

Population Structure, Home Range and Food Habits of Hanuman Langur in Gir Lion Sanctuary and National Park, India

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ABSTRACT

Aspects of ecology of Hanuman langur *Presbytis entellus entellus* were studied from January 2002 to March 2002. Langur troops were located through systematic surveys and by monitoring of road and foot transects. Visual counts were carried out and troops were classified into different age and sex categories. Data on food habits were collected by direct observations. Adhoria and Pilipat troops were followed from dawn to dusk in order to determine the winter home ranges of both troops. Troop size ranged from 45 to 15 individuals and average troop size was 19. Sex ratio, biased in favour of female, was 1♂ : 3.02♀. Langurs utilised 41 plant species in the study area. The size of the winter home range of Adhoria and Pilipat langur troop was 0.28 km² and 0.44 km², respectively. The findings of this study are discussed in the light of result obtained in other studies carried out on Hanuman langur in India.

Key Words: Food Habits, Gir Lion Sanctuary and National Park, Hanuman Langur, Home Range.

INTRODUCTION

Hanuman langur *Presbytis entellus* is a well-known old world monkey widely distributed in India. Out of 16 subspecies of Hanuman langur *Presbytis entellus entellus* is very common, highly adaptable and ranges from the snow covered peaks of Himalayas up to about 3600 m in the north to deciduous forest in the south and from parts of great Indian desert of Rajasthan in the west to rain forests in the east. The large-scale destruction and degradation of forests outside protected areas has affected the status of Hanuman langur in India but within protected areas, it continues to thrive throughout its distribution range. The Hanuman langur has been subject of intensive field investigations in many areas of India (e.g., Kurup 1970, Rahman 1973, Mohnot 1974, Newton 1984, Kar-Gupta and Kumar 1984, Agoramoorthy 1992). We studied aspects of ecology of Hanuman langur in Gir National Park and Lion Sanctuary in winter 2002 and the present paper deals with the findings of that study.

STUDY AREA

The Gir Lion Sanctuary and National Park (21°20' to 20°57' N latitudes, 70°27' to 71°13' E longitudes) cover an area of 1412 km² in the Kathiawar peninsula of Gujarat (Figure 1). Gir is divided into three management units i.e. Sanctuary West, National Park and Sanctuary East. These units differ in terms of vegetation, water availability, topography and human settlement density. Grazing by livestock belonging to Maldharis (a pastoral community) is heaviest in Sanctuary East and least in National Park. Rainfall data over the past several years show average annual rainfall to be approximately 1000 mm in the west and 800 mm in the east. Seasons are distinct. December through March is winter (average minimum temperature 9°C) followed by a hot summer (average maximum temperature 42°C) until mid-June. Monsoon breaks in June and continues till September, which is followed by a dry post-monsoon season until mid-December.

