GAJAH 16 (July 1996) 23 - 42

REPRODUCTIVE PERFORMANCE OF CAPTIVE ASIAN ELEPHANTS IN MYANMAR

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ABSTRACT

The remaining populations of the Asiatic elephant are at critically low levels and declining rapidly throughout most of their range. The continuing loss of habitat for wild populations and the limited scope of domesticated breeding programmes are the primary obstacles to the goal of preserving viable elephant populations in Southeast Asia. The long-term survival of the elephant is crucial to Myanmar's ecosystem. The Ministry of Forestry of the Union of Myanmar has laid great stress in implementing a combined management programme incorporating both wild and domestic elephant populations which provides the best means for ensuring the continued survival of this species. As the elephants of Myanmar are providing an invaluable service to support the national economy, the research on captive breeding of Myanmar elephants is the major on-going project of the Union of Myanmar, the objectives of which are :-

(1) to encourage natural mating among captive working elephants at the first phase to meet the demand of Myanmar Timber Enterprise for the recruitment of the timber elephants.

(2) to implement a captive breeding programme based on the selection of desired characteristics such as tuskness, tractability, good mothering ability, reliability etc.

(3) to explore more about the reproductive parameters of Myanmar elephants.

This paper deals with some of the reproductive parameters of Myanmar cow elephants from the Myanmar Timber Enterprise, the state-owned enterprise with special reference to population structure of timber (captive) elephants, calving rate, intercalving interval and the age range with prime reproductive performance in Myanmar cow elephants.

INTRODUCTION

The Union of Myanmar is the largest country on the mainland Southeast Asia with a total land area of 676,677 Km^2 (32.4 million ha.) and is well known as a prosperous country due to its rich natural resources, the most prominent of which is its vast area of natural forests. Different types of forest cover some 32 million ha. (or about 50% of its land area) with over 8,000 plant species including 2,300 tree species, 97 varieties of bamboo and 32 different types of cane. Its teak is still the most reputable in the world market and Myanmar accounts for the largest share of world teak trade. Myanmar has a well established tradition of harvesting its natural resources conservatively. To ensure the sustainable production of the timber resources, forests are not clear cut. The Union of Myanmar has steadfastly applied the Myanmar's Selection Felling system with the felling cycle fixed at 30 years, and teak trees are allowed to cut only when they have grown up to the size of 7 feet 6 inches (229 cm) girth at breast height (gbh) in good teak forest and 6 feet 6 inches gbh in poor teak forest. GBH for other hard woods are ranged from 8 feet to 6 feet 6 inches according to species. The annual allowable cut is less than 3 million cubic meters for both teak and hardwood.

The forests are mostly of deciduous type with a wide variety of valuable species of timber growing together. It is therefore of great importance that utmost care be taken in the harvesting of timber. Topographically, the country is very rugged and mountainous in the north and west of Myanmar, where most of the timber harvesting sites are situated. Myanmar has three different seasons, the rainy season (Monsoon), summer and cold season. The rainy season lasts for four months, from July to October in southern Myanmar but much longer in the up country, where it extends up to December. Due to the rugged terrain and long monsoonal climate, it is impossible to use machines in most extraction sites and elephants have been playing a vital role since prewar period. It is universally accepted that animal skidding is the most environmentally friendly method and the Union of Myanmar is the only country in the world that extensively utilizes the elephant's draft power in logging operations. Many countries are now reverting to this method of logging, using buffalo, cattle, horse etc. According to the available sources 10,000 - 17,000 Asian elephants are kept under domestication as captive elephants, majority being used in the timber industry and few animals are used for religious ceremonies and in the tourist industry. Approximately 6000 elephants are kept as captive animals in the Union of Myanmar; 3000 elephants are under the care of Myanma Timber Enterprise while 3000 elephants are in private hands. It means that nearly half the world's captive population of tame elephants are in Myanmar. The existing animal power deployed in timber harvesting industry is stated in table (1 a) and the sex ratios of each age group is shown in pie graph of Fig. 1.

Since prewar period, Myanmar elephants had been grouped into three age categories in accordance with the utilization capability of the animal. Until 4 years of age, they are put under the class of CAH (calf at heel) and they keep trailing their mother on and off duty but all calves that reach the age of 4 to 5 years or a height of 4.6 feet are put into

the systematic weaning, taming and training programme. Only after training are they given a registration number and are taken care of by separate methods. Young elephants between 5 and 17 years of age are grouped as TC (trained calves) and they are trained to learn simple words of commands, getting used to their harness and fetters and given light jobs, and used as baggage elephants. This is the long period of learning for young elephants during which the strong relationship between man and elephant is gradually built up. They try to understand how to communicate with each other during this twelve years period which allows the animals to learn to live in close harmony in their semi-domesticated environment. When they reach 18 years of age, they are put into the class of FG (fully grown) and introduced to logging operations as working/draft elephants until they reach the retirement age of 50 years.

