

**MOVEMENT PATTERN OF ASIATIC ELEPHANT ELEPHAS
MAXIMUS IN PARAMBIKULAM WILDLIFE SANCTUARY, KERALA**

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INTRODUCTION

Movement is one of the prime characteristics of animals and various reasons have been attributed to the pattern of movement. Home range is defined as the area which the animal normally travels in pursuit of its routine activity. The concept of home range has attracted the attention of biologists and wildlife managers due to its significance in the interpretation of behaviour and management of wild population.

Elephant is a highly wide ranging animal traversing great distances for its basic requirements. The elephant population in the country has been adversely affected by the loss and fragmentation of the natural habitat, considerably limiting its movement

The movement pattern and home range of African elephants in different geographical areas have been reported by different workers. The movement pattern of Asian elephants in Sri Lanka and Malaya has been described in the literature. In India, but for the work of Sinha (1981) and Sukumar (1985), not much has been reported.

STUDY AREA

The study was conducted in Parambikulam wildlife sanctuary, Palghat district, Kerala (between $76^{\circ}35'$ and $76^{\circ}50'$ E and between $10^{\circ}20'$ and $10^{\circ}26'$ N.)

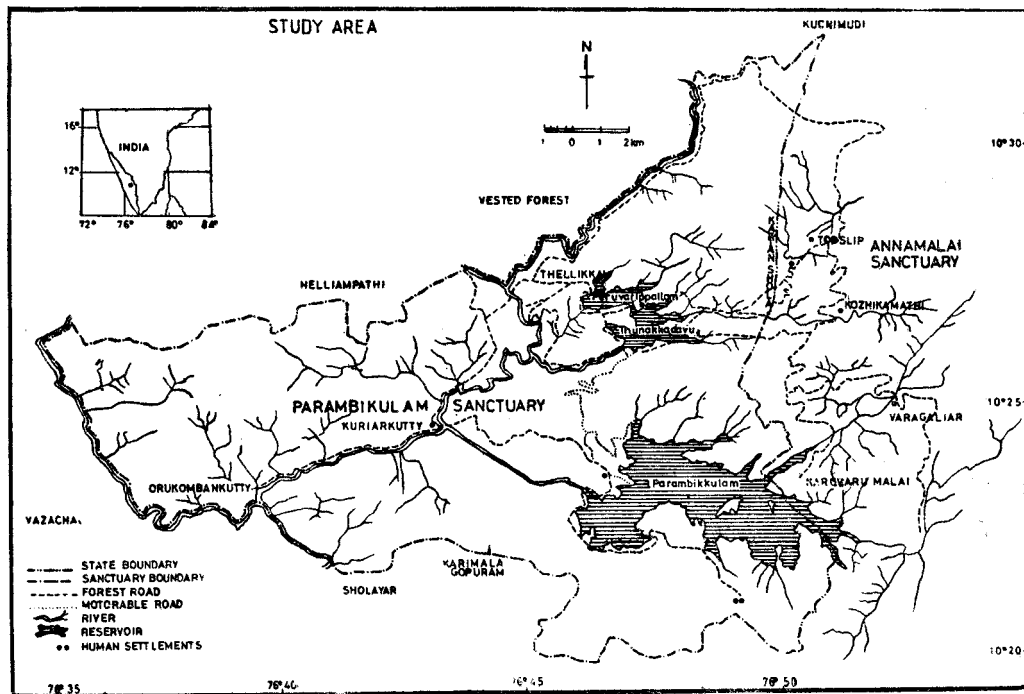


Fig. 1. Study area

and the adjacent Anamalai wildlife sanctuary of Tamil Nadu (Fig. 1). Parambikulam wildlife sanctuary with an area of about 270 km² is situated at an elevation of about 600m. The area is bordered on the eastern side by the Anamalai wildlife sanctuary of Tamil Nadu and the other three sides by the reserve forests of Sholayar, Vazhachal, Nelliampathy and vested forests of Nemmara. There are three reservoirs of Parambikulam Aliyar Project inside the area. The vegetation consists of both natural forests and plantation, and in general could be described as heterogenous and mosaic. The sanctuary is very rich in fauna and almost all Peninsular Indian mammals are represented.