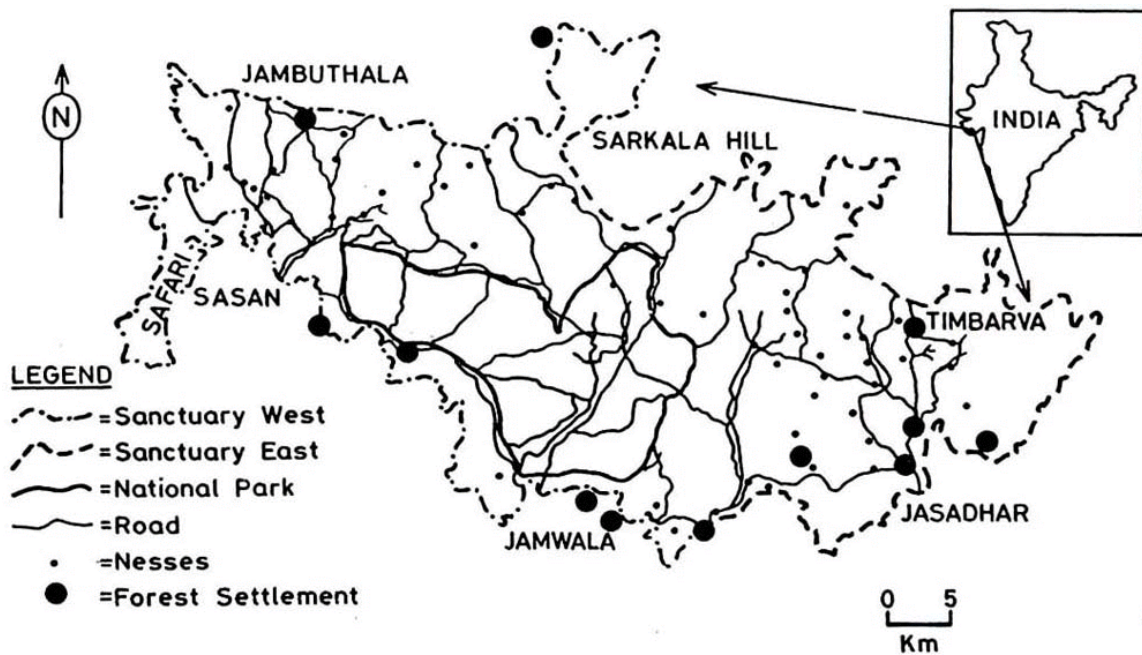


Figure 1. Map of Gir Lion Sanctuary and National Park.

The vegetation is tropical dry deciduous forest interspersed with tropical thorn forest (Champion and Seth 1968). Nearly 70% of the total area of Gir (west and central) is covered with teak *Tectona grandis* L. and its several associates, while much of Sanctuary East is dominated by *Anogeissus latifolia* Roxb. Eight major habitat types are present in Gir: riverine woodland, thorn woodland, *Tectona-Acacia-Zizyphus* woodland, *Tectona-Boswellia-Sterculia* woodland, *Anogeissus-Boswellia-Lannea* woodland, *Anogeissus-Terminalia* woodland, mixed teak woodland, and mixed valley community. These habitat types differ in species composition and spatial distribution.

METHODS

The study was conducted from January 2002 to March 2002. A thorough survey of study area was carried out to locate troops in different localities. The troops of Hanuman langur in Sanctuary West and National Park were located by systematic monitoring of road transects, foot transects and by regular random searches in forest, especially into areas that had streams with riverine vegetation. Local people including Maldhari graziers were also interviewed to gather information on location of langur troops in different

localities. The location of each detected troop was described in terms latitude and longitude co-ordinates by using a Global Positioning System (GPS, Magellan 310) and name of the places.

Visual count of each troop was carried out carefully from close proximity. The counting was done mostly during the early morning hours when the langur alighted from the roosting site i.e. post-roosting or in the late evening when they were retiring for roosting i.e. pre-roosting. The population of each troop was categorized into five age groups namely adult male, adult female, sub-adult (male and female), juvenile and young ones. Only adult individuals could be sexed and the sex ratio is, therefore, based on the proportion of adult males and adult females in a troop.

Out of 58 Hanuman langur troops encountered during study period, 31 were fully classified. Data on food habits were collected by Ad libitum and focal animal sampling method (Altmann 1974). Individual troops were followed and langur feeding on different plant species and plant parts were systematically recorded. In order to assess availability of different food plants, vegetation sampling was carried out in four major different habitats namely, Riverine, Thorn Woodland, *Tectona-Acacia-Zizyphus* Woodland and *Tectona-Boswellia-Sterculia* Woodland. A total of thirty sampling plots were laid in each habitat. Different plot

and plot less vegetation sampling methods such as Point Centred Quarter (riverine), Ten Tree (*Tectona-Boswellia-Sterculia* Woodland), Belt transect (*Tectona-Acacia-Zizyphus* Woodland and Thorn Woodland) and circular plots (shrub and climber) were used depending upon the topography and feasibility of sampling.