The total population of wild elephants in Asia was estimated to be between 35,000 and 55,000 (Santiapillai and Jackson, 1990) but Daniel (1992) put the number to be between 36,000-44,000. Through questionnaire surveys and local information, Myanmar is known to support between 6,000-10,000 wild elephants- the second largest wild stock in Asia inhabiting some 32 million ha of forested area. The capture of wild elephants has stopped in Myanmar since the 1994/95 fiscal year.

REPRODUCTIVE PARAMETERS OF MYANMAR COW ELEPHANTS

Data concerning repoductive performance of Myanmar timber elephants is extracted from the annual reports of elephant log book known as Form J of the Extraction Department of the Myanma Timber Enterprise. Only after taming and training, every domestic elephant in Myanmar is given a registration number and a log book in which all the bio data such as sex, name, age at time of acquisition or date of birth (if captive born), age of training, date of registration, date of mating/calving etc. are routinely recorded. Additional information on training methods, name of trainer, temperament of the animal, veterinary inspection and treatment, reproductive history, prescribed work load and nature of work, musth condition etc. are also recorded. There were 278 calvings from 269 cows during the period 1991-1994. The data was sorted to identify the range of age and the number of calving rates and the prime age of reproduction in Myanmar cow elephants. Nine out of 269 cows gave birth to their calves during the 1991/92 to 1994/94 fiscal years. From 1991/92 to 1994/94 fiscal years. The number of calves born and the sex ratio of male and female are 80 (35:45), 68(32:36), 72(37:35) and 58(27:31) respectively. Due to the inconsistencies of filling the Form J by different officials, 86 cases of calvings were found as unknown paras. Out of 278 calves, 117 (55 males & 62 females) were sired by captive bulls from MTE and private-owned bulls, 75 (31 males & 44 females) were sired by wild elephants, and 86 (45 males & 41 females) were born from pregnancies without known breeding history. The reproductive parameters of Myanmar cow elephants and the number of calves and their sex ratio from MTE cows which are grouped in 5 years age intervals are displayed in Tables 3 & 4 and Fig. 2. which indicate that the prime reproductive age of Myanmar cow elephants is between 21 and 35 years. Fig. 3. shows the number of calves born from first to ninth calvers.

The estimated calving rate (range 6.02 to 8.3%) and the number of calves representing the percent population (range 1.9 to 2.7%) during the last 4 fiscal years is described in Table 5. The range of miximum and maximum age limits in respective calvings between first and fifth calvings are shown in Table 6.

COLLABORATIVE RESEARCH ON CAPTIVE BREEDING OF ELEPHANTS

The total number of MTE elephants with calves in comparison with the mortality rate and number of animals captured from the wild during 1980-1995 are shown in Tables 8 and 9 and in Figs. 4 and 5. It is noted that the total number of MTE timber elephants is quite stable at the figure of 2900 but the mortality rate among the calves under 5 years is higher than that of the other age groups (Table 7). As the current birth rate was not adequate to replenish the present stock of timber elephants, the captive breeding programme becomes one of the alternatives to capture. Experience of rearing calves born under captivity are more intelligent, less aggressive, easier to train, tractable and are of more reliable temperament than those captured from the wild. The Ministry of Forestry has encouraged the following research projects.

1. To develop RIA of serum progesterone to study the oestrous cycle of Myanmar cow elephants to improve breeding management.

A research grant was awarded by the International Foundation for Science (IFS) of Sweden and scientific advice and instrumental help was given from the Metro Washington Park Zoo, U.S.A. This is the first research work in Myanmar on elephant reproduction, working to develop artificial insemination (A I) procedures that will be repeatable and practical for the implementation of captive breeding programmes. Paramount to the success of A I. Procedures is timing the insemination to coincide with ovulation, so as to optimize conception and make prudent use of limited amount of semen. Characterization of the events of the oestrous cycle leading to ovulation must first be documented endocrinologically and accurate information on the endocrine status of the female is basic for the understanding of oestrous cycle, pregnancy, gestation, parturition and the impact of stress caused by season and fatigue.

Myanma Timber Enterprise has committed to the study on captive elephant since March 1992, utilizing the expertise of the staff of Division of Nuclear Medicine of the Department of Medical Research, Ministry of Health, Myanmar. It is hoped to trace the detailed profile of progesterone for 3 years, followed by correlating it to other indicators such as *Flehmen* responses (urine tests) and core body temperature. The interrelationship of these indicators should point to the optimal time to mate or inseminate leading to a repeatable and practically identifiable insemination time.

