.7	10.4	6.0	9.0	10.5	98.1
Idle	Days	52.6	51.4	65.8	83.7	77.4	60.0	41.9	47.1	62.0	77.4	62.7	50.3	61.0
	Percentage	16.3	14.4	20.4	25.1	24.0	18.0	13.0	14.6	18.6	24.0	18.8	15.6	222.6

Month wise utilization of Elephants of Group.4

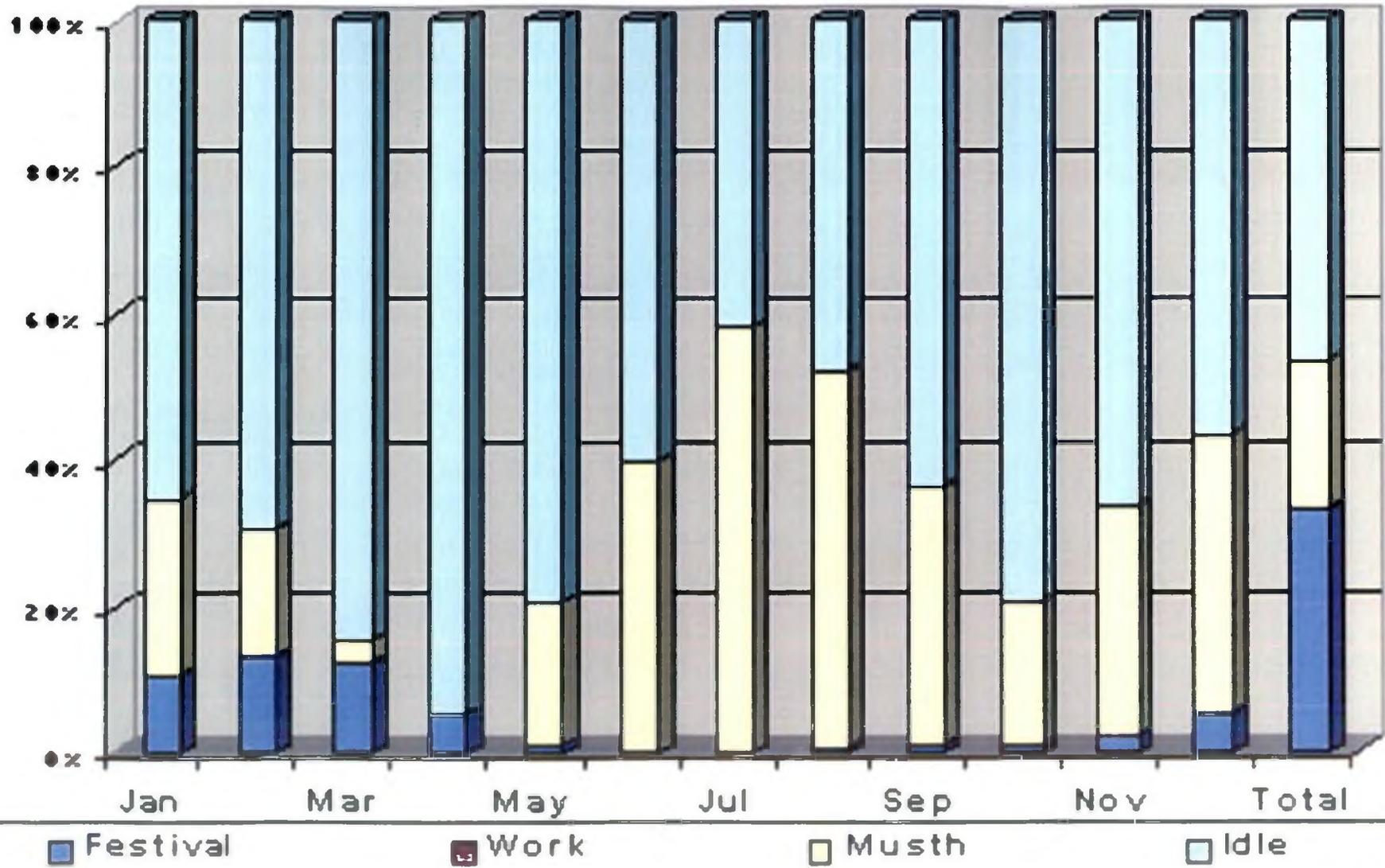


Table-15. Month wise percentage distribution of various activities in a year in Group-4

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	19.6	22.3	22.3	11.1	2.3	0.0	0.0	1.6	2.3	2.3	5.0	11.1	100.0
Work	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Musth	6.1	3.8	0.7	0.0	6.1	12.2	18.3	16.0	10.6	6.1	9.2	10.7	100.0
Idle	7.3	6.5	9.2	11.3	10.8	8.1	5.8	6.6	8.4	10.8	8.4	7.0	100.0

It can be seen from Table –14 that the animals of this group were not used for any work, and they were idle for more than sixty percent of days in a year. They were spending maximum percentage of days idling in the month of April (83.7) followed by May (77.4) and October (77.4). Furthermore, the animals of this group spend more than fifty percent of their time idly in all the months except July and August - during which period they were in musth for more than fifty percent of the days.

The data in Table-15 shows the month wise distribution of various activities that the elephants of Group-4 have undertaken in percentage scale. It was calculated using the same procedure as in Table-9.

It can be inferred from the above table that more than sixty percent of the festivals attended by the elephants of this group fell in the months of January, February and March. The months of April and November further contributed another eleven percentage each. The animals coming to musth showed two annual seasonal peaks in the months of July and December.

Group – 5 Elephants of forest department

The data in Table-16 shows the elephants of this group were idle for the majority of time. It can be seen that the elephants were idle for almost 90 percent of days in the year. It was also seen that the elephants were in musth for more than 10 percent of the total days in the year. Further it could be seen that the elephants of this group were not used for work in that year, and the average number of festivals attended were about 2.7.

The data in Table-16 shows the average number of days for which the animals belonging to Group-5 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

It can also be seen from the same table that the elephants of forest department were used for very few functions only. It was seen that the animals of this group were not used for any work during the previous year. So, the animals of this group remained idle round the year.

The data in Table-16 shows the average percentage of days for which the animals belonging to Group-5 were used for various activities in each month of the year. It was calculated using the same procedure as in Table-8.

The data in Table-16 reveals that the animals in this group were idle for almost 90 percent of the days in a year. It can also be seen that the animals of this group were not used for work and the average percentage of days spend by attending festivals were negligible (0.7%).

Table-17 shows the month wise distribution of various activities that the elephants of Group-5 have undertaken in percentage scale. It was calculated using the same procedure as in Table-9.

3.2 Changes in management due to variation in utilization pattern

It was seen that the elephants used for work were given a short bath at the end of the day's work. During this bath, special attention was paid to areas like the foot, inner thigh region, forehead, etc., which were scrubbed and washed thoroughly.