To determine whether a particular food plant species was preferred or avoided by Hanuman langur, 95% Bonferroni confidence intervals were calculated following Neu et al. (1974) and Byres et al. (1984) for all the utilized plant species. All individuals of a plant species sampled in different habitats types were summed up to calculate the proportional availability of each plant species ($P_{io} = n_i/\Sigma N$) where, P_{io} is the proportional availability of a plant species, n_i is the number of individuals of a particular plant species and ΣN is the total number of individuals of all plant species sampled. This was then compared with the proportional utilisation of each plant species ($P_{ie} = n_i/N$) where, n_i is the number of feeding records for a particular plant species and N is the total number of feeding records of all plant species. Plants species was significantly preferred or avoided when P_{io} lay outside the 95% confidence limits of P_{ie} .

The troops located at Adhoria and Pilipat were selected for home range estimation. Both these troops were regularly followed from dawn to dusk and locations of these troops were recorded on gridded topo-sheets of 1:25000 scale. The range size was calculated using minimum convex polygon method (Mohr 1947). Here the free hand lines connected the outermost locations of each troop and the numbers of grids were calculated. Grids that occurred more than half of their size into the polygon were counted in home range calculation whereas grids falling less than half of their size into polygon were excluded. Thus the home range size was equal to the total number of grids falling within polygon multiplied by the area of each grid.

RESULTS

Distribution

Table 1 provides the details of 58 troops recorded during the study in Gir and their distribution is shown in Figure 2. Except for two troops of eastern Gir, all the

