SKEWED SEX RATIO IN ELEPHANT POPULATION - HOW IT MAY AFFECT THE DEMOGRAPHY AND POPULATION GROWTH? A CASE STUDY IN MUDUMALAI WILDLIFE SANCTUARY AND NATIONAL PARK, TAMIL NADU, SOUTHERN INDIA

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Introduction

The Asian Elephant (*Elephas maximus*), once distributed throughout Indian subcontinent is now confined to only four distinct pockets in South India, Central India, Northern India and North-Eastern India (Sukumar, 1989). One of the major reasons for its decline is loss of habitat and its degradation brought about by the over exploitation (Sukumar, 1989).

Apart from the overall decline in the Elephant population there is a drastic reduction among adult male Elephant population, which would affect genetic variation, demography and social life (Menon *et al.*, 1997; Sukumar *et al.*, 1998). Baskaran and Desai (1999) reported that selective poaching of adult males resulted in the skewed sex ratio and this ratio would affect population adversely in long run. Sukumar (1986) predicted that the at current level of poaching in parts of South India, the adult sex ratio could reach 1:10-20 and suggested that if the male mortality is kept below 8% per annum the adult sex ratio may be pecked at 1:5. This calls for a regular monitoring of Elephant population. Further, it is said that the more unequal the sex ratio, the lower the effective population (Uma Ramakrishnan *et al.*, 1998).

Selective poaching of adult males is also a serious problem in Mudumalai Wildlife Sanctuary & National Park (MWLS&NP). Since this sanctuary area is contiguous to Bandipur and Wayanad Sanctuaries and free migration of Elephants takes place among the sanctuaries, selective poaching in any of these areas will have the impact in all the areas. Therefore, it is essential to study the impact of selective poaching of adult male Elephants in MWLS&NP as a case study for the better management and conservation of this endangered animal in all these sanctuaries.

Objectives

In the present study it is proposed to determine the demographic pattern of the Elephant population with special reference to adult male female ratio and also to find out the changes that have taken place in the Elephant's population

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density and in its age structures over the past years as a result of poaching in MWLS&NP using earlier studies and reports.

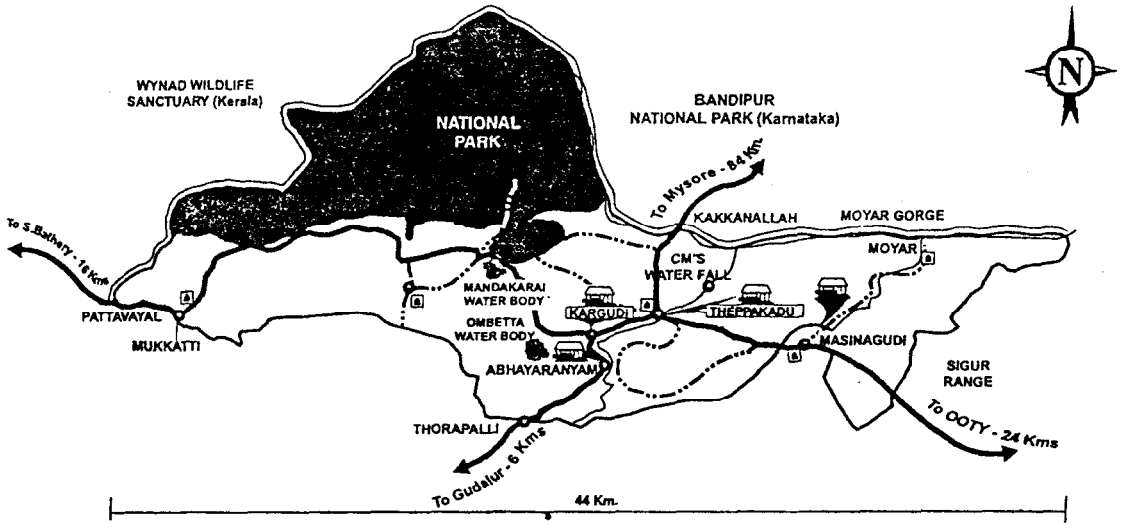
Methodology

Study area : The study area of MWLS & NP, that lies between 11° 32' and 11° 45' North latitude and 76° 20' and 76° 45' East longitude. This is also located with in the Niligiri Biosphere Reserve. The bundaries of this Sanctuary bounded by Bandipur National Park in the North and Waynad Wildlife Sanctuary in the West and North-West and, Singara and Sigur Reserved Forests at the South and the East boundaries (Fig.1). This Sanctuary and National Park area together constitute 321 km^2. and lies within the Elephant reserve 7, which is one of the 11 Elephant reserves declared by the project Elephant (Govt. of India). This Elephant reserve 7 is contiguous to Elephant reserve 8 (Area 2,500 km^2), and there is movement of Elephants between these two reserves (Baskaran *et al.*, 1995).