Most of the owners and mahouts reported that the frequency of bath was reduced during festival season due to scarcity of time and lack of availability of sufficient number of water holes. They reported that the elephants were usually given a brief wash before they were taken for festivals.

The management practices during musth varied significantly from that of the normal physiological condition. It was seen that the animal in musth were not given bath

Table-16. Average month wise utilization of elephants of Group - 5 for various activities and its percentage in that month

Activity	Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	Days	0.7	0.6	0.6	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.3	2.7
	Percentage	2.3	2.1	1.9	0.7	0.0	0.0	0.3	0.0	0.0	0.0	0.7	1.0	0.7
	Days	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	Percentage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Days	3	0	0	0	3	3	3	3	6	5	6	8	40
	Percentage	9.7	0.0	0.0	0.0	9.7	10.0	9.7	9.7	20.0	16.1	20.0	25.8	11.0
	Days	27.3	27.4	30.4	29.8	28.0	27.0	27.9	28.0	24.0	26.0	23.8	22.7	322.3
	Percentage	88.1	97.9	98.1	99.3	90.3	90.0	90.0	90.3	80.0	83.9	79.3	73.2	88.3

Table-17. Month wise percentage distribution of various activities in a year in Group-5

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Festival	25.9	22.2	22.2	7.4	0.0	0.0	3.7	0.0	0.0	0.0	7.4	11.1	100.0
Work	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Musth	7.5	0.0	0.0	0.0	7.5	7.5	7.5	7.5	15.0	12.5	15.0	20.0	100.0
Idle	8.5	8.5	9.4	9.2	8.7	8.4	8.7	8.7	7.4	8.1	7.4	7.0	100.0

during the musth period. Most of the animals were aggressive towards their mahouts. So most of the mahouts avoided going near their animal during this period. But it was seen that the animal was frequently wetted during this period. Water was provided to the animal using a long hose, or by keeping a big vessel or a tank full of water, at a place just reachable to the animal. The animal was fed with easily digestible feeds like cooked rice and dates during this period. Some owners reported the practice of feeding the trunk of palm tree whenever available. Most of the owners reported the practice of feeding some fresh fruits and vegetables like cucumber, banana, watermelon, etc during the musth period.

4. Musth

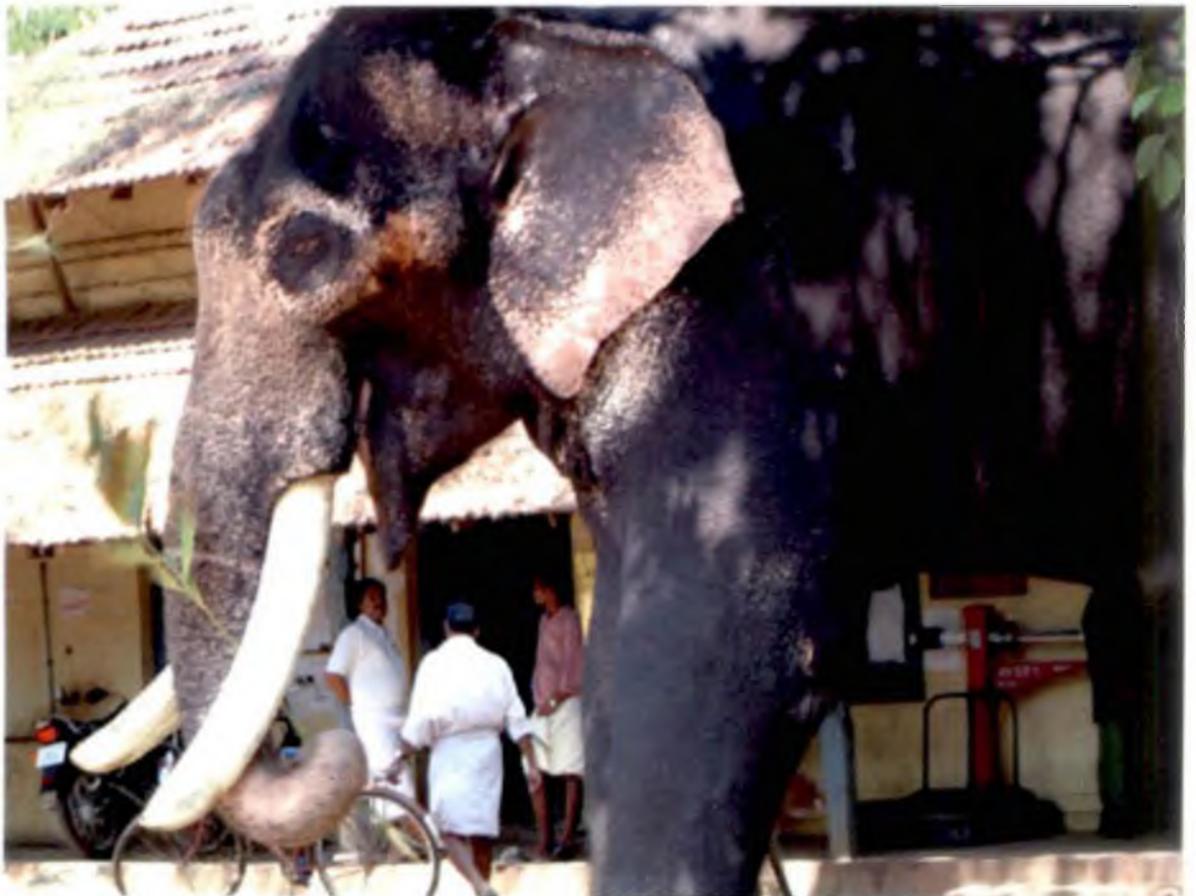
It was seen that the month of onset, duration of musth and the criteria for tying for musth varied from animal to animal and from group to group. The data collected in this regard was analyzed and is presented in Tables 18 - 20.

4.1 Group wise distribution of month of onset of musth

It can be seen from the above table that the month of onset of musth in elephants of private owners with one elephant were almost uniformly distributed throughout the year in comparison to the elephants of private owners with more than one elephant and elephants of temple trusts, which mainly came to musth during the months of April to September.



