

Seasonal variations in Home Range Size of Capped Langur (*Trachypithecus pileatus*) in a degraded habitat in Assam, India

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Abstract. A group of capped langurs, *Trachypithecus pileatus* comprising eight individuals was studied in Sri Surya Pahar, a degraded habitat in Goalpara district of Assam to record the seasonal variations in distance travelled, home range, and habitat utilization through direct observation supplemented by Geographical Information system (GIS). Scan sampling method was followed to record data on ranging behaviour. Seasonality in the home range size was evident and significant ($P < 0.01$), it was 20 ha in winter, 17 ha in pre-monsoon, 17.75 ha in monsoon and 16.25 ha in retreating monsoon. The mean daily travel distance varied significantly ($P < 0.01$), it was 375 m in retreating monsoon to 490 m in winter. The mean daily travel length was 439 m and the total annual home range size was 38.25 ha. The variation of home range size was correlated with the distribution and abundance of food resources. Home range size and daily travel distance showed significant seasonal variations. In both the cases the ranging patterns were longer during the winter season. This may be due to shortage of new leaves during winter, which is the preferred food item of capped langur. Spatial availability of the different food resources over different seasons may also be a reason for significant changes in ranging pattern during different seasons. The present data on home range size and ranging pattern of capped langur in degraded habitat could be useful for improvement of habitat and the conservation of this endangered species in Assam.

Keywords: Sri Surya Pahar, Goalpara, scan sampling, endangered species, GIS, winter season.

1. Introduction

Home range is defined as the area which the animals are known to use for foraging and other activities during a specific period. Knowledge about the home range of animals is important to understand the behaviour and ecology of animals in a particular habitat (Reynolds & Laundre, 1990). This also provides significant information for habitat evaluation and conservation (Li et al., 2000). Primates have several added advantages due to marked home range area where they become acquainted with the availability of food plants, location of safe roosts, and the shortest routes between resource patches (Dunbar, 1988), water resources etc. However, there are considerable intra-specific and

inter-specific variations in the way primates use their home ranges. The home of a particular primate group is not always constant, varying with time and seasons (Hemingway & Bynum, 2005; Li et al., 2000; Li & Rogers, 2005; Minhas et al., 2010; Zhou et al., 2011a; Wada & Ichiki, 1980). The pattern of ranging behavior in primates is influenced by a number of factors like body weight and dietary habits (Milton & May, 1976), abundance and distribution of food in time and space (Clutton Brock, 1977; Dunbar, 1988), population density and group size (Olupot et al., 1994; Ostro et al., 1999; Grueter et al., 2009; Koeing et al., 2013), environmental conditions (Isbell, 1983) and so on. Largely, the folivorous primate species have been found to possess smaller home ranges and shorter daily travel range as compared to the frugivorous primates (Milton