The elevation of this study area varies between 850 m and 1250 m with an average of 1000 m. Moyar river and its tributaries provide perennial source of water to this sanctuary. There are several large waterholes created by the park management, which act as a major water sources during dry season.

The study area receives from both South-West monsoon and North-East monsoon, that contribute to a long wet season and a short dry season (January to April). Temperature ranges between 8°C to 35°C . The rainfall has a marked East-West gradient, with the eastern areas getting least amount of rain (600mm- 1000 mm) and the western region the heaviest rain (1000 mm-2000 mm). This rainfall pattern corresponds

Fig. 1



Map of the study area : Mudumalai Wildlife Sanctuary & National Park

with changes in the vegetation type ranging from moist deciduous forests from West to dry deciduous forest and dry thorny forests towards East.

Methods : The demography of the Elephants was studied using direct observation methods (Anon., 1998). Fairly good visibility was possible as the study period was during the dry season. The whole sanctuary areas were periodically visited during morning and evening and the sightings of all individuals in the groups were classified into juvenile, (<5 yrs.), sub-adult (6-15 yrs.) and adults (>16yrs.) of male and females. This broad age group was selected in order to avoid confusions in determining the age classes.

The age was estimated using shoulder height and ear folding as suggested by Sukumar (1989). Data on group size and age-sex classification were also collected. Care was taken to count all the animals in a group whenever it was sighted and, such data alone were included. The whole study period extended between December 1999 and May 2000 which covered the dry season. The dry season was specifically selected for this study because, all age group animals could be sighted around the water holes with perennial water supply (Sukumar, 1989).

Data on death of Elephants in MWLS&NP were collected for a period of ten years (1990 to 1999) from the causality register maintained by the Office of the Wildlife Warden, Ooty.

Observation and Results

A total of 23 groups varying the sizes between 2 and 27 were recorded in 102 numbers of observations. The observations were analysed with reference to sex and age. The result on different age structure of the Elephant population in MWLS & NP is given in Table 1.

The death details of the wild Elephants in the MWLS & NP for different age and sex classes for the period between 1990 and1999 is given in Table 2.

The age structure of the Elephant casualty in Mudumalai Wildlife Sanctuary and National Park is given in Fig. 2.

Discussion

The present study reveals that the current adult male and female ratio for the Mudumalai Wildlife Sanctuary and National Park Elephants is 1:15.8. This is in general agreement with the observations made by Anon. (1998), where the ratio is mentioned as 1:14.3. However, Baskaran and Desai (1999), calculated the adult male female ratio for MWLS & NP Elephants as 1:29.4. This may be due to a different classification of adult males; according to them over 20 yrs of age was taken as adult male whereas, in our present study over 15 yrs is taken as adult male. However, the present adult male female ratio of 1:15.8 is highly skewed one. This is mainly due to selective poaching of adult male Elephants for the tusks. This is evident from past ten-year mortality data for the Elephants of this sanctuary (Table 2). Although poaching of adult male Elephants were going on and widespread over two decades such a highly skewed sex ratio was not observed in early eighties. According to Daniel *et al.* (1987), the adult male female ratio

Table 1

Age structure and the sex ratios of the Elephant population in Mudumalai Wildlife Sanctuary and National Park

Age Class	No. of animals		Percentage		Sex ratio
	Male	Female	Male	Female	M : F
Young <5 yrs.	13	21	6.2	10.0	1 : 1.6
Sub-adult 5-15 yrs.	19	39	9.1	18.6	1 : 2.1
Adult >15 Yrs.	7	111	3.3	52.8	1 : 15.8
Total	39	171	18.6	81.4	1 : 4.4