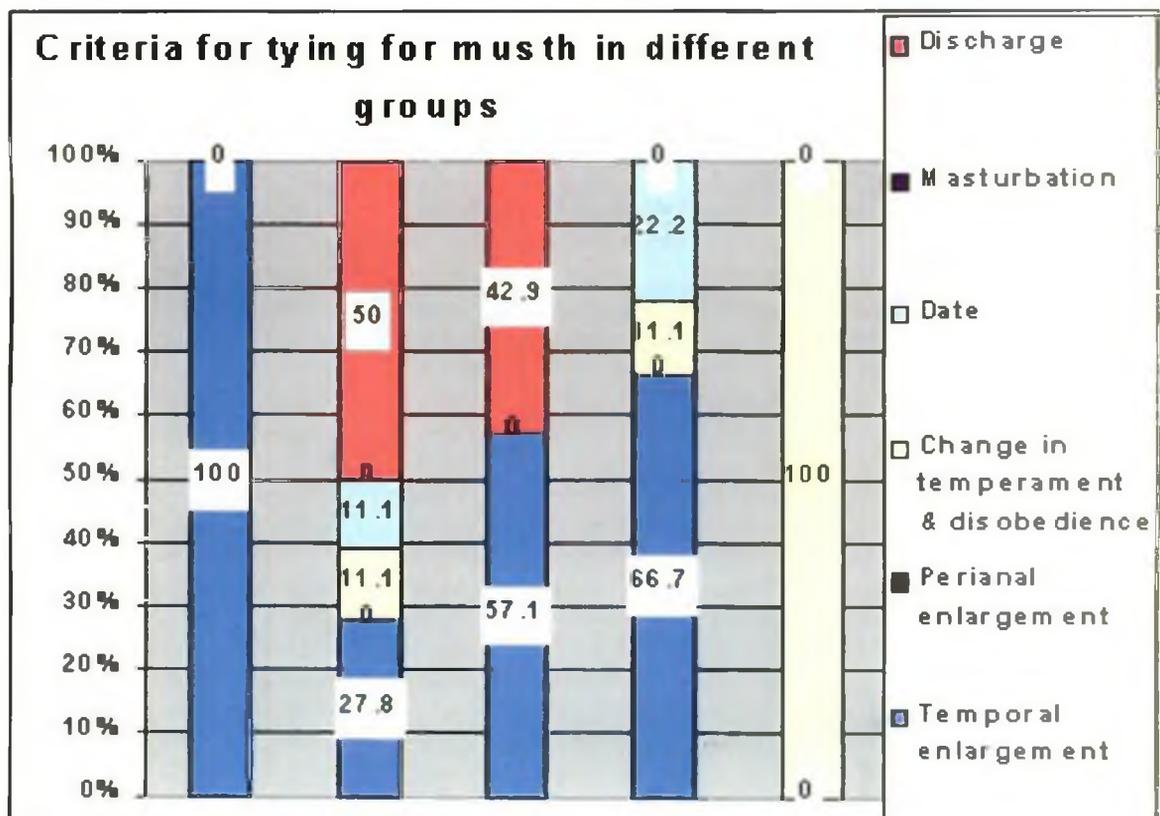
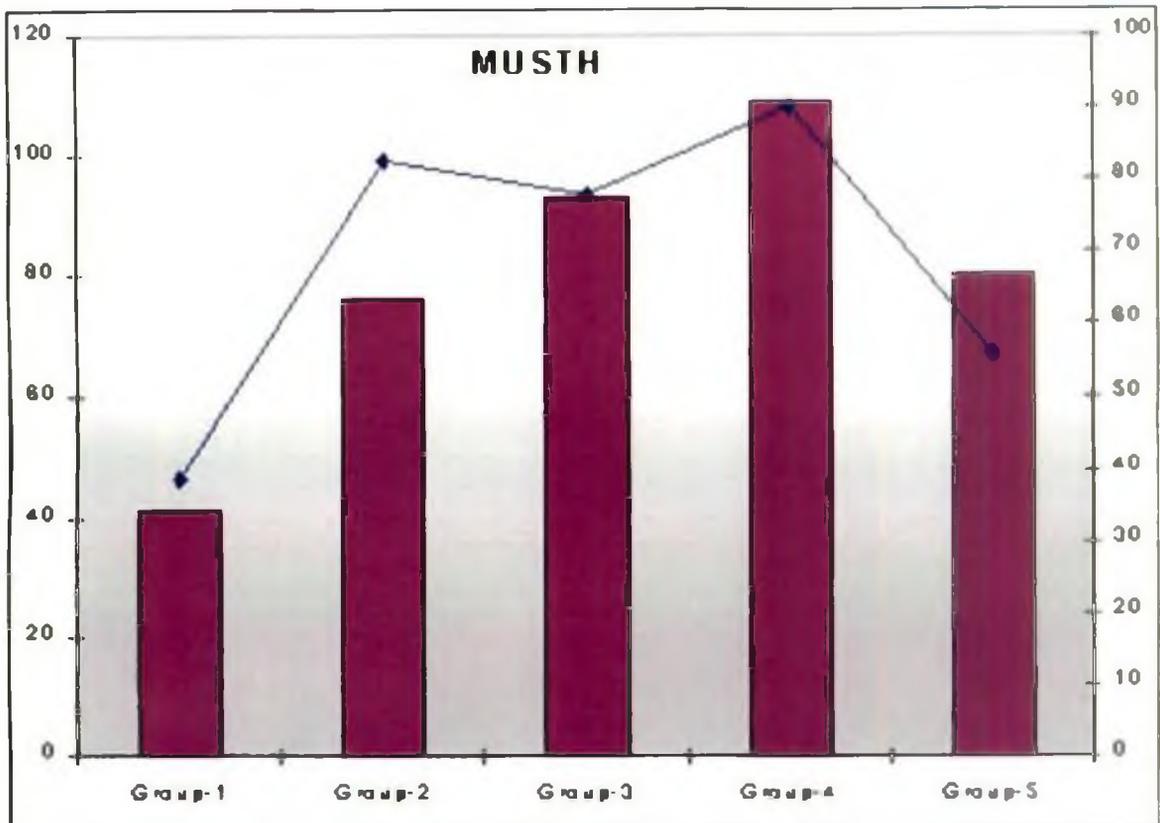
MUSTH ELEPHANT



TEMPORAL DISCHARGE IN A MUSTH ELEPHANT

Table 18. Group wise distribution of the month of onset of musth.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Group-1	1	0	1	1	1	0	1	0	0	1	1	0	7
Group-2	0	0	0	2	2	2	2	5	2	0	2	1	18
Group-3	2	0	0	1	1	1	1	0	0	0	1	0	7
Group-4	0	0	0	0	2	2	2	1	0	0	1	1	9
Group-5	0	0	0	0	1	0	0	0	1	0	1	2	5
Total	3.0	0.0	1.0	4.0	7.0	5.0	6.0	6.0	3.0	1.0	6.0	4.0	46.0



4.2 Group wise average days in musth and the percentage of animals that have shown musth

Table 19. Percentage of animals that showed musth and average duration of musth

	Group-1	Group-2	Group-3	Group-4	Group-5
Percentage of animals that came to musth	38.9	82.6	77.7	90.0	55.6
Average duration of musth*	41.4	76.3	92.9	108.9	80.0

* Includes only those animals that came to musth in the year of study.