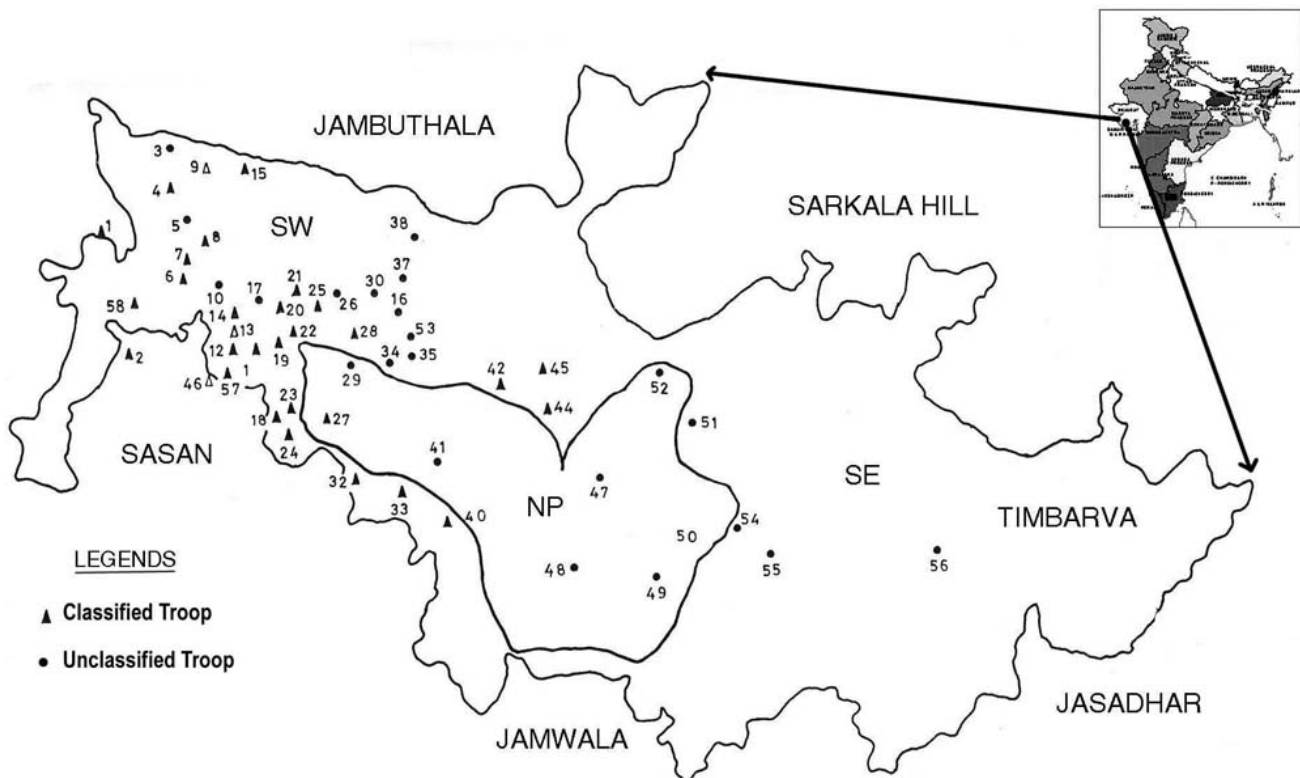


Figure 2. Location of Hanuman Langur troops in Gir Lion Sanctuary and National Park.

Table 1. Distribution, age and sex composition of Langur troops in Gir (- troops not classified)

S.No. & Code	Location	Stratum	Number of individuals	Adult male	Adult female	Sub-adult	Juvenile	Young	Unidentified
1	Vaniavav	SW	28	2	15	6	3	2	0
2	Lakkarvera	SW	42	5	21	5	4	7	0
3	Kairamba	SW	21	1	6	2	4	2	0
4	Between Khada & Kairamba	SW	15	-	-	-	-	-	-
5	Paniaguna	SW	11	-	-	-	-	-	-
6	Juni Raidi	SW	23	8	4	5	3	3	0
7	Raidi	SW	28	11	4	4	6	3	0
8	Parvia turnoff	SW	11	2	4	2	3	0	0
9	Dedagri	SW	17	1	6	3	5	2	0
10	Kadeli	SW	13	-	-	-	-	-	-
11	Bambhaphod	SW	16	-	-	-	-	-	-
12	Sasan station	SW	23	1	10	5	3	4	0
13	Vasador	SW	14	2	5	1	4	2	0
14	Pilipat	SW	24	3	7	5	6	3	0
15	Jambuthala	SW	15	1	7	2	4	1	0
16	Adhoria	SW	17	1	7	1	4	4	0
17	Nanava	SW	11	-	-	-	-	-	-
18	Kapuria	SW	17	2	5	3	4	3	0
19	Chodia	SW	21	2	6	4	5	4	0
20	Dadia	SW	17	1	10	4	0	2	0
21	Sandiagali	SW	16	2	6	2	3	3	0
22	Mindholiwala	SW	19	2	7	1	6	3	0
23	Andhari	SW	16	1	4	3	2	2	4
24	Amrutvel	SW	26	6	7	5	5	3	0
25	Kamleshwar	SW	22	3	6	5	6	2	0
26	Panvi ki Kheri	SW	14	-	-	-	-	-	-
27	Sapadra ka chela	NP	16	-	-	-	-	-	-
28	Piplawali Ati	SW	10	2	2	6	0	0	0
29	Amla	SW	11	-	-	-	-	-	-
30	Before Panvi	SW	10	-	-	-	-	-	-
31	Sukhnath	SW	10	-	-	-	-	-	-
32	Shirwan	SW	12	1	5	1	1	4	0
33	Devadungar	NP	14	1	5	2	4	2	0
34	Pataryala	NP	16	-	-	-	-	-	-
35	Varvanga	SW	16	-	-	-	-	-	-
36	Sukhiran	SW	>10	-	-	-	-	-	-
37	Ahead of Sukhiran	SW	>10	-	-	-	-	-	-
38	Barwania	SW	7	-	-	-	-	-	-
39	Bamnasa road	SW	>10	-	-	-	-	-	-
40	Janvadla	NP	16	1	7	3	2	3	0
41	Kissa turnoff	NP	11	-	-	-	-	-	-
42	Miakuan	NP	24	1	9	4	8	2	0
43	Mundachowk	NP	13	-	-	-	-	-	-
44	Kankai temple	NP	45	2	20	8	8	7	0
45	Sankara	SW	19	1	10	2	2	4	0
46	Sasan Hiran	SW	12	1	4	1	4	2	0
47	Before Chodavadi	NP	14	-	-	-	-	-	-
48	Shingora dam	NP	4	-	-	-	-	-	-
49	Dhabhala road	NP	7	-	-	-	-	-	-
50	Lapatni road	NP	>5	-	-	-	-	-	-
51	Biliat road	NP	8	-	-	-	-	-	-
52	Before Biliat	NP	4	-	-	-	-	-	-
53	Karamdari	SW	3	-	-	-	-	-	-
54	BetweenBhanej & Chodavadi	NP	10	-	-	-	-	-	-
55	Ahead of Kardapan	ES	20	-	-	-	-	-	-
56	Bhimchas	ES	12	-	-	-	-	-	-
57	Khokhra 2	SW	17	3	6	2	4	2	0
58	P.W.D. Guest House	SW	1	1	0	0	0	0	0