2. To study spermiogram of elephant semen with special reference to its employment for natural and artificial breeding

Scientific support and financial assistance was given by the IFS of Sweden. As it pertains to livestock, AI allows the most efficient use of sires. There is a need for greater understanding of safe and reliable method of semen collection and the characteristics of ejaculate as well as the storage of semen. For wildlife species AI could be particularly valuable for ensuring reproduction between behaviourally incompatible pairs, eliminating the risks of animal transport and providing an avenue for infusing genes from wild stocks into captive populations many of which are genetically stagnant.

3. To initiate database management of studbooks of domestic elephants from the Union of Myanmar.

The collaborating research institution is the National Zoological Park of the Smithsonian Institution, USA. We are examining the parameters of life history of the domestic elephant population in Myanmar that would enable us to calculate descriptive statistics for each of the life history variable which could then be used to model population growth rate and to recommend changes in management necessary for births to exceed deaths of elephants under captivity. We have found that the elephant log books are scattered all over the country. It is very difficult to trace the biodata concerning breeding, calving rate, intercalving interval, inbreeding problems as well as management problems among working elephants. No research has been done to learn the ethnozoology of elephants. The goals of our study are not only to explore the life history parameters but also to learn the demography as well as the assessment of body condition and reproductive perfor mance under different working and management conditions which would allow us to calculate descriptive statistics for each of the life history variables. The major output of this project is to initiate centralized database of all possible information on elephants from every region which is readily accessible for analysis, contributing to the improvement in the management of domestic elephants.

DISCUSSION

Sex -ratio is a measure of the reproductive performance of any population and a knowledge of it is essential to understand and interpret other vital statistics of the population (Downing, 1980). In general, the sex-ratios among neonates is nearly 1:1 but timber elephants of age groups (under 5 years, between 5 and 17 years or calf at heel and trained calf) are roughly 1:1 with a little bias to females but total number of female adults over 18 years old is nearly 50% more than the adult males and the sex- ratio of male and female is 1:1.6 (Table 2 and Fig. 2). The elephant is a polygynous species, where one bull can successfully mate with a number of cows in estrous therefore it is an advantage to have surplus females for mating. As Sukumar (1989) pointed out, a certain proportion of adult females would also be either pregnant or in anoestrous state and therefore not available

for conception, in which case, the operational sex ratio would not be as disparate as the observed sex-ratio in the population.

Age-ratios are also an important source of information for management of elephant population (Downing, 1980). During 1994-95 fiscal year, the population of working elephants in Myanmar composed of 1622 fully grown elephants (over 18 years old), 962 trained calves (age between 5 and 17 years) and 269 calves at heel which comprise 56.9%, 33.7% and 9.3% of total population respectively. The lower population of calves at heel is one of the indicators of declining birth rate and high mortality rate among subjuveniles before weaning age at 4-5 years. The age at which a female elephant becomes sexualty mature ranges from approximately six to twelve years (Mikota *et al.*, 1994). The age of first calving in Asian elephants ranges from 5-16 years (Flower, 1943), 13 years (Robinson, 1934) to 9 years (Evans, 1910). But Schmidt (1986) stated that age at sexual maturity in captive elephants varied widely and appeared to be influenced by nutrition.

In this paper, we are trying to emphasize some little known aspects of reproductive parameters of Asian elephants regarding the age range of first calvings, sex ratio and minimum and maximum age of respective calvings from first to ninth calvings, population structure of elephants from Myanmar Timber Enterprise comparing mortality and calvings in all three age groups. Information on reproductive performance of Myanmar cow elephants was first described by U Toke Gale (1971) as follows :-

"The Burmese cow-elephants, engaged as they are in strenuous timber work from the age of 18 to over 55 years, do not live to procreate right up the ripe age of eighty as Sanderson states, but during their span of life in captivity, healthy cows will produce from three to five calves at an interval of 5 to seven years between each confinement"

The calving time and the sex-ratio of 967 calves born during 1948 and 1964 (average 56.9 calves per year) were also recorded by U Toke Gale with the maximum number of calving taking place in cooler part of the year (December, January, February and March). No detailed information concerning the range of age, number of calves born on para basis was given. Concerning the age at sexual maturity in Asian elephants, Sukumar (1989) had stated that the age of pubery in Asian cow elephants of India is very plastic and he assumed that in most Asian countries the mean age at first calving may be as late as 18 to 20 years and bull elephants can not mate until they are 20 to 25 years old. The mean intercalving interval was estimated at 4.7 years according to his field studies. The birth of 74 calves from 37 captive adult cows from the state of Tamil Nadu during the period of 1950 and 1983 was also described as a sucess in breeding elephants in semicaptive conditions.