The duration of musth of those animals that come to musth =

$$= \frac{\text{Grant total of the number of days in which the animal was in musth in the year}}{\text{Total number of animals that came to musth on that group}}$$

Percentage of animals that come to musth in a group =

$$= \frac{\text{Number of animals that came to musth in that group in that year}}{\text{Total number of animals in that group}}$$

It can be seen from the above table that Group-4 had the maximum duration of musth and the maximum percentage of animals showing musth, which were 108.9 days and 90.0% respectively. It is seen that these values were the lowest for the animals owned by private individuals with one elephant.

4.3 Criteria for tying for musth in different categories

The data in Table-20 show that the criteria for tying for musth varied from group to group and animal to animal. The data in the table says that all the elephants of private owners with one elephant and most of the elephants belonging to temple

trusts were tied when the temporal enlargement was evident. Table-20 also reveals the fact that the elephants of the forest department were tied when the mahout noticed some changes in temperament of the animal. It can also be seen from the above table that a small percentage of animals belonging to private owners with more than one elephant and to temple trusts with more than one elephant were tied according to the date of previous year's discharge, their respective percentages being 11.1 percent and 22.2 percent. The table also shows that a large number of elephants, belonging to private owners with more than one elephant, and temple trusts with one elephant, were tied on seeing the discharge or on the day of discharge. The table also shows that none of the elephant keepers reported perianal enlargement or masturbation as the main criteria for tying the elephant for musth.

	Group - 1	Group - 2	Group - 3	Group - 4	Group - 5
Temporal enlargement	100	27.8	57.1	66.7	0.00
Perianal enlargement	0.00	0.00	0.00	0.00	0.00
Change in temperament & disobedience	0.00	11.1	0.00	11.1	100
Date	0.00	11.1	0.00	22.2	0.00
Masturbation	0.00	0.00	0.00	0.00	0.00
Discharge	0.00	50	42.9	0.00	0.00

Table 20 Shows the criteria for tying for musth in various categories in percentage.

4.4 Feeding during musth

It was seen that some elephants refused feed completely during the musth period whereas; some other animals consumed the normal quantity of feed even during musth. It was seen that the feed consumption was markedly reduced during musth in most of the animals.

It was also seen that the elephants were fed with feed items rich in water content like curd, watermelons, cucumber, stem of plantain, etc. Some owners fed energy rich feeds like rice gruel, cooked rice, mixture of rice and jaggery, etc during the musth period to prevent the deterioration of physical condition of the animal due to reduced feed intake.

5. Nutrition

Different feeds fed to elephants of Kerala were analyzed for proximate principles; and the results of the study are shown in the table below.

Table-21 Dry matter content of different feed items fed to the elephants of Kerala.

Sl. No	Composition	Palm leaf*	CPL*	Rice*	Wheat*	Horse gram*	Green Gram*	Jaggery*	Aval*
1	Dry matter	41.3	35	90.36	90	93.6	93.50	85.0	85.35
2	Crude fiber	9.6	8.9	9.09	1.8	8.3	5.20	0.3	8.59
3	Crude protein	2.1	2	6.75	9.36	20.1	19.7	1.0	6.38
4	Ether extract	1.2	0.9	1.35	2.34	5.7	1.30	1.0	1.28
5	NFE	24.7	23.2	65.61	74.34	63.1	70.10	82.5	61.97
6	Total ash	3.7		7.56	2.16	2.8	3.70		7.14
7	Calcium	0.39				0.35	0.25		
8	Phosphorus	0.26				0.53	0.84		

* Indicate the values on fresh basis.



ELEPHANTS CARRYING THEIR DAILY RATION OF PALM LEAVES



AN ELEPHANT FEEDING ON PALM LEAVES

The average of each nutrient consumed by idle animals of each group was calculated by multiplying the data in the above table with the feed consumed by animals of each group. The data so obtained is presented in the table below.

Table – 22 Group wise average consumption of each proximate principle

Composition	Group - 1	Group - 2	Group - 3	Group - 4
Dry matter	142.0078	165.6864	192.131	187.4377
Crude fiber	33.26647	38.88548	44.24549	43.41417
Crude Protein	8.062626	8.658965	9.942477	9.55875
Ether extract	3.978723	4.686825	5.53814	5.42955
NFE	87.60133	101.2607	115.3088	112.2499
Total ash	9.648724	12.19439	17.19389	16.78528
Calcium	0.994616	1.267266	1.784653	1.7589
Phosphorus	0.663856	0.844844	1.189802	1.1726

The data in Table 22 shows the group wise average consumption of each proximate principle. It is evident from the table that the average dry matter consumption of group-3 is the highest, and that of group-1 was the lowest. It can also be seen that the average crude protein consumption was the highest in group-3.

The average percentage dry matter fed to the elephants in each of the four groups was worked out considering that the average body weight of the elephant was 4000 kg. It was found that this value ranged between 3.55 percent and 4.80 percent.

6. Restorative therapy

Restorative therapy is the process of feeding the elephant with a diet rich in easily digestible protein and energy. It is generally given in the month of May. The ingredients, quantity and duration of administration usually vary from animal to animal.

6.1 Group wise percentage of animals given restorative therapy

Table – 23 Percentage of animals given restorative therapy

	Group - 1	Group - 2	Group - 3	Group - 4	Group - 5
Percentage of animals given restorative therapy	50.0	90.9	70.0	100	0.00

It is evident from the Table-23 that all the elephants (100%) belonging to temple trusts with more than one elephant and a great majority (90.9%) of the elephants belonging to private individuals with more than one elephant were given restorative therapy annually. It can also be seen that the elephants belonging to forest department were not given any restorative therapy.

7. Vaccination, history of diseases

None of the elephants surveyed were told to be immunized or vaccinated against any disease although most of the mahouts and owners reported the use of tetanus toxoid; especially just before or after the musth. It could be seen that the major diseases affecting elephants were nail problems, impaction, colic, respiratory infection, corneal opacity, etc. Out of this, impaction is the single greatest problem. It is usually seen when the animal is over worked, or when feed and water was given soon after a tortuous journey, especially when the function is about to start.

Discussion

5. DISCUSSION

Data on more than 75 discrete groups of elephants consisting of more than 250 elephants were collected. The data were divided into five different groups based on the ownership condition as,

- Group- 1 :- Elephants of private owners with one elephant.
- Group- 2 :- Elephants of private owners with more than one elephant
- Group- 3 :- Elephants of temple trusts with one elephant
- Group- 4 :- Elephants of temple trusts with more than one elephant
- Group- 5 :- Elephants of forest department

Earlier Krishnamurthy (1998) used an almost similar classification to classify the management systems of captive elephants of India. He classified the different types of ownership of elephants into elephants of logging camps maintained by the respective state forest departments, elephants of zoological parks, elephants kept in temples, and elephants under private ownership.