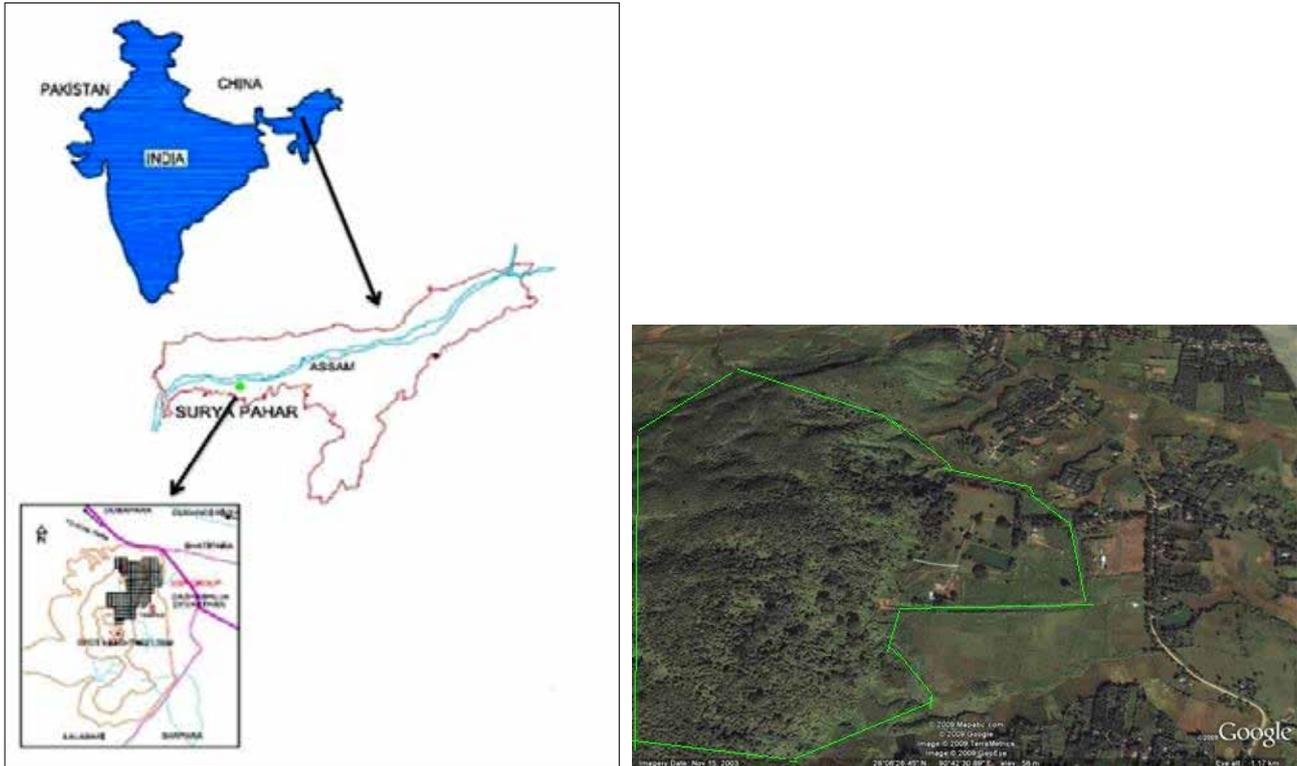


Figure 1. Location of Sri Surya Pahar, Goalpara, Assam

& May, 1976; Chapman & Chapman, 2000). The feeding nature also helps to explain the ranging behaviour of the primates (Clutton Brock & Harvey, 1977).

There have not been many studies on the ecology and the home range of *Trachypithecus* species, the picture remains quite incomplete, with disparate values. The information available on home range of *Trachypithecus* species are mainly on *T. francoisi*, *T. leucocephalus*, *T. obscures* and *T. margarita* (Zhou et al., 2007; 2011b; Li & Rogers, 2005; Monge, 2016). The present study focus on Capped langur (*Trachypithecus pileatus*) which is primarily a folivorous species (Solanki et al., 2008). Some aspects of ranging behaviour of capped langur were earlier studied by a few researchers like Stanford (1991a; 1991b), Kabir and Islam (1995) in rainforest habitat in Bangladesh. In the present study, the ranging behaviour of Capped langur was observed in a degraded habitat in Assam along with the seasonal variations in home range. The study of the home range and ranging patterns would generate the data which may facilitate the formulation of a conservation management plan for capped langurs and other folivorous primates in the region.

2. Study area

The study was conducted in Sri Surya Pahar of Goalpara district of Assam – a place of archaeological importance with a degraded habitat (Fig.1). It is geographically situated at

26°05'N latitude and 90°42'E longitude covering an area of around 3.42 km². Three species of primates: capped langur (*Trachypithecus pileatus*), rhesus macaque (*Macaca mulatta*) and the Assamese macaque (*Macaca assamensis*) inhabits in the area. Sri Surya Pahar is characterized as mixed deciduous forest predominated by tree species. Capped langur derived food from 41 plant species from this habitat (Borah et al., 2021). The average annual temperature ranges from 28.4°C to 17.8°C and the average relative humidity is 81%. The average elevation is 35 m (114 ft.) above sea level and receives an average annual rainfall of 2739 mm.