For African elephants, Williamson (1976) stated that the interval was 4.3 years with the mean age of first ovulation was approximately at 11 years of age. Smith and Buss (1973) indicated that female African elephants reached sexual maturity between 7 and 15 years of age with loctation period for the young lasting for 4.8 years. Lee (1991) estimated

the age of maturity in African elephants at 12-14 years and she commented that cows under the age 10 may be capable of ovulation but less likely to become pregnant. She also stated that the range of intercalving interval was 3 to 9 years depending on the local environmental conditions (rainfall, food supply, etc.), the presence of a suckling calf, its sex and the age of cow and those of 15 to 50 years were most likely to conceive while younger animals and the oldest showed reduced fertility.

From the four year data on 278 calvings, it appears that:

1. the youngest age of cow for her first calving is 12 years 5 months, indicating that age of puberty in Myanmar elephants can be as young as 10.75 years (Table 6).

2. the oldest age at the time of calving (during the last 4 years) is 55 years and maximum number of calves produced from a Myanmar elephant is nine (older records had shown some cows can drop up to 12 calves during their life time).

3. the number of calves born at first, second and third calvings is dramatically increased in comparison to the later calvings and the age at first three calvings ranged from 12 years 5 month to 55 years with the prime reproductive age clearly shown in the Fig.2 with 21 to 35 years age group. This information is important in choosing the best age group for a captive breeding programme.

4. if we exclude the births from cows under 15 years of age (7 out of 280 births) the estimated calving rates between 1991/92 and 1994/95 are 8.3%, 6.8%, 7.3% and 6.02% respectively with the mean calving rate being 7.1%.

5. two pairs of twin s were born among 278 calves during the last 4 year period which also indicates that tendency of twinning in Asian elephants is 1 in 140 births.

6. Tables 8 & 9 and Fig. 5 indicate the fact that current calving rates do not meet the number of deaths and there is no doubt that the captive breeding programme is the only alternative to replenish Myanmar logging elephants.

7. nearly one quarter of total mortality lies with the age limit of under 5 years, veterinary care of young calves and lactating mother should be put into a priority project in the near future (Table 7).

8. we traced the reproductive histories of cows that give birth more than 5 calvings from the 4 years calvings. It is most interesting to note that 5 cows have intercalving interval of less than 2 and a half years. The shortest intercalving interval ever recorded during the last 4 years is exactly 2 years for a cow with registration number of 3734. She dropped 2 calves (her second and third calves), on 01/13/87 and 01/13/89, While she was carrying her third pregnancy, lactation process was not

disturbed and the older calf suckled until the mother gave birth to her third calf. The biodata of this cow is as follows;

Name : Win San
Registration no : 3734
Birth type : captive born with the date of birth 03/26/69

Reproductive history :			
	first calf	(female)	05/15/84
	second calf	(female)	01/13/87
	third calf	(female)	01/13/89
	fourth calf	(male)	10/14/91
	fifth calf	(female)	06/05/95

Remark : all five calves are still altive

9. we came to realise that shorter intercalving interval is not a desirable characteristic as it provokes competion between siblings and can lead to higher neonatal mortality in younger calves due to reduced opportunities for obtaining enough milk during the first few months of age. The heavy burden of lactating two calves at a time can deplete more body reseves than the cow with one sucking neonate and this would eventually induce the mother to delay resumption of the next oestrous cycle.

CONCLUSION

With the global oil crisis, and high cost of mechanization, the use of readily available elephant power will prove much more economical than mechanization. In addition, the elephants involved in timber hauling do not damage or churn up the forest. Hence the long-term survival of the elephant is crucial to Myanmar's ecosystems. A sound scientific understanding of a natural resource is fundamental to any well planned management of that resource. Long term conservation of Myanmar elephant need not depend on quantification of its population throughout the country but it is important to know whether the population trend shows declining picture. We are encouraged to learn that adult-dominated age structure and femal biased sex -ratios are characteristics of the population structure of Myanmar elephants. If the recruitment of the stock of working elephant by capturing from the wild is stopped, implementation of captive breeding programmes and active measurements to reduce calf mortality is of paramount importance and these are the alternatives to maintaining a sustainable population of working elephants.

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TABLE 1. Draft animals used for timber harvesting during 1994-95 fiscal year

Departmental Power

Adult elephants

(working elephants over 18 years of age)	1622
Trained/baggage elephants (5 to 17 years old)	962
Calves at heel (under 5 years of age)	269