Table 2

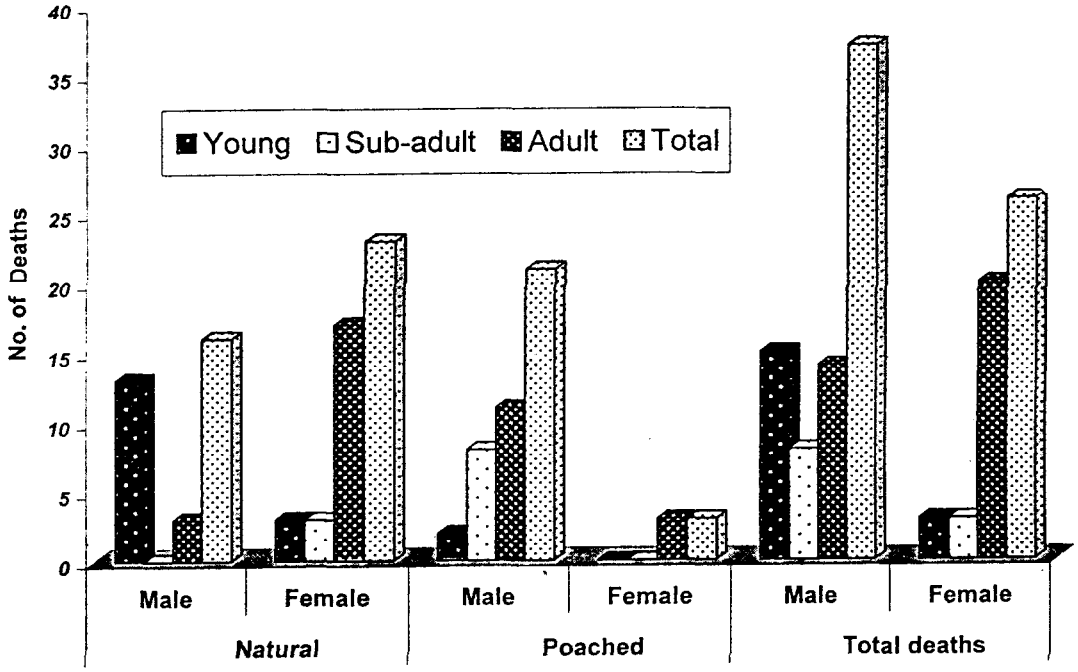
Incidences of Elephant deaths in Mudumalai Wildlife Sanctuary and National Park during the period between 1990 and 1999

Age class	No. and nature of death and sex				Total deaths	
	Natural		Killed / poached			
	Male	Female	Male	Female	Male	Female
Young <5 yrs.	13	3	2	0	15	3
Sub-adult 5 –15 yrs.	0	3	8	0	8	3
Adult > 15	3	17	11	3	14	20
Total	16	23	21	3	37	26

during the period 1985-1987 was 1:4.9 in MWLS & NP. According to Sukumar, (1989), the above ratio was 1:5 for an Elephant population in Tamil Nadu during the years 1981-1982. As early as 1981-1983, Sukumar (1989) predicted that if poaching levels were not reduced the adult male female ratio could further widen from 1:5 between 1:10 and 1:20. Daniel *et al.* (1987), has recorded high level of poaching and reported that over 90% of the adult male deaths were caused by human. The present study reveals about 80% deaths of adult males was due to poaching. This has resulted in the present highly skewed sex ratio.

If we analyse the effect of selective poaching of adult male Elephants on the age class distribution, the present study reveal that the proportions of juveniles, sub adults and adults constitute 16.2%, 27.6% and 56.1% respectively in the population. If we compare the situation in 1985 – 87, Daniel *et al.* (1987) reported that the proportions of juvenile (including calves), sub-adults and adults were 39.6%, 21.1% and 39.3% respectively. Similarly, Anon. (1998), reported the above age structure as 34.1%, 22.5% and 43.3% respectively in MWLS&NP. These reports reveal that there is no much variation in the distribution of sub-adult population