remaining 56 troops were recorded from the Sanctuary West and National Park. Majority of troops were located along the riverine habitat. The two troops that were recorded from the eastern Gir were also found close to the riverine habitat. Rahman (1973) monitored 11 troops from Sanctuary West. Out of those 11 troops, 4 troops namely Talala road troop, Chitrode troop, Karnya troop, and Sasan Railway station troop (which was a solitary male), have now disappeared. The remaining 7 troops persist at their original locations. The position of Sasan Railway station troop (solitary male) has been taken over by Sasan fence troop.

Out of 58 troops encountered, the size and composition of 31 troops were analysed. A total of 581 langurs were counted in 31 troops. Of the 31 troops, 29 were bisexual and 2 were "male bisexual" (solitary male). Among bisexual troops, 16 were multi-male and 15 were single male troops. The troop size ranged from 45 individuals in Kankai troop to 11 individuals in Pareyvia turnoff troop. The average troop size was 19 individuals. The overall population comprised of 71 adult males, 215 adult females, 97 sub adults (males and females), 113 juveniles, and 81 infants. Four individuals could not be classified. According to Rahman (1973) the average troop size of bisexual troops in Gir was 30.4. Out of 11 troops analysed by Rahman (1973), 7 were reanalysed and compared (Table 2). Except Janwadla troop, the number of individuals decreased substantially in six troops. The overall adult sex ratio was 1♂ : 3.02♀. Rahman (1973) reported an average sex ratio of 1♂ : 5.5♀ in Gir.

Food Habits

The main food items of Hanuman langur during the study period were comprised of leaves, buds, flowers, fruits and bark of stem of various trees, shrubs and climbers (Table 3). Langurs were found to utilise 41 plant species in Gir. Leaves, flowers and fruit of *Carissa congesta* Wight., leaves and fruit of *Ficus glomerata* Horti, leaves and flowers of *Combretum ovalifolium* Linn. and leaves of *Syzygium cumini* Gaertn comprised the staple food of Hanuman langur in Gir. Langurs mostly fed on fresh leaves but mature leaves of *Cocculus hirsutus* DC. were also eaten. Many times 5-6 individuals of different sex and status sat very close to one another and fed, showing the absence of competition for food. Although langurs started feeding after dawn at 7:30 hours, it reached a peak around 10:30 hours and again at around 16:00 hours. According to Rahman (1973) feeding reached a peak around 10:00 hours and 17:00 hours in the monsoon.

Out of 41 plant species, seven plant species were preferred, seven were avoided and remaining species were eaten in proportion to their availability in Gir by langurs (Table 3). The plants preferred by langur were *Holoptelea integrifolia* Planch., *Ficus glomerata*, *Combretum ovalifolium*, *Morinda tinctoria* Roxb., *Carissa congesta*, *Garuga pinnata* Roxb., *Luffa echinata* Roxb. and the species avoided by langur were *Tectona grandis*, *Aegle marmelos* Cirrea., *Cassia glauca* Lam., *Diospyros melanoxylon* Hassk., *Wrightia tinctoria* R.Br., *Syzygium cumini* and *Cocculus hirsutus*.