5.1 Details about the animal

5.1.1 Age and height of elephants

It was observed that a large percentage of the surveyed elephants of private owners with more than one elephant and temple trusts with one elephant (91.0% and 88.9% respectively) were between 25-45 years of age. The statistical analysis of the data on age of the elephants in various groups revealed that the average age of elephants of private owners with one elephant was significantly lesser ($p < 0.05$) than that of private owners with more than one elephant and temple trusts with one elephant. The differences between all the other groups were statistically insignificant. The study revealed that single elephant owners preferred young elephants.

The range of height of the surveyed elephants was 312 to 167.6 centimeters respectively. The average height of elephants of different groups varied from 245 centimeters, in the case of elephants of forest department, to 283.9 centimeters in the case of elephants owned by temple trusts with one elephant. This agreed with the findings of Anilkumar (2002) who reported that the height of adult Indian elephants ranged between 2.5 meters and 3.5 meters. The statistical analysis of the data on height of the elephants proved that the average height of the animals of forest department was significantly lower than the average height of the animals of private owners with more than one elephant and temple trusts with one elephant ($p < 0.05$). Obviously the comparatively lesser average height of the elephants of forest department is due to the large number of young elephants in this group. The variation in the average height of animals of all the other groups were non significant which was not the case with other groups.

The data also reveals that the majority of the elephants in all the groups were between 280-300 cm in height. Studies of Ashraf and Manikar (2003) reported that height of the majority of elephants that attended the Sonpur Mela-2003 in Bihar were between 7 to 9 feet (213 to 274 cm). Moreover a plausible explanation for keeping taller elephants may be that the elephants of private owners and temple trusts is due to the aesthetic preference for such elephants occasionally meant to carry the deity during temple festivals.

5.2 General management steps

5.2.1 Frequency and duration of bath

Though it was revealed that the elephants of the forest department are given on an average of 5.89 baths in a week compared to group-3, which

was given only 4.8 baths in a week. The statistical analysis of this data showed that this difference was not statistically significant ($p > 0.05$).

It can further be seen that the average time taken for bath in case of the first four groups were almost 3.7 hours; compared to 1.4 hours in case of elephants belonging to the forest department. The statistical analysis of the data showed that the difference between the first four groups had no statistical significance. It also said that the average duration of bath in the case of elephants of forest department was significantly lower ($p < 0.05$) than the average duration of bath of all the other groups.

5.2.2 Frequency of wetting

Again the average frequency of wetting in all the groups was more in summer than in winter. Besides, the statistical analysis of the data revealed that the frequency of wetting in summer was significantly higher ($p < 0.05$) than the frequency of wetting in winter in all the groups except group-5 which again indicated a negligence on the part of the elephant keepers of the forest department who require proper training and motivation as mentioned elsewhere. Nevertheless, the elephants belonging to the forest department are restrained in a comparatively shady and cooler environment being a forest ecosystem. This could be a valid justification for the comparatively and significantly lesser ($p < 0.05$) duration of bathing as well as frequency of wetting.

It was a notable observation that even during summer, as well as in winter, the frequency of wetting was comparatively lower ($p < 0.05$) in the case elephants of forest departments. This was so even among the private elephant owners since the frequency of wetting was significantly lower ($p < 0.05$) in the case of single elephant owners as compared to those with more

than one elephants. Rajeev (2001) reported that the elephant owners had a comparatively lesser knowledge of elephant management practices.

5.2.3 Frequency of watering and feeding

The frequency of watering varied with season as normally expected and was highest in summer when elephants drank more water, and the least in winter, in all the groups, as it varied between two to four times in hot summer months and one to two times in rainy season. Though there were marked differences between individual animals or owners, there was no much difference between different groups in this regard.

It was observed that the animals drank more water during summer than during rainy season. Mercy (2002) recommended that elephants should be given 250 liters of water per day.

The animals were fed two to three palm leaves at a time and were provided with fresh palm leaves when the already offered ones were eaten. In the evening, few additional palm leaves were given to sustain the night. Mercy (2002) also reported that the animals were fed continuously during the daytime.

It was also observed that, the owners usually fed their elephants with some easily digestible concentrates and like rice, dates, jaggery, etc. in addition to the green fodder mentioned above.

5.2.4 Type of housing provided

The majority of the elephants of Kerala lack proper housing facilities. This is evident from the fact that most of them were tethered under trees on sand floors. Similar observation was made by Sarma (2002).

It can be seen that only 6.25 percentage of the surveyed elephants enjoyed the comfort of a permanent roof and that these elephants either belonged to temples with more than one elephant or elephant camps of forest department. Mathew (2002) has also reported that the elephants of West Bengal forest department were kept in specialized shelters called pikhnas. It was also noted that one of the individual owners with a single elephant gave a temporary roof to protect his animal from rain during the monsoon season. Incidentally, this was a 5.5 year old animal and the youngest animal in that group. It however, felt that further studies are required to ascertain whether permanent shelters are needed to house domesticated elephants at least during rainy season.

5.2.5 Restrain

It was seen that the mahouts usually took enough precaution while approaching their elephants. The animals were usually controlled using restraining equipments and tools like chains, ropes, stick, hook, long pole, knives, etc. The chains used in normal animals were found to have links of $\frac{1}{2}$ to $\frac{5}{8}$ -inch in diameter.

It was seen that the mahouts of Kerala usually carried a knife, a hook and a short stick while they were attending their elephants. The knife was used not only for collection and preparation of fodder for the elephant, but also for self-defense in case of an offensive move by the elephant. The hook was also meant to control the elephant. The mahouts themselves reported that a mahout sitting on the elephant could successfully use the hook to prevent the elephant from using its tusk to assault another person.

5.2.5.1 Restrain during riding

The mahouts were seen using body chain and double rope around the neck when the animal was taken out by walk. It was observed that one end of the body chain was usually tied on the hind limb and the other went around the body of the animal. The mahout sitting on the elephant could easily unhook body chain in case the animal went out of control. The so unlocked body chain with one end still attached to the leg forms a sufficiently long piece of chain trailing from the hind leg of the animal, which could be used to restrain the animal from a reasonably safe distance. Cheeran (1999) recommended the use of body chain and double rope around the neck when the animal was taken out by walk. This is similar to the recommendation made by Panicker (1999).

5.2.5.2 Restrain during musth

All the owners and mahouts of Kerala irrespective of the ownership status, age, and height of the animal reported that the musth elephants were tethered by both fore & hind limbs using big thick chains. The links of this chain were found to be 7/8-inch in diameter. This is in accordance with the suggestions of Kaimal (1999) and Cheeran (1999). Most of the mahouts also reported swapping of chain between the two hind limbs during musth.