3. Materials and methods

Study group: a one-male multi-female group with eight individuals was selected for recording data on ranging behavior for 12 months covering all the seasons. The group included one adult male (AM), one sub-adult male (SAM), one juvenile male (JuM), three adult females (AF), one sub-adult female (SAF), and one infant female (InF). The group was habituated for three months before recording the data. All animals within the group were individually recognized based on body features and marks present on body parts. Information on range use was collected on protocol data sheets designed for behavioral data collection through Scan sampling method (Altman, 1974). Barthakur (1986) was

followed for dividing the observation period. Four seasons: Pre-monsoon (March–May), Monsoon (June–September) and Retreating monsoon (October–November) and Winter (December–February). Based on available day light time and visibility, the data collection period varied from season to season.

Preparation of map: Geographic Information System (GIS) was used to analyse the data collected on home range of capped langur in the study area. The target group was followed by first author and geographical coordinates of the group were noted during movement with the help of a portable (Handheld) GPS (GPS Make: Garmin E-trex Vista C). The datum used was WGS-84 (World Geodetic System). The data were downloaded by using GPS data downloading software (Map source V6) and assigned in the UTM (Universal Traverse Mercator) projection system. The projection zone is UTM 46N for the study area. Satellite images were collected from Google Earth software by using AutoCAD civil 3D 2010 for the study area. A digital map was prepared from the satellite image collected by using AutoCAD civil 3D 2010.

The study group was followed in the study area 12 days per season during which GPS readings of the group's location were recorded at every 30 minutes interval and activity budget scans were also conducted. Only complete day were considered for analysis of ranging behavior. The period when the animals were located in the morning on sleeping tree till evening when animals began to move towards sleeping tree without losing audiovisual contact was considered a complete day. During the study period, GPS readings were obtained at regular intervals except when weather conditions were not congenial to get signals inside the forest. If a clear satellite signal in the immediate vicinity of the individuals could not be picked up owing to heavy canopy cover, the nearby open location was used.

Data collection began at dawn (04.30 hrs– 05.00 hrs) to dusk (17.50 hrs – 18.00 hrs) at locations after each major movement by the group.

The most common methods applied for home-range estimation are the grid cell count method (White & Garrott, 1990; Adams & Davis, 1967) and the minimum convex polygon (MCP) method (Grueter et al., 2009). Grid-cell method was selected over the MCP-based method as it gives the most precise estimates for total or annual home ranges (Grueter et al., 2009) as it includes large areas of habitat not actually used by the study group (White & Garrott, 1990).

Variations in daily travel distance covered and home range size by langurs in different seasons was tested using student's 't' test. Comparison of variations in travel distance across the seasons was tested using one way Analysis of variance (ANOVA) adopting methods described by Simpson et al. (1960)

Grid cell count method (GCC): White and Garrott (1990) and Adams and Davis (1967) method was followed to estimate home range size. In this method, the areas traversed by the study group were dissected by grid cells with associated positional records, were added to estimate the home range. Home range size was measured by superimposing a grid of 50x50 m cells over the plotted group locations. To estimate the home range size, number of different grid cells the group visited during the study period was counted. ArcView was used to construct the map. Total home range size was calculated by adding the areas of all grid cells visited by the study groups. The size of a grid cell was 50x50 m.

4. Results and discussion

Individuals of the study group were active during daylight hours and maintain an arboreal lifestyle. Considerable seasonal variations were recorded in ranging patterns.