Table 2. Comparison of population structure of troops reported by Rahman with that of present study (PS = Present study, R = Rahman (1973)).

Name of Troop	AM		AF		SA		JUV		YG		TOTAL	
	PS	R	PS	R	PS	R	PS	R	PS	R	PS	R
Pilipat	1	2	7	27	5	5	6	1	3	3	24	38
Sasan Rly. Station	1	3	10	10	5	20	3	9	4	6	23	48
Amrutvel	6	1	7	20	5	2	5	3	3	4	26	30
Kapurua	2	2	5	15	3	10	4	9	3	5	17	41
Shirvan	1	3	5	23	1	9	1	2	4	6	12	43
Sasan Hiran	1	1	4	8	1	3	4	2	2	2	12	16
Janwadla	1	1	7	3	3	1	2	8	3	3	16	16

Table 3. List of plant species utilised by langurs in Gir with their proportional availability (P_{io}) and their proportional utilization (P_{ie}). 0 = Utilized in proportion to availability - = Significantly avoided + = Significantly preferred, *Species which did not occur in vegetation sampling but are present in Gir Division.

S.No.	Plant species	Part eaten	Habit	P_{io}	P_{ie}	Confidence limit for P_{ie}	Rating
1	<i>Tectona grandis</i>	Leaves	T	0.164	0.004	$-0.0054173 \leq P_{ie} \leq 0.0134173$	-
2	<i>Holoptelea integrifolia</i>	Buds & Fruit	T	0.004	0.076	$0.0364621 \leq P_{ie} \leq 0.1155379$	+
3	<i>Tamarindus indica</i>	Leaves	T	0.005	0.015	$-0.0031357 \leq P_{ie} \leq 0.0331357$	0
4	<i>Ficus glomerata</i>	Fruit	T	0.003	0.043	$0.0127336 \leq P_{ie} \leq 0.0732664$	+
5	<i>Capparis separia</i>	Leaves	S	0.008	0.013	$-0.0039005 \leq P_{ie} \leq 0.0299005$	0
6	<i>Bombax ceiba</i>	Flower	T	0.003	0.020	$-0.0008881 \leq P_{ie} \leq 0.0408881$	0
7	<i>Sterculia urens</i>	Bark & Flower	T	0.001	0.004	$-0.0054173 \leq P_{ie} \leq 0.0134173$	0
8	<i>Aegle marmelos</i>	Leaves	T	0.055	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	-
9	<i>Zizyphus mauritiana</i>	Leaves	T	0.073	0.076	$0.0364621 \leq P_{ie} \leq 0.1155379$	0
10	<i>Butea monosperma</i>	Flower	T	0.009	0.028	$0.0033859 \leq P_{ie} \leq 0.0526140$	0
11	<i>Sesbania bispinosa</i>	Leaves	H	0.055	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	0
12	<i>Cassia glauca</i>	Leaves & Flower	T	0.011	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	-
13	<i>Acacia nilotica</i>	Leaves & Fruit	T	0.065	0.093	$0.0496672 \leq P_{ie} \leq 0.1363327$	0
14	<i>Combretum ovalifolium</i>	Leaves & Flower	C	0.061	0.157	$0.1027207 \leq P_{ie} \leq 0.2112793$	+
15	<i>Terminalia crenulata</i>	Leaves	T	0.008	0.013	$-0.0039005 \leq P_{ie} \leq 0.0299005$	0
16	<i>Morinda tinctoria</i>	Leaves	T	0.002	0.028	$0.0033859 \leq P_{ie} \leq 0.0526140$	+
17	<i>Manilkara hexandra</i>	Leaves	T	0.006	0.011	$-0.0045620 \leq P_{ie} \leq 0.0265620$	0
18	<i>Diospyros melanoxylon</i>	Leaves	T	0.032	0.011	$-0.0045600 \leq P_{ie} \leq 0.0265620$	-