5.2.5.3 Restrain at night

It was observed that the elephants were tethered by one hind limb to a tree or strong pole made of Iron or concrete. Cheeran (1999) also made a similar observation. This practice is different from the observation reported by Mathew (2002) who reported that the elephants of West Bengal forest department were kept in specialized shelters called pikhnas.

5.2.5.4 Control during festivals

It was observed that the elephants were hobbled and body chains were worn during festivals with one end of the chain going around a hind leg and the other around the body of the animal. The elephant was hobbled to restrict the movement of the animal during the festival. Similar observations were made by Nayar (1999). The body chain facilitated the restraint if animal goes out of control. Such efficient restraining methods are highly warranted during festivals taking into consideration the large fervent merry making mobs, which usually throngs festival bases of Kerala.

5.3 Utilization pattern of elephants belonging to all the five groups

The elephants in all the five groups were idle for most of the time in the year. It was seen that the elephants of forest department were idle for the maximum number of days in the year. This is contrary to the report of Eswaran (2002) who reported that the elephants of the forest department were used for timber hauling, religious ceremonies, tourism and for driving away problematic wild elephants. This may be due to the fact that the ban on timber logging was enforced only in the previous year. Moreover, most of the male elephants of this group fell either in the very young age group, or very old group. So, the female elephants of the camp were preferred over the male elephants for various activities.

Statistical analysis of the data on the number of festivals attended by the elephants of each group revealed that the average number of festivals attended by the animals of group-5 (Elephants of forest department) was significantly lower ($p < 0.05$) than that of all the other groups. Further, the average number of festivals attended by the animals of group-4 (Elephants of temple trusts with more than one elephant) was significantly lower ($p < 0.05$)

than the corresponding values of all the groups other than group-3 (Elephants of temple trusts with one elephant). The reasons that can be attributed to the low number of functions attended by the elephants of forest department are that the forest elephants are camped in remote areas away from common sites of festival and other temple functions, which necessitate longer transport, and the cumbersome government procedures necessary for taking the elephants from the camps.

The data in Table-7 also shows that the elephants of groups 3, 4 & 5 were not used for work. The main reason is that the temple trusts usually do not send the animals for work, and that the elephants of forest department are not used for work due to the ban on timber logging. Ponnappan (1999) also reported that the elephants of temple trusts were not used for work. The analysis of the data on work done by elephants in each group also confirmed that the animals of group-1 were used for a significantly more number of days than the animals of group-2. This was so because a considerable number of elephants in group-1 belonged to timber mill owners who used their elephants for work in their mills.

It can also be seen from the data in Table-7 that the elephants of group-4 (Elephants of temple trusts with more than one elephant) were in musth for almost 100 days. ie, they were in musth for more than one fourth of the year. This is in accordance with the study of Prasad *et.al.* (2000) who reported that the average duration of musth in elephants of Guruvayoor Devaswom was 99 ± 36 days.

It can be seen that the average number of days in musth in that year was less than 20 days in the animals of group-1. This may be due to the presence of large number of sub-adult elephants surveyed in this group. This

may be due to the fact that elephants that were over worked did not go to musth as opined by Ponnappan (1999).

5.3.1 Average month wise utilization of elephants belonging to all the five groups

Group – 1 Elephants of private owners with one elephant

The average month wise utilization pattern of elephants of Group-1 for various activities in days says that out of the average of 71.1 festivals attended by the elephants of this group, 63.6 were in the five months from December to April; which is the major festival season in Kerala. Table-9 shows that this forms about 90 percent of the functions attended by the elephants in the year. Table-8 and Table-9 also reveals that the animals of this group did not attend even a single function during the four months from June to September.

The data in Table-8 also shows that the elephants of this group spend almost 58.6 and 56.8 percent of their time in the months of February and March for attending festivals. It also reveals that the maximum percentage of time spent for work was in the month of June.

Similar reasons can be cited for the elephants of the other four groups.

5.3.2 Changes in management due to variation in utilization pattern

The mahouts reported that the elephants were given through scrubbing at least once in a week during bath during the period when the animals were idle. This practice was reported by Namboothiripad (1999) and Ponnappan (1999).

Elephants used for heavy work like those elephants working in timber mills were given a short bath at the end of a day's work. During this bath, the mahouts paid special attention to scrub areas like foot, inner thigh region, forehead, etc. Ponnappan (1999) also favored such bathing. The owners and the mahouts of working elephants reported that the elephants were given bath only in the evening; after the days work.

Most of the owners and mahouts reported that the frequency of bath was reduced during the festival season due to scarcity of time and lack of availability of sufficient number of water holes at their disposal. They reported that the elephants were given a brief wash before they were taken for festivals.

The mahouts also reported that during festival seasons the elephants were tied under trees at the site of the festival, or in a place in close proximity to this site.

It was observed that the working elephants of Kerala were used mainly in the morning and evening hours. Wherever possible the elephants were given rest at noon. This is in accordance with the results of the study of Krishnamurthy (1998) who reported that the working hours of the elephants were adjusted according to the season in order to avoid working in the hot part of the day.

5.4. Musth

Musth is an annual physiological phenomenon seen in healthy male elephants, characterized by the increased aggressiveness, heightened sexual activity, flow of temporal discharge, decreased temperament, etc. The external manifestations of musth like temporal enlargement, flow of temporal secretion,

increased aggression, disobedience, perineal enlargement, and increased frequency of masturbation were observed. Cheeran (2002) and McGaughey (1963) made similar observations. It was seen that the month of onset of musth, duration of musth and the criteria for tying for musth, etc. varied from animal to animal and group to group, but remained fairly uniform and periodic for a particular animal. Similar observations were made by Poole (1994) who reported that older bulls came into musth annually at a specific time of year and that there was no synchrony between the individuals in a population.

5.4.1 Group wise distribution of month of onset of musth

The month of onset of musth in the pooled data reveal two distinct peaks of onset of musth. The first one was in the beginning of the rainy season and the second one was by the onset of winter. This is in accordance with the studies conducted by Prasad *et.al.* (2000) and Eisenberg *et.al.* (1971). The results of this study differed from the reports of Sarma and Dutta (1996) and Cheeran *et.al.* (1991) who reported that the Asian bull elephants came to musth in winter months. Stracy (1991) reported the case of an animal showing periodic musth in rainy season. Sabapara and raval (1993) reported cases of occurrence of musth in summer. Cheeran *et.al.* (1991) reported that more than 80 percent of the elephants of Myanmar showed musth between the months of December and May.

The month of onset of musth in elephants of private owners with one elephant were almost uniformly distributed throughout the year in comparison to the elephants of private owners with more than one elephant and elephants of temple trusts, which mainly came to musth during the months of April to September, which happen to be months with least number of festivals.

It can be seen from Table-23 that a considerably large percentage of the elephants of groups 2,3 & 4 were given restorative therapy during the onset of monsoon. The proximate analysis of the feed given in restorative therapy shows that it was rich in easily digestible nutrients.