Anamalai wildlife sanctuary bordering the eastern side of Parambikulam area is about 958 km² in extent. The vegetation includes deciduous, semi-evergreen forests, and plantations.

Elephant population:

The Parambikulam wildlife sanctuary holds a good population of elephants. The census in 1983 gave a figure of 114 elephants in the area with a density of 0.5 animal/km². Various aspects of the elephant population in the sanctuary has been discussed by Easa and Balakrishnan (1983).

Rainfall, water availability and food availability:

The data on rainfall in two stations (Thunacadavu of Parambikulam and Topslip of Anamalai), collected during the study period by the Parambikulam Aliyar Project authorities, clearly indicate a similar pattern. The water holes in both Anamalai and Parambikulam areas were almost dry during summer.

The reservoir of parambikulam Aliyar Project and the perennial streams in some parts of Anamalai wildlife sanctuary were the sources of water. The food availability in dry and wet seasons in both the sanctuaries were comparable.

METHODS

The study was conducted during the two year period from 1985 to 1986. Two groups of elephants (one in each year) were selected and followed. The composition of the groups followed is given in Table 1. The classification of individuals in the group is based on Eisenberg and Lockhart (1972). Photographs of the groups were also taken for confirmation upon repeated sightings (Fig. 2).

Table 1. Composition of the groups

GroupNo	Subadult Female	Sub adult Male	Juvenile Female	Juvenile Male	Calves	Total
Group 1	6		2	1	2	11
Group 2	5	2	1	1	2	11



Fig. 2. A part of the first group near the lake

The selected groups were followed during day time. The last location was visited on the following day and the group was located by following the track. The routes followed by the groups were plotted on an area map (1:50000 scale). A qualitative assessment of the vegetation as well as water availability in different parts of the study area was also made. The human activities related to forestry and other operations were also noted.

ANALYSES

Home range: The place where the group was first sighted on each day was taken as the location of sighting for analysis. The X and Y co-ordinates for each location of sighting were measured from the map and were used to analyse the home range using Minimum Convex Polygon method (Jennrich and Turner, 1969) with a micro-computer programme McPAAL, version 1.1 (Sruwe and Blohowiak, 1985). The locations of sightings in March-April and in June-July were used for dry and wet seasonal home range analyses respectively. The annual home range was calculated using the locations of sightings throughout the year.

Rate of mobility: The rate of mobility, which is defined as the daily mean distance covered by the group, was calculated for both the seasons and the whole year. The rate of mobility between seasons in each group, and between groups were compared using weighted t-test.

RESULTS

The movement of the first group in dry season was restricted around the Thunacadavu and Peruvuripallam reservoirs and at the onset of rains the group extended its movement to far away places including Anamalai wildlife sanctuary (Fig. 3). The dry season movement of the second group of elephants was confined mostly to Anamalai wildlife sanctuary and adjacent areas of Parambikulam (Fig. 4a). During wet season, there was a shrinkage in areas traversed and was around Thunacadavu reservoir (Fig. 4b).