Hired animals

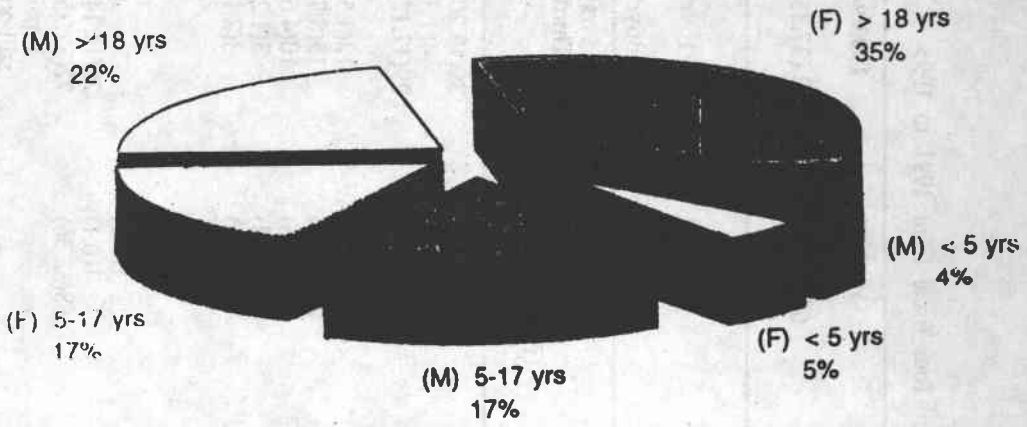
Private owned elephants (workable age/size)	2280
Baffalo paris	1400

TABLE 1.a Coding of age categories by Sikes (1971)

Neonate :	birth through 30 days of age
Infants :	31 days through 1 year of age
Calves :	greater than 1 year through 5 years of age
Juveniles :	greater than 5 years through 10 years of age
Sub adult :	greater than 10 years through 20 years of age
Prime adults :	greater than 20 years through 40 years of age
Seniour adults :	greater than 40 years of age
Unknown :	birth date unknown

TABLE 2 Age groups of elephants owned by Myanmar Timber Enterprise during 1994/95 fiscal year

Age group	Male	Female	Total
Fully Grown (over 18 years)	619	1003	1622
Trained calves (5-17 years)	478	484	962
Calves at heel (under 5 years)	123	146	269
Total	1220	1633	1853



FG = Fully grown (over 18 years)

TC = Trained calf (5-17 years)

CAH = Calf at heel (under 5 years)

Fig. 1. Overall population of MTE elephants showing sex ratios

TABLE 3. Reproductive parameters of MTE cow elephants in four fiscal from 1991 to 1995

	1991/92	1992/93	1993/94	1994/95
The number of calves born Total (Male. Female)	80 (35.45)	68 (32.36)	72 (37.35)	58 (27.31)
The age of cow at the time of her 1st calving youngest	13yr5m	13yr10m	16yr*	14yr11m
Oldest	49yr*	38yr*	36yr*	42yr*
The oldest age at the time of calving	50yr* (Third)	51yr* 3 cows (Fourth, third & second)	55yrs* (Third)	50yrs* (sixth=twin)
Calves sired by bulls from MTE, FD	26 (9.17)	20 (11.9)	39(19.20)	32(16.16)
& private owned wild bulls	33(15.18)	32(13.19)	4(1,3)	6(2.4)
Unknown	21(11.10)	16(8.8)	29(17.12)	20(9.11)
Calvings as first para	26(16.10)	16(6.10)	12(7.5)	9(4,5)
Calvings as second Para	24(8.16)	22(12.10)	15(8.7)	19(9.10)
Calvings as third Para	10(0.10)	12(6.6)	10(4.6)	9(1.8)
Calvings as fourth Para	5(1.4)	2(0.2)	3(1.2)	5(4.1)
Calvings as fifth Para	2(2.0)	1(0.1)	3(2.1)	2(1.1)
Calvings as sixth Para	1(1.0)	-	-	-
Calvings as seventh Para	1(0.1)	-	-	-
Calvings as eighth Para	-	-	-	-
Calvings as ninth Para	-	1(0.1)	-	-
Unknown	11(7.4)	1(0.1)	28(14.14)	11(7.4)
Total no. (Male. Female)	80(35.45)	68(32.36)	72(37.35)	58(27.31)
Twinning			1 pair stilborn	1 parir (females)
*wild caught				

TABLE 4. The number of calves born and its sex-ratio at different age groups of MTE cows during 1991/92 to 1994/95 fiscal years

	Age group	1991/92		1992/93		1993/94		1994/95	
1.	The youngest age at her first calving	13yr	5m	13yr	10m	16	yr*	14yr.	11m
2.	Under 15 years	1	1	1	1				1
3.	Between 16 and 20 years	4	5	3	6	7	2	3	4
4.	Between 21 and 25 years	14	13	10	7	5	9	4	5
5.	Between 26 and 30 years	9	9	9	5	8	5	4	3
6.	Between 31 and 35 years	2	5	8	3	7	8	7	5
7.	Between 36 and 40 years	2	4	1	5	6	6	1	5
8.	Between 41 and 45 years	2	4	1	3	2	4	3	4
9.	Between 46 and 50 years	1	4	-	2	1	1	5	3
10.	Over 50 years	-	1	1	2	1	-	-	1
11.	Total number of calvings	80		68		72		58	
		35	45	32	36	37	35	27	31