Seasonal Variation in Home Range size: There are many ecological factors that affect primate ranging behaviour and home range size, and the main factor is considered to be variation in the spatial and temporal distribution of preferred food. Therefore home range size varies during different seasons (Monge, 2016; Clutton-Brock, 1977). The home range size varied significantly in different seasons (Fig. 2). The variations in home range size were tested using one-way student's "t" tested and variations were found to significant (N= 4, t=21.77, P< 0.01). The home range size in winter was the largest (20 ha) and was smallest during retreating monsoon (16.25 ha). Pre monsoon and monsoon home range sizes were almost similar with 17 ha and 17.75 ha, respectively. During winter capped langur spent more time feeding in this site (Borah et al., 2021) as compared to other seasons. The distribution of food items influences the home range size. Therefore the primates have to travel more during winter which leads to an increase in the range size. The mean size of the home range for any season was 17.75 ha which constitutes 46% of the total range. A high degree of variation in home range size is presented in different primate genera. However in Asian colobines, the average home range is as little as 1.7 ha in *Presbytis thomsoni* and as larger as 5600 ha in *Rhinopethicus bieti* (Gurmaya, 1986; Grueter et al., 2009). In *Trachyupithecus* species home range size is reported as small as 10 ha and a maximum of approximately 50 ha (Curtin, 1980; Li & Rogers, 2005; Zhou et al., 2007, 2011a, 2011b).

Annual Home range: The annual home range size of the study group was found to be 38.25 ha. It is the compilation of seasonal home ranges excluding the overlapped areas. The