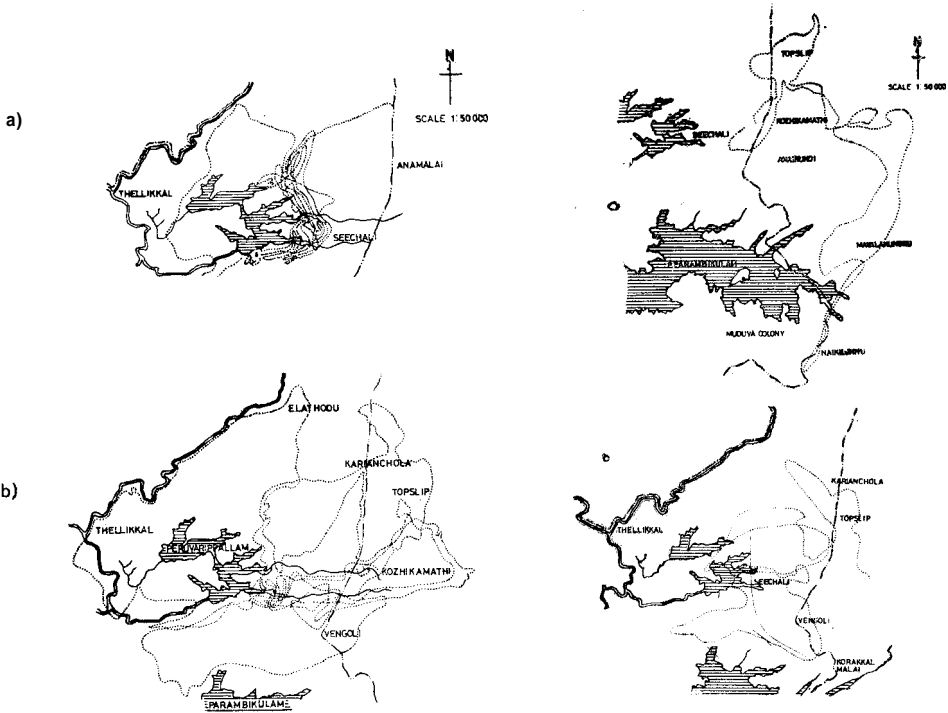


Fig. 3. Movement of the first group during
a) dry season and b) wet seasons track.

Fig. 4. Movement of the second group during
a) dry and b) wet seasons track

There was considerable difference in the seasonal and annual home range sizes of the groups (Table 2). The wet season home range size of the first group was comparatively larger, The seasonal home range sizes of the second group showed an entirely different pattern with a greater dry season home range size.

Table 2. Home range size - a comparison between groups

Group No.	Season	Number of locations of sightings	Home range size in Km ²
1	Dry	47	34.7
	Wet	49	87.2
	Annual	226	124.3
2	Dry	54	81.3
	Wet	59	46.1
	Annual	200	156.6

The computer plots of the seasonal and annual home ranges are shown in figure 5. The dry season range of the second group extended along the north-south axis, while the wet season range was along the east-west axis (Fig. 5 d and e.)

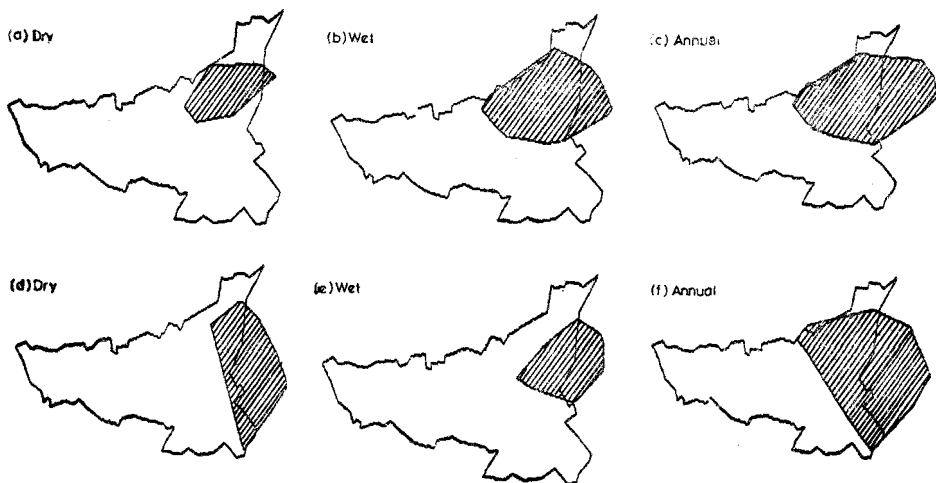


Fig. 5. Home range computer plots of groups : (a) - (c) - First group (d) - (f) - Second group. Home range — shaded portion.

The annual home range size of the second group was greater than that of the first group (Table 2). A sizeable portion of the annual home range of both groups was in Anamalai wildlife sanctuary (Fig. 5c and f).

Rate of mobility:

The rate of mobility of each group in two seasons and for the whole year is given in Table 3. There was no significant difference between seasons in the rate of mobility of the first group ($t=0.29$ ns.). But the difference was

significant in the second group ($t=2.72$). The rate of mobility between the two groups for the same season was significantly different ($t=3.49$ for dry and $t=8.75$ for wet). The difference in the annual rate of mobility between groups was highly significant ($t=6.97$).