* wild caught

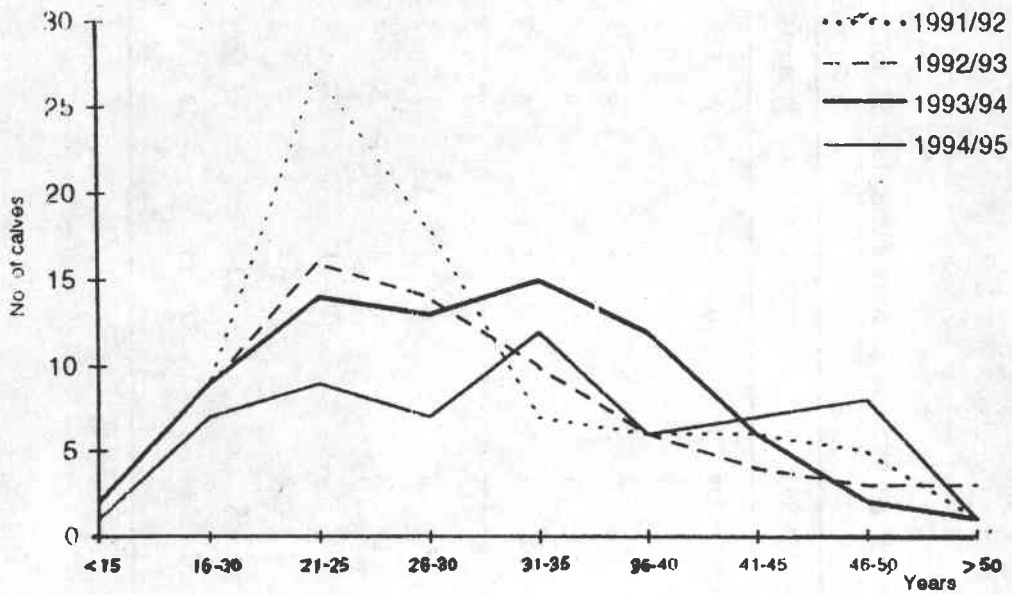


Fig. 2. The number of calves born from MTE cows according to 5 years age grouping, showing the age range of prime reproduction is (21-35).