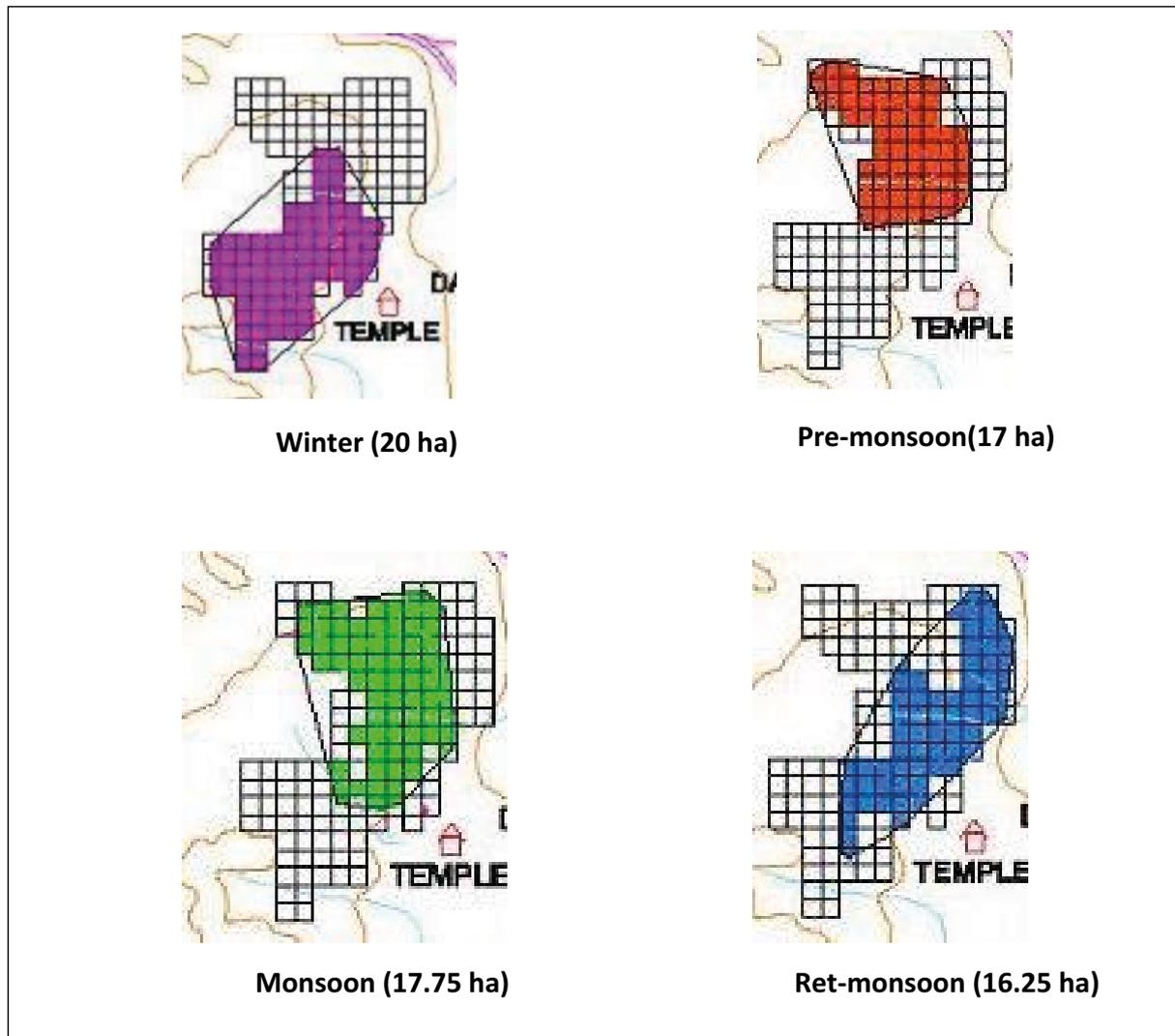


Figure 2. Seasonal variation in home range of capped langur in Sri Surya Pahar

home range size of the study group in any season was much smaller than the area calculated for the entire year because the group used only part of its annual home range in any particular season. There were overlaps between home ranges in different seasons (Fig. 3.)

Daily travel length: The mean daily travel distance covered in each season is given in Table 1. Daily travel distance varies significantly across the seasons ($P < 0.01$). The mean travel distance was 435 m in pre-monsoon, 456 m in monsoon season, 490 m in winter, and 375 m in retreating monsoon season. Mean daily travel length was found to be the lowest in retreating monsoon season and highest in the monsoon. The mean daily travel length during the study period was 439 m. The average daily travel distance annually and seasonally is shown in Table 1.

Table 1. Mean daily travel distance of capped langur in Sri Surya Pahar

Sl. No.	Winter	Pre Monsoon	Monsoon	Ret. Monsoon
1	490	410	450	410
2	500	440	480	420
3	520	380	445	340
4	470	495	380	360
5	550	445	475	425
6	440	415	440	355
7	510	430	535	415
8	475	460	520	365
9	550	390	435	345
10	405	480	500	405
11	500	375	420	335
12	470	500	390	325
Sum	5880	5220	5470	4500
Mean	490	435	456	375

Mean of Distance travelled across the seasons by the group of capped langur in degraded habitat was tested using one way ANOVA and the variations were also found significant ($P < 0.01$). Anova table is given below (Table 2).

Table 2. ANOVA table

Source of Variation	SS	df	MS	F	P-value
Between Groups	83956.3	3	27985.4	15.30	$P < 0.01$
Within Groups	80441.7	44	1828.22		
Total	164398	47			

The distribution and abundance of palatable plant species are one of the main factors that affect the home range size of a primate (Li et al., 2000). The study of home range and day range length of animals are important to recognize the feeding competition. The study of home range and day range length of primates is important to understand the relationship between ecological variables with ranging behaviour (Di Fiore, 2003).

Home range size and daily travel length shown by capped langur had significant variations ($P < 0.01$) in the study area. The capped langur in Sri Surya Pahar were reported consuming 77.42% of leaves in their diet (Borah et al., 2021). Abundance and even distribution of leaves than fruits may have created greater reliance of the study group on leaves (Richard, 1985). The seasonal home range size was mainly affected by the distribution of palatable food plant species in the area. The home range size was larger during the winter season as compared to the other seasons (Fig. 2). The use of relatively larger areas during the winter season may be due to the fact that new leaves are relatively less abundant as compared to other three seasons. Availability of the new leaves was the determining factor for seasonal home range variations of capped langur in the study area. Home range size was also reported 256 ha that was larger in dry season than rainy season in case of *Trachypitecus margarita* in Cambodia (Monge, 2016), likely because of different food availability.