Table 3. Rate of mobility

Group No.	Rate of mobility in meters		
	Dry season	Wet season	Annual
1	1771 \pm ^a 144	1821 \pm 144	1540 \pm 46
2	1199 \pm 78	949 \pm 49	1122 \pm 38

a, standard errors of the mean

DISCUSSION

The dry season range of the first group around Thunacadavu and Peruvrippallam reservoirs was extended during the wet season (Fig. 3). A shrinkage in the area of movement of the second group was observed during the wet season. The dry season range of the second group contained part of Anamalai wildlife sanctuary with perennial streams and areas adjacent to Pararnbikulam reservoir (Fig. 4a). The water availability around Topslip compared to Thunacadavu was almost nil during dry seasons and the fodder availability in both these areas was comparable. Considering these, the observations clearly indicate the influence of water availability on the movement pattern of the study groups. Influence of rainfall and water availability have also been reported in both African and Asian elephants.

The difference in the pattern of movement observed in the groups, extension and shrinkage of ranges, could be for optimum resource

The dry season range of the first group contained more of secondary forests and plantation compared to the primary forest habitat of the second group. The difference in the dry season home range size of the groups (Table 2) could be attributed to the difference in the type of habitat traversed. Olivier (1978) obtained a similar higher home range size in primary forests and attributed this to the greater distances the groups had to traverse in primary forests due to the scarcity of food in such habitats. Since the movement was in north-south direction with a slight deviation to the east-west, the calculation has included areas which were not at all used by the group (Fig. 5d). This has also contributed to the increased size of the dry season home range of the second group.

The dry season range of the first group and the wet season range of the second group contained more of secondary forests. Wet season range of the

first group and the dry season range of the second group were comparable due to primary forest habitat. The home range sizes of the groups in similar habitats, though in different seasons, didn't differ much (Table 2). This observation further strengthens the theory of reduction of home range size in secondary forests

The annual home range size of the second group was greater than that of the first group (Table 2). Not much published reports on the home range size of the Asian elephants, based on long term monitoring, are available for comparison. Foenander (1961) has mentioned an area of 518 km² in Malaya for a group of unspecified size, Khan (1967) estimated 313 km² for a group of nine. Olivier (1978). using radio-telemetry, obtained 167 km² and 59 km² in primary and secondary forests respectively for a group of unknown size and for which the number of sightings were few. Sukumar (1985) worked out an approximate home range size of 240 km² and 250 km² for two clans in Chamarajanagar and Satyamangalam forest divisions. However, he has remarked that these values should be considered only as averages.

The range of the second group contained more of primary forests compared to that of the first group. The greater annual home range size of the second group could be attributed to this difference in habitat types traversed. The present findings doesn't agree with the statement of Sukumar (1985) that the diversity of habitat would reduce the home range size.

Considering the habitats traversed by the groups, it could be seen that the rate of mobility was higher in ranges with primary forests. This was so due to the comparatively less food availability in primary forests. During dry season, the food availability was more around the reservoirs. This caused reduction in the rate of mobility in the dry season and wet season of the group one and two respectively

CONCLUSIONS AND RECOMMENDATIONS

The observations clearly indicate the influence of water availability on the movement pattern of the groups in the study area. The annual home range sizes of the groups in a diverse habitat was found to be almost similar to those reported in primary forests of Malaya. The type of habitats utilized contributed much to the size of the home range. The rate of mobility was higher in primary forests.

In the light of the study, the following suggestions are put forth for management of the sanctuary. The areas around the reservoirs are frequently visited by different groups of elephants during dry season. Other species also make use of the same areas. Concentration of animals in a particular area will adversely affect the habitat in the long run. Since animals tend to disperse in relation to resource availability, concentration of animals around the reservoirs can be prevented by ensuring availability of water in different

areas during dry season. There are a number of ponds made for this purpose. but they get dried up in summer, Maintenance of these ponds, assuring year round water availability, could solve the problem to a great extent.

The vested forest areas bordering the north-west portion of the sanctuary are used by elephants and other animals to a great extent. Addition of this area to the sanctuary will ensure maximum protection and can act as a buffer.

The disturbance to elephants due to forestry operation in the sanctuary is minimal. However, care should be taken to avoid overnight stay of labourers in the forest.

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