Fig. 2



Age structure of the Elephant casualties in Mudumalai Wildlife Sanctuary & National Park during the period from 1990-1999

over the years. Baskaran and Desai (1999), who also compared the present situation with 1983-88, concluded that there appears to be very little difference in the population structure. They further reported that major changes were detected if we take in to consideration both age structure and sex ratios. Our present study reveals that the ratios of male and female in juvenile, sub-adult and adult are 1:1.61, 1:2.07 and 1:15.8, respectively. This is well in agreement with the study of Anon. (1998), where it is reported the above ratios as 1:1.2 for juveniles, 1:1.9 for sub adults and 1: 14.3 for adults. This is in general agreement with our observation. If we compare the situation in 1985-87, Daniel *et al.* (1987), reported the above ratio as 1:0.8, 1:1.1 and 1:4.9 respectively for juveniles, sub-adults and adults. The above observation reveals that there is no much variation in male female ratio in juveniles whereas, the ratio for sub-adults varied considerably. This indicates that the males are being eliminated even before they join the breeding pool. This same view was expressed by Baskaran and Desai (1999) for MWLS&NP Elephant population. Our present study reveals

that out of eight sub-adult male deaths reported, all were found to be poached which constitutes more than one-third of total number of male Elephants poached in this sanctuary (Table 2).

The alarming situation of depletion of sub-adult male population is of great concern. This may lead to a very high skewed adult male female ratio in the future. How for this highly skewed adult male female ratio is going to affect the growth of the population is to be looked into seriously. Sukumar *et al.* (1998), reported that with an adult sex ratio skewing to about 1:100, the average fecundity had fallen to 0.075/adult female/ per year among the Elephant population in Periar Tiger Reserve. As for as the growth of overall population of the Elephant in MWLS&NP is concerned, reports from 1983 to the present day reveal an increase with some seasonal fluctuation. The present population density is reported varying between 2.39/km^2 (Baskaran and Desai, 1999) and 2.46/km^2, Tamil Nadu Forest Department Census for the year1999 and this is much higher than an earlier estimate of approximately 350 Elephants (1.1/km^2) as reported by Daniel *et al.* (1987) for the years 1985-1987.

In spite of heavy depletion of adult male population over the year, it is surprising to note that it has not affected the growth of the population. The reason for this is explained by Desai (1997). According to him, the female have an inter calving interval of 4 to 5 years. This means that only 20 to 25 % of females are receptive in any given year. Secondly, he explains males are polygamy, so one male mates with several females. That means that the sex ratio can drop even further without affecting the fertility of the population.

However, it should be noted that severe depletion of adult male population might reduces the chances of meeting the mates. The cow Elephant comes to oestrus three times in a year (Desai, 1997). Even if we take there is no definite breeding seasons, the animals tend to disperse and segregate during wet season, which is extending up to 8 months in MWLS&NP. During this period, the adult males migrate far from the herds and the chances of meeting the receptive female is considerably reduced. The female will be receptive only for a few days and a few numbers of males that are roaming far off from the crowed may not get a chance to mate during the short period of oestrus. It is note-worthy to mention here that no adult male was sighted in the study area during wet months (June-July), out of 21 sightings of Elephant herd during the above period. In addition, such situation will lead to *Allee* effect, according to which, with an extremely low no. of adult males in the population, a substantial proportion of females coming into oestrus would not be detected (Uma Ramakrishnan *et al.*, 1998).

Coming to the current situation of fecundity rate in the MWLS & NP Elephants, the proportion of calf Elephant population is 9.5% (Baskaran and Desai, 1999) and that of adult female is 53% (present study). If we take the inter calving period as 4.7 years and if all adult are breeding, the expected calf population would be 11%. Since the percentage of calf population is very close to the expected population, it is presumed that the fecundity rate is not affected among the Elephant population of the

MWLS&NP. However, Desai (1997), is of the view that more sightings of large number of calves in a population alone will not indicate a healthy condition of the population and fertility is likely to drop when breeding male number are extremely low and the latter situation may result to a loss of genetic variability.

Another interesting finding of our present study is the increased proportion of *makhna* (tusk-less male) Elephants seen in the population. Out of seven adult male Elephants identified during our study, two were happened to be *makhnas* (28%) that is higher than the normal proportion of 8% among the South India Elephant population (Sukumar, *et al.*, 1998). If selective poaching of tuskers is not curtailed, in addition to the other impacts already discussed, more and more *makhnas* will join in the breeding pool which ultimately result in a *makhna* dominated Elephant population as in the case of Sri Lanka.