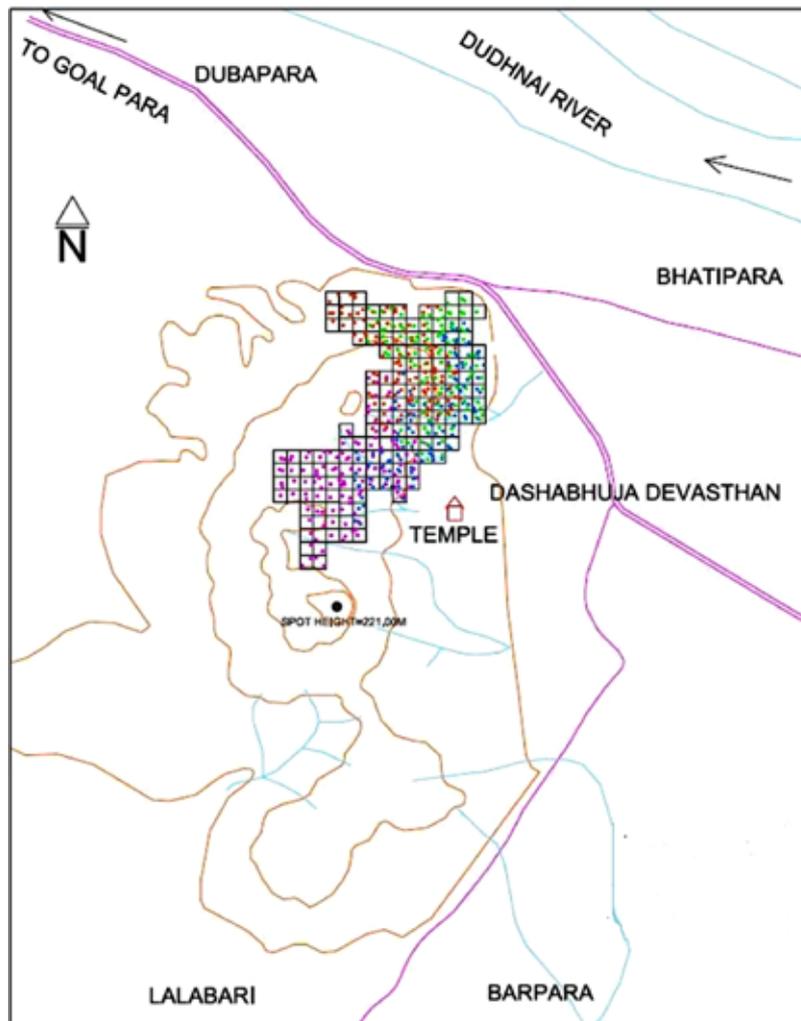


Figure 3. Annual home range of capped langur in Sri Surya Pahar

The study group inhabited a degraded habitat which is basically a temple surrounded by paddy fields and human habitations. The group was unable to extend its daily travel length due to gaps in the canopy and clear ground cover. Apart from this, the group was never found to come down to the ground due to the presence of humans, other livestock, domestic dogs and their prime competitor, the rhesus macaque in the surrounding temple area. This suggests that habitat quality plays a significant role in determining the size of the home range and daily travel length.

In Sri Surya Pahar the food resources were clumped as the trees were distributed in and around the human habitation. The capped langur group confined itself to a very limited area where they get their food and roosting facilities. Similarly, seasonal variations in home range and day range size are because of spatial availability of the food resources

over different periods. Sarkar (2000) on Assamese macaque also reported similar differences in the home range and day range of the forest-dwelling and temple groups of primates. In the temple, the availability of food is confined, the group had a comparatively smaller home range and day range than the forest-dwelling group where the food resources are randomly distributed.

If food availability is in abundance spatially and temporally that will shorten the home range and travel distance that primates undertake to procure food. Thus energy spent due to movement for procurement of food can be reduced and that will be utilized for population growth. Therefore, the present findings will improve conservation planning for capped langur in Sri Surya Pahar and other degraded habitats of Assam.



Figure 4. Various activities of capped langur in the study area. **A.** The study group while foraging. **B.** Adult male in vigilance while the other members rest. **C.** Adult females with newly born infant. **D.** Facial display to express aggression. **E.** A sub-adult male while foraging in Sri Surya Pahar

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