It can also be seen that the elephants of group-1 work for a considerably large number of days in comparison with the elephants of the other four groups.

These two reasons can be attributed to large number of animals of groups 2,3,&4 coming to musth in monsoon season. The first being the increased plane of nutrition due to the administration of restorative therapy; and the other being the increased amount of time spent idle (Sarma and Dutta; 1996).

5.4.2 Group wise average duration of musth and the percentage of animals showing musth

The data on the group wise average duration of musth and the percentage of animals showing musth in all the groups is presented in Table-24. This data shows that the average duration of musth was longest in group-4 and was shortest in group-1. The statistical analysis of the data showed that the average duration of musth in animals of group-4 was significantly higher than that of all the other groups. The analysis also revealed that value of group-1 was significantly lower than the value in all the groups barring group-5. The study by Malhotra and Kumar (2003) reported the duration of musth in Asian elephants to be 3 months and 17 days. This is similar to the average duration of musth in group-4.

It can also be seen that less than 40 percent of the elephants of group-1 come to musth regularly in contrast to 90 percent in group-4. The

lesser number of animals coming to musth in group-1 and group-5 may be attributed to the larger number of young and sub-adult elephants present in these two groups. It may also be due to the fact that animals of group-4 were maintained on a better plane of nutrition in comparison to the elephants of group-1.

5.4.3 Criteria for tying for musth in different categories

It was seen that the criteria for tying for musth varied from region to region, animal to animal and group to group. It can be seen that all the private owners with one elephant and most of the elephants belonging to temple trusts were tied when the temporal enlargement was evident. It can also be seen that the elephants of the forest department were tied when the mahout noticed some changes in the temperament of the animal. The data also reveals 11.1 percentage of animals belonging to private owners with more than one elephant and 22.2 percentage of animals belonging to temple trusts with more than one elephant were tied according to the date of previous year's discharge. The table also shows that a large number of elephants belonging to private owners with more than one elephant and to temple trusts with one elephant were tied on seeing the discharge. Similar observation was made by Rasmussen *et al.* (1984). It was also seen that none of the elephant keepers reported perianal enlargement or masturbation as the main criteria for tying the elephant for musth.

5.4.4 Management of musth

The musth elephants are very dangerous and unmanageable and are usually kept restrained with chains away from contact with people (Eisenberg *et.al.*; 1971) in Kerala. Thakuria and Barthakur (1994) reported the use of chemical sedatives to manage a case of violent musth (Sarma and Dutta;

1996). Similar cases were reported by Valandikar and Raju (1996) and Chandrasekharan and Cheeran (1996):

Anonymus (2000) reported that the duration of musth in young males declined significantly after the introduction of older males to Pilanesberg national park in South Africa.

5.5 Nutrition

The data on the group wise average consumption of each proximate principle reveals that the average dry matter fed to group-3 (192.2 kg/day) is the highest, and that of group-1 was the lowest (142.0 kg/day). It can also be seen that the average crude protein fed to was the highest in group-3. The statistical analysis of the data showed Group-1 was significantly different from the other three groups in this regard. These results were not in agreement with the study of Ananthasubramaniam (1979) who establish that a DCP and dry matter of around 2.36 kg and 42.7 kg respectively satisfied the maintenance requirement of an elephants approaching the adult age and weight but were not adequate for promoting growth in young animals.

The average dry matter fed to elephants of groups 1,2,3 and 4 according to this study were 142.0, 165.7, 192.1 and 187.4 kilograms respectively. The average CP fed ranged between 8.1 and 9.9 kilogram per animal per day.

Comparing these values with the recommendations made by the previous studies reveal that the DCP and TDN values of the feed fed to the elephants in all the groups were more than the recommendations made by Ananthasubramaniam (1979). This may partly be due to the fact that the elephants of all the groups in this study were older and heavier than those in the above study.

The dry matter fed to of the elephants of the forest department could not be ascertained correctly because a significant number of these elephants

were taken to the forest for grazing. Similar observations were made by Sarma (2002) on the elephants in Assam.

The average amount of concentrate ration fed to the elephants of Kerala forest department can be seen in table-27. The recommended ration of forest department is shown in Table-28. Krishnamurthy (1998) reported that apart from natural grazing for 14 to 15 hours a day, the elephants in the southern states was provided with additional grain ration in cooked form twice a day.

The average dry mater fed to the elephants of each group were calculated by assuming that an average elephant weighed around 4000kg. It was found that the value thus obtained ranged between 3.55 and 4.80 percent. This value was slightly lower than the values reported by Cheeran (1999). These values were significantly higher than the values reported by Sukumar (1989). This may be due to the fact that the study did not consider the wastage of feed.

5.6. Restorative therapy

This is the system of feeding the elephants with a diet rich in easily digestible nutrients during the monsoon season. Similar result was reported by Joseph and Ananth (2002). It is obvious from table-25 that annual restorative therapy was administered to all the elephants (100%) belonging to temple trusts with more than one elephant and a great majority (90.9%) of the elephants belonging to private individuals with more than one elephant. It can also be seen that the elephants belonging to forest departments were not given any restorative therapy.

5.7. Vaccination and history of diseases

It was seen that none of the surveyed elephants were immunized or vaccinated against any disease. Most of the mahouts and owners reported the use of tetanus toxoid; especially just before or after musth.

It could be seen that the major ailments observed to be affecting elephants were nail problems, abscesses, impaction, colic, respiratory infection, etc. which was in accordance with the report of Ashraf and Manikar (2003). Out of this, impaction is the single greatest problem. It is usually seen when the animal is over worked, or given feed and water soon after a tortuous journey, especially when the function is about to start. It was seen that most of the cases of impaction reported occurred in the hot summer months when the animals were having a hectic schedule attending festivals (Chandrasekharan; 2002).

In general the most common cases observed were few cases of abscess and a case of impaction. This is similar to the report of Krishnamurthy (1998) who reported that the general condition of the elephants of Kerala and Assam were good as the owners took pride in having the animal in good health.

Summary

6. SUMMARY

Kerala has a rich cultural heritage with festivals throughout the year for which elephants form an integral part. Elephants are also used for draught purposes in timber mills.

The present population of captive elephants in Kerala is estimated to be around 700, owned and managed by private individuals, temple trusts and government bodies like the forest department.

Systematic studies on the utilization pattern, management and nutrition of elephants are very scanty. Hence, this study is intended to document the utilization pattern, management conditions and nutritional status of elephants under various ownership conditions prevalent in Kerala.

The data on the above aspects were collected in the period between June-2003 and July-2004 using survey method. The credibility of the information so collected was checked using triangulation method where, the information about an animal was collected from the owner, the mahout, and also by physical verification of the claims in all possible cases.

The major findings of the study are mentioned below.