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SUMMARY

The present study on the demography pattern and the sex ratio of the Elephant population of the Mudumalai Wildlife Sanctuary and National Park revealed that there was not much change in the proportion of juvenile, sub-adult and adult over a period of fifteen years. However, the sex ratio of the sub-adult and adult population changed alarmingly due to the poaching of adults as well as sub-adult males. The present sex ratio of adult animals, 1:16 is skewed which had not physically affected the growth of the population and age distribution. Selective killing of tuskers, if not checked, will lead to a highly skewed adult sex ratio in an exponential rate, the impacts of the latter are discussed with reference to the earlier studies.

हाथियों की संख्या में विषय नर मादा अनुपात – जनसंख्या और संख्यावृद्धि पर उसका क्या प्रभाव पड़ सकता है ? – मदुमलाई वन्यप्राणि अभयारण्य और राष्ट्रीय उपवन तमिलनाडु, दक्षिण भारत में किया गया एक विशेष अध्ययन

एस० पाउलराज व सी० सुब्रामनियन्

साराशं

मदुमलाई वन्यप्राणि अभयारण्य और राष्ट्रीय उपवन की जनसंख्या रूपसज्जा और वहाँ के हाथियों के यौन अनुपात का यह अध्ययन करने से पता चला कि पिछले पन्द्रह वर्षो में वहाँ बच्चों, उपवयस्कों और वयस्क हाथियों की संख्या में कोई वृद्धि ही नहीं हुई है । तथापि, उपवयस्क और वयस्क हाथियों के यौन अनुपात में वयस्क हाथियों और उपवयस्कों का चोर-शिकार किया जाने से चिन्ताजनक परिवर्तन हुआ है । वयस्क हाथियों का वर्तमान यौन अनुपात 1:16 बहुत ही विषम है जिसका संख्या वृद्धि और आयु वितरण पर बहुत बुरा प्रभाव पड़ा है । यदि दन्तैल हाथियों का चुन-चुनकर मारा

जाना रोका नहीं गया तो वयस्कों का यौन अनुपात बिगड़ने में बहुत ज्यादा तेजी आएगी । इसका क्या-क्या प्रभाव पड़ेगा, पूर्वतर अध्ययनों के सन्दर्भों में उसे विवेचित किया गया है ।

References

Anon. (1998). Ecological Research in Nilgiri Biosphere Reserve. *Annual Report for 1997-1998*, Centre for Ecological Sciences, Indian Institute of Science. Bangalore.

Anon. (1999). Monitoring Age Structure of Mudumalai Wildlife Sanctuary – *Annual Report for the period 1.4.1998 to 31.3.1999*. Centre for Ecological Science, Indian Institute of Science, Bangalore.

Baskaran.N., M.Balasubramaniam and S. Swaminathan (1995). Home rangeof Elephants in the Nilgiri Biosphere Reserve, South India. *A week with Elephants* (Eds. Daniel, J.C. and H. Datye). BNHS, Bombay. pp. 535.

Baskaran, N., and A.A. Desai (1999) Elephant Estimation in Mudumalai Wildlife Sanctuary and National Park, *Final Report 1999-2000.* Bombay Natural History Society, Bombay.

Daniel, J.C., A.A.Desai, N. Sivaganesan and S. Ramesh Kumar (1987). The Study of some endangered species of wildlife and their habitats – *The Asian Elephant. Report : October 1985 - September 1987.* BNHS, Bombay.

Desai, Ajay (1997). The Indian Elephant endangered in the land of Lord Ganesha. *NCSTC - Hornbill Natural History Series,* Mumbai. pp.65.

Menon, Vivek, Raman Sukumar and Ashok Kumar (1997*) A God in Distress.* Asian Elephant Conservation Centre and Wildlife Protection Society of India, Bangalore. pp. 91.

Sukumar,R. (1986). The Elephant Population in India – Strategies for conservation. *Proc.Indian Acad. Sci (Anim.Sci./Plant Sci.) Supll.,* November. pp. 59-71.

Sukumar,R., Uma Ramakrishnan and J.A.Santosh (1998). Impact of poaching on an Asian Elephant population in Periyar, Southern India: a model of demography and tusk harvest. *Animal Conservation,* **1** : 281-291.

Sukumar,R. (1989). *The Asian Elephant – Ecology and management.* Centre for Ecological Sciences, Indian Institute of Science, Bangalore,Cambridge University Press. pp.255.

Uma Ramakrishnan, J.A. Santosh and R.Sukumar (1998). The Population and Conservation Status of Asian Elephants in the Periar Tiger Reserve, Southern India. *Curr. Sci,.* **74** (2). 25 January.