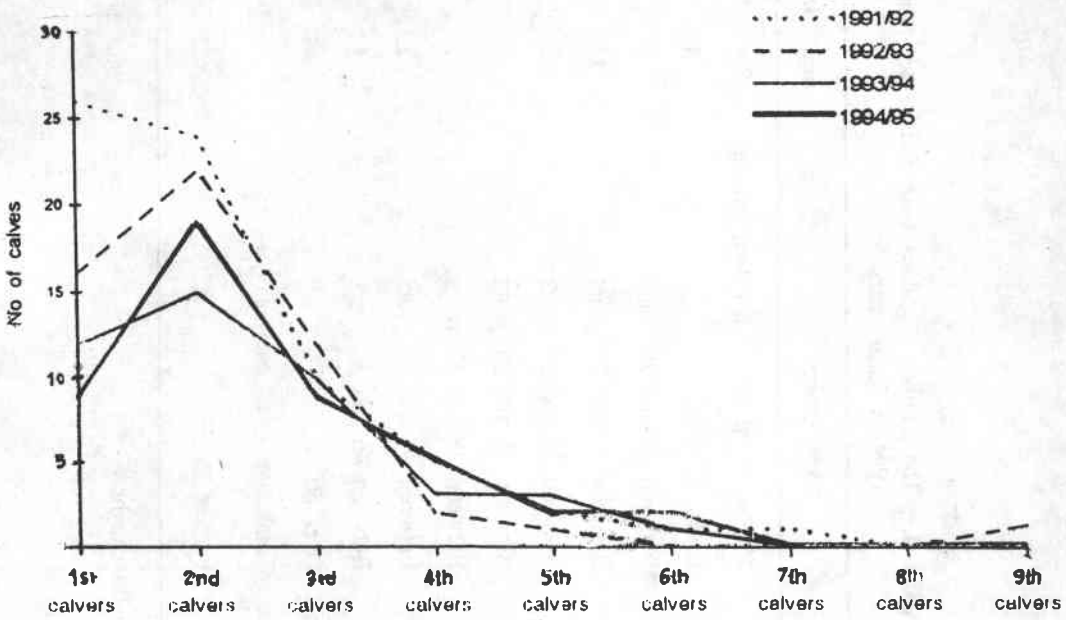


Fig. 3. The number of calves born from MTE cows elephants showing various paras

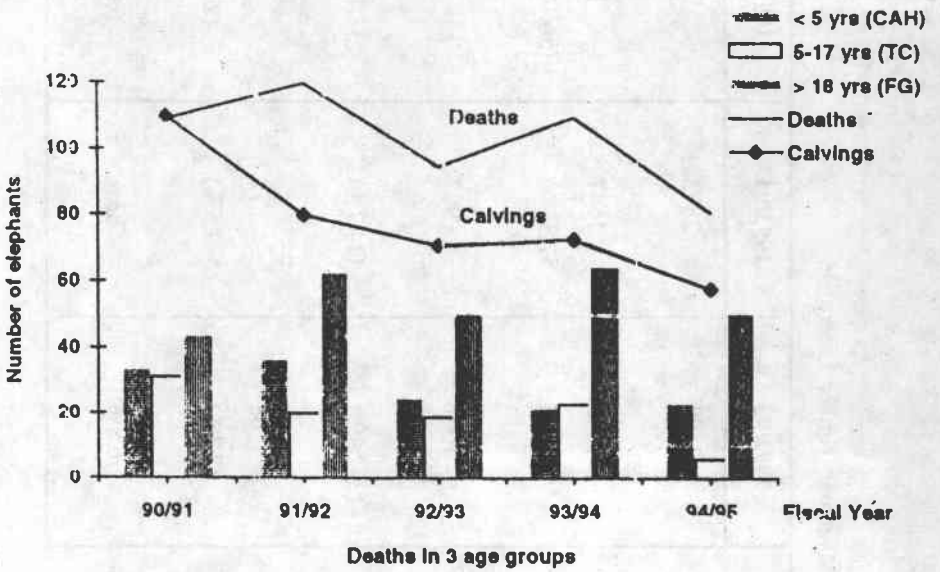


Fig. 4. Comparison of mortality and calvings of timber elephants according to three age groups during 1990-1994

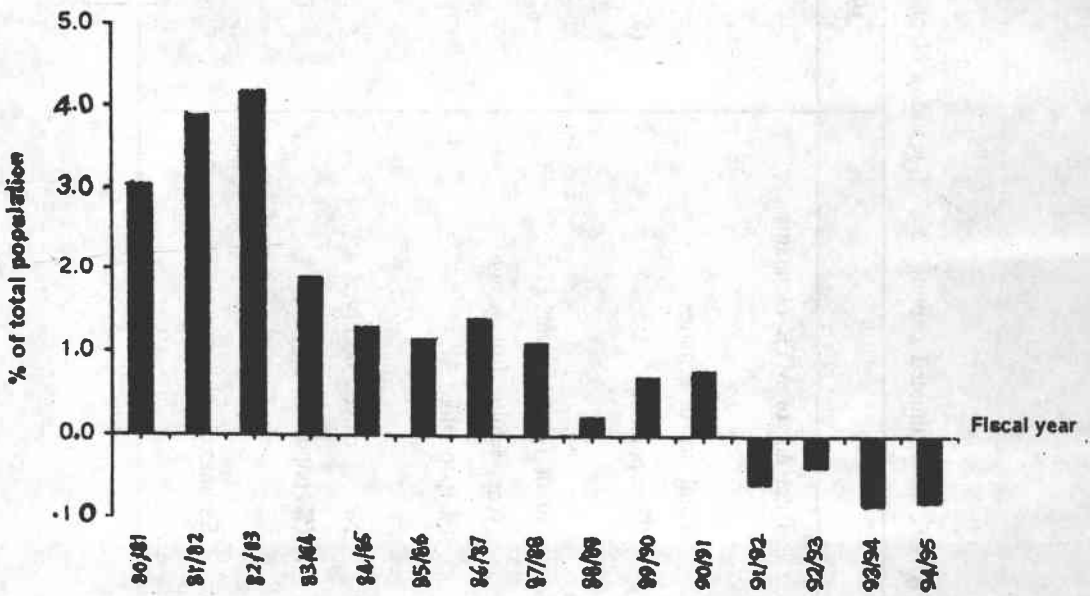


Fig. 5. Population trend of elephants from Myanma Timber Enterprise

TABLE 5. Estimated calving rate of working elephants from Myanmar Timber Enterprise

	1991/92	1992/93	1993/94	1994/95
1. Total no. of MTE elephants	2895	2898	2873	2858
2. Total no. of females	1667	1632	1647	1622
(% population)	(57. 58%)	(56. 31%)	57.32%)	(56. 75%)
3. No. of females over 17	962	1001	997	962
(years -adults, full grown				
(% popultion)	(33.23%)	(34.54%)	(34.7%)	(33.71%)
4. No. of calves born/year	80	68	72	58
(% population)	(2.7%)	(2.3%)	2.5%)	(2.0%)
5. Estimated calving rate (%)	8.3%	6.8%	7.3%	6.03%