..... Proximate analysis of various feed ingredients fed to the elephants was done. The result obtained was then multiplied by the average quantity of various feed consumed by the elephants of every group so as to quantify the total amount of each proximate principle fed to the elephants. The results so obtained were then compared with the findings of the Ananthasubramaniam (1979) to evaluate the nutritional status of the elephants of Kerala. It was seen that the animals of temples trusts with one elephant were maintained on the highest plane of nutrition. The average dry matter fed to all the groups was higher (3.5%) than the recommended levels (1.5-2%).

The study also showed that all the elephants of temple trusts with more than one elephant were given restorative therapy in comparison with 50, 90 and 70 percent in group-1, 2 and 3 respectively where as none of the forest elephants were given this special diet.

The elephants of private owners with one elephant were significantly younger (25.2 years) than the elephants of private owners with more than one elephant and elephants of temple trusts with one elephant (32.7 and 35.4 years respectively). The comparison of the height of the elephants revealed that the average height of elephants of forest department (245 cm) was significantly lesser than the average height of elephants of private owners with more than one elephant and elephants of temple trusts with one elephant (278.7 and 283.9 cm respectively).

It could be seen that the frequency of bath given to the elephants of various groups were insignificant. The average duration of bath given to forest elephants was significantly lower than the average duration of bath in all other groups. Frequency of watering the animals varied between twice to four times in hot summer months and once to twice in rainy season. There was a marked difference between individual animals or owners but there was no significant difference between groups in this regard.

It was also observed that most of the elephants in Kerala did not have proper housing facilities, and that they were tied under tree on sandy floor. Studies on the utilization pattern of the elephants revealed that the elephants remained idle for 238.1, 200.3, 219.9, 222.6 and 322.3 days in a year in group 1 to 5 respectively. The elephants of group-2 attended the maximum number of festivals (82.9 days) in a year. The month wise split-up of various activities revealed that most of the festivals attended by the elephants were in the five months from December to April. The elephants of temple trusts were not sent for work.

It was seen that the average duration of musth (108.9) and the average percentage of animals coming to musth (90.0) was highest for the elephants of temple trusts with more than one elephant.

It was comprehended that none of the elephants were vaccinated against any disease. The major diseases affecting elephants were reported to be impaction, colic, respiratory infection, abscess, foot problems and corneal opacity.

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**MANAGEMENT SYSTEMS AND UTILISATION
PATTERN OF CAPTIVE MALE ELEPHANTS
(*Elephas maximus*) IN KERALA**

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ABSTRACT

The utilization pattern, management and nutrition of the elephants of Kerala under different ownership conditions were studied between June-2003 and July-2004 using survey method. The credibility of the information so collected was checked using triangulation method where, the information about an animal was collected from the owner, mahout, and also by physical verification of the claims in all possible cases.

It was seen that the elephants of private owners with one elephant (25.2years) were significantly younger than the elephants of private owners with more than one elephant and elephants of temple trusts with one elephant (32.7 and 35.4 years respectively). The comparison of the height of the elephants revealed that the average height of elephants of forest department (245cm) was significantly lesser than the average height of elephants of private owners with more than one elephant and elephants of temple trusts with one elephant (278.7cm and 283.9cm respectively).

The group wise variations in the frequencies of bath given to the elephants were insignificant but the duration of bath in elephants of forest department was significantly lesser than the average duration of bath in all other groups.

It was also seen that most of the elephants in Kerala did not have proper housing facilities, and that majority of them were tied under tree on sandy floor.

Studies on the utilization pattern of the elephants revealed that the elephants irrespective of their type of ownership were idle for most of the time in the year and that the elephants idled for the maximum number of days in a year (322.3 days). Further, the elephants of group-2 attended the maximum number of festivals in a year (82.9 ± 6.92 days).

Proximate analysis of the feed fed to the elephants revealed that the nutritional status of elephants of temples with one elephant was the highest. The study also revealed that all the elephants of group-4 were given restorative therapy and the elephants of group-5 were not given restorative therapy.

Appendix

APPENDIX

SURVEY OF ELEPHANTS OF KERALA

Name of owner :-
 Name of mahout :-
 Address :-
 Type of ownership :-
 Number of elephants (1st) :-

General Management

- i) *Bath/Wash*
- ii) *Rest/ Sleep*
- iii) *Watering*

Feeding (*Frq-Time-Interval-Qty*)

	<i>Summer</i>	<i>Rain</i>
<i>Rice</i>		
<i>Times</i>		
<i>Hay/Str/Gra</i>		
<i>Times</i>		
<i>Palm leaves</i>		
<i>Coconut</i>		
<i>Times</i>		
<i>Water</i>		
<i>Times</i>		
<i>Others</i>		
<i>Times</i>		

Comments :-

.....

.....

Additional feed given (Qty- Freq-Season)

Processions, Pageants, Civic receptions :-

Work :-

Idle :-

Musth :-

Travel :-

Comments :-(Restorative).....

.....

.....

Utilization

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<i>Processions</i>													
<i>Work</i>													
<i>Travel</i>													
<i>Musth</i>													
<i>Idle</i>													

Comments :-

.....

.....

Criteria for tying for musth :-

- i) *Discharge*
- ii) *Perennial enlargement*
- iii) *Temporal enlargement*
- iv) *Masturbation*
- v) *Others*

Utilization and Management

	Bath		Wash			Feed/ Rest			Sleep		Watering(q TY	
	No.	Time	No	Time	Durati	No.	Durati	Time	No.	Duratio	No.	Time
Processions												
Work												
Musth												
travel												

Comments :-.....

.....

.....

HOUSING PROVIDED :-

- i) *Flooring* :-
- ii) *Roofing* :-

Vaccinations :-

History of diseases :-

- i) *Foot rot* :-
- ii) *Impaction* :-
- iii) *Injuries* :-
- iv) *abscess* (Site-Month-Duratuon-peroid
- v)

Insurance :-

Restrain :-Chain-Rope

- i) *Musth*
- ii) *Travel (Road/Walk)*

Attachment

Name of owner :-

Address :-

Elephant number () :-

Feeding

	<i>Summer season</i>	<i>Rainy season</i>
<i>Rice</i>		
<i>Times</i>		
<i>Hay/Str/Gra</i>		
<i>Times</i>		
<i>Palm leaves</i>		
<i>Coconut</i>		
<i>Times</i>		
<i>Water</i>		
<i>Times</i>		
<i>Others</i>		
<i>Times</i>		

Comments :-

.....

.....

Additional feed given

Processions, Pageants, Civic receptions :-

Work :-

Idle :-

Musth :-

Travel :-

Comments :-.....
.....
.....

HOUSING :-

History of diseases :-

- i) *Foot rot* :-
- ii) *Impaction* :-
- iii) *Injuries* :-
- iv) .
- v)

Mahout elephant relation :-