TABLE 6. The range of age showing minimum and maximum age at the time calving in MTE cow elephants between 1991/92 and 1994/95 fiscal years

Fiscal year Age at calving	1991/92		1992/93		1993/94		1994/95	
	Max.	Mini.	Max.	Mini.	Max.	Mini.	Max.	Mini.
1. First calving	49y*	13y5m	38y*	13y10m	40y10m	16y*	42y11d	14y11m
2. Second calving	46y*	18y*	51y*	17y4m	42y*	20y*	48y*	15y 5m
3. Third calving	52y*	20y*	51y*	25y2m	55y*	25y*	47y*	19y*
4. Fouth calving	50y*	27y*	51y*	46y*	44y*	27y6m	45y11m	25y2m
5. Fifth calving	41y*	26y*	41y*	41y*	47y*	34y*	39y*	37y*
6. Para Unknown	11		16		29		14	
7. Total number of calves born	80(35M 45F)		68 (32M 36F)		72 (37M 35F)		58 (27M 31F)	

* = approximate age at the time of calving from the wild caught cow elephants

TABLE 7. Mortality showing sex ratio of MTE elephants in 5 years age grouping during in 1993/94 fiscal year

MTE elephants with different age group	Mortality			
	Male	Female	Total	%
Under 5 years	9	10	19	23.5
6 to 10 years	5	2	7	8.6
11 to 15 years	1	-	1	1.2
16 to 20 years	2	3	5	6.1
21 to 25 years	1	3	4	4.9
26 to 30 years	1	2	3	3.7
31 to 35 years	3	2	5	6.1
36 to 40 years	3	4	7	8.6
41 to 45 years	2	2	4	4.9
46 to 50 years	3	4	7	8.6
51 to 55 years	1	6	7	8.6
56 to 60 years	2	4	6	7.4
over 60 years	2	4	6	7.4
Total	35	46	81	

TABLE 8. Mortality in different age groups of MTE elephants during 1980 to 1995

Year	Total population of MTE elephants	Adults (fully grown) over 18 years			Trained calves (5-18) years			Calves (under 5 years)		
		no.	deaths	%	no.	deaths	%	no.	deaths	%
1980-81	2539	1244	20	1.60	981	15	1.53	314	22	7.0
1981-82	2652	1266	23	1.82	1036	22	2.12	350	26	7.4
1982-83	2755	1317	26	1.97	1033	15	1.45	405	28	6.9
1983-84	2798	1131	29	2.56	1061	18	1.69	406	30	7.39
1984-85	2832	1164	21	1.80	1045	28	2.68	423	47	11.1
1985-86	2872	1393	41	2.94	1029	19	1.85	449	30	6.68
1986-87	2920	1434	46	3.21	1056	22	2.08	430	39	9.06
1987-88	2947	1515	40	2.64	1058	24	2.27	424	27	6.36
1988-89	2955	1514	45	2.94	1040	32	3.08	401	26	6.48
1989-90	2942	1547	55	3.56	997	33	3.30	398	38	9.54
1990-91	2925	1549	44	2.8	992	31	3.2	384	34	8.85
1991-92	2895	1548	63	4.7	988	20	2.0	359	37	10.30
1992-93	2898	1606	51	3.1	935	19	2.0	357	25	7.0
1993-94	2873	1605	65	4.0	968	23	2.3	300	22	7.3
1994-95	2858	1622	48	2.9	962	6	0.62	269	26	9.7

TABLE 9. Mortality of MTE elephants in comparison with annual calvings and captures from 1980 to 1995

Year	Mortality in elephants Totalel number of deaths in all age groups	% death of total populati.	Calvings number	% total population	Number of ephants captured from the wild	Population difference increased or decreased in no.	% total popula.
1980-81	57	2.24	60	2.36	75	78	3.07
1981-82	71	2.67	99	3.73	76	107	3.9
1982-83	72	2.61	102	4.07	44	116	4.2
1983-84	78	2.78	95	3.39	35	52	1.9
1984-85	96	3.38	115	4.06	28	38	1.3
1985-86	90	3.13	100	3.48	28	33	1.16
1986-87	107	3.66	115	3.93	33	41	1.40
1987-88	91	3.08	85	2.88	39	33	1.12
1988-89	103	3.48	90	3.05	20	7	0.23
1989-90	126	4.29	118	3.99	29	21	0.71
1990-91	109	3.72	110	3.76	22	23	0.79
1991-92	120	4.15	80	2.76	23	-17 decreased	- 0.59
1992-93	95	3.37	69	2.4	15	-11 decreased	- 0.38
1993-94	110	3.8	7.3	2.5	13	-24 decreased	- 0.84
1994-95	81	2.8	58	2.0	- -	-23 decreased	- 0.80