19	<i>Carissa congesta</i>	Leaves, Flower & Fruit	S	0.034	0.126	$0.0764879 \leq P_{ie} \leq 0.1755121$	+
20	<i>Wrightia tinctoria</i>	Leaves & Bark	S	0.116	0.030	$0.0045483 \leq P_{ie} \leq 0.0554517$	-
21	<i>Emblica officinalis</i>	Leaves	T	0.001	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	0
22	<i>Ficus benghalensis</i>	Buds & Fruit	T	0.001	0.020	$-0.0008881 \leq P_{ie} \leq 0.0408881$	0
23	<i>Syzygium cumini</i>	Leaves	T	0.032	0.013	$-0.0039005 \leq P_{ie} \leq 0.0299005$	-
24	<i>Cocculus hirsutus</i>	Leaves	C	0.041	0.020	$-0.0008881 \leq P_{ie} \leq 0.0408881$	-
25	<i>Gloriosa superba</i>	Leaves	T	0.001	0.007	$-0.0054392 \leq P_{ie} \leq 0.0194392$	0
26	<i>Boswellia serrata</i>	Flower	T	0.002	0.013	$-0.0039005 \leq P_{ie} \leq 0.0299005$	0
27	<i>Garuga pinnata</i>	Bark, leaves & Flower	T	0.004	0.035	$0.0075800 \leq P_{ie} \leq 0.0624200$	+
28	<i>Luffa echinata</i>	Leaves	C	0.0004	0.028	$0.0033859 \leq P_{ie} \leq 0.0526140$	+
29	<i>Ficus rumphii</i>	Buds & Fruit	T	0.001	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	0
30	<i>Acacia catechu</i>	Leaves & Bark	T	0.011	0.007	$-0.0054392 \leq P_{ie} \leq 0.0194392$	0
31	<i>Pongamia pinnata</i>	Leaves & fruit	T	0.031	0.026	$0.0022570 \leq P_{ie} \leq 0.0497430$	0
32	<i>Acacia senegal</i>	Buds & Fruit	T	0.002	0.004	$-0.0054173 \leq P_{ie} \leq 0.0134173$	0
33	<i>Mitragyna parvifolia</i>	Fruit	T	0.001	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	0
34	<i>Xeromphis spinosa</i>	Bark & Leaves	T	0.012	0.033	$0.0063473 \leq P_{ie} \leq 0.0393473$	0
35	<i>Ficus religiosa</i>	Fruit	T	0.001	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	0
36	<i>Balanites aegyptica</i>	Leaves & fruit	T	0.01	0.004	$-0.0054173 \leq P_{ie} \leq 0.0134173$	0
37	<i>Flacourtia indica</i>	Flower	T	0.005	0.002	$-0.0046657 \leq P_{ie} \leq 0.0086657$	0
38	<i>Ixora arborea</i>	Leaves	T	0.004	0.007	$-0.0054392 \leq P_{ie} \leq 0.0194392$	0
39	<i>Terminalia catappa</i> *	Leaves	T	0.000	0.004	$-0.0054173 \leq P_{ie} \leq 0.0134173$	0
40	<i>Acacia leucophloea</i>	Leaves	T	0.001	0.002	$-0.0054173 \leq P_{ie} \leq 0.0134173$	0
41	<i>Unidentified species</i> *	Leaves	T	0.000	0.007	$-0.0054392 \leq P_{ie} \leq 0.0194392$	0

Home Range

The home range of two troops namely Adhoria troop and Pilipat troop were estimated. The Adhoria troop moved in an area of approximately 0.28 km² while the

Pilipat troop moved in an area of 0.44 km². The Adhoria troop had its home range running along the Visavadar road and stretching from Adhoria to Kankai check post. It also crossed the Visavadar road and the railway track near Kankai check post (Figure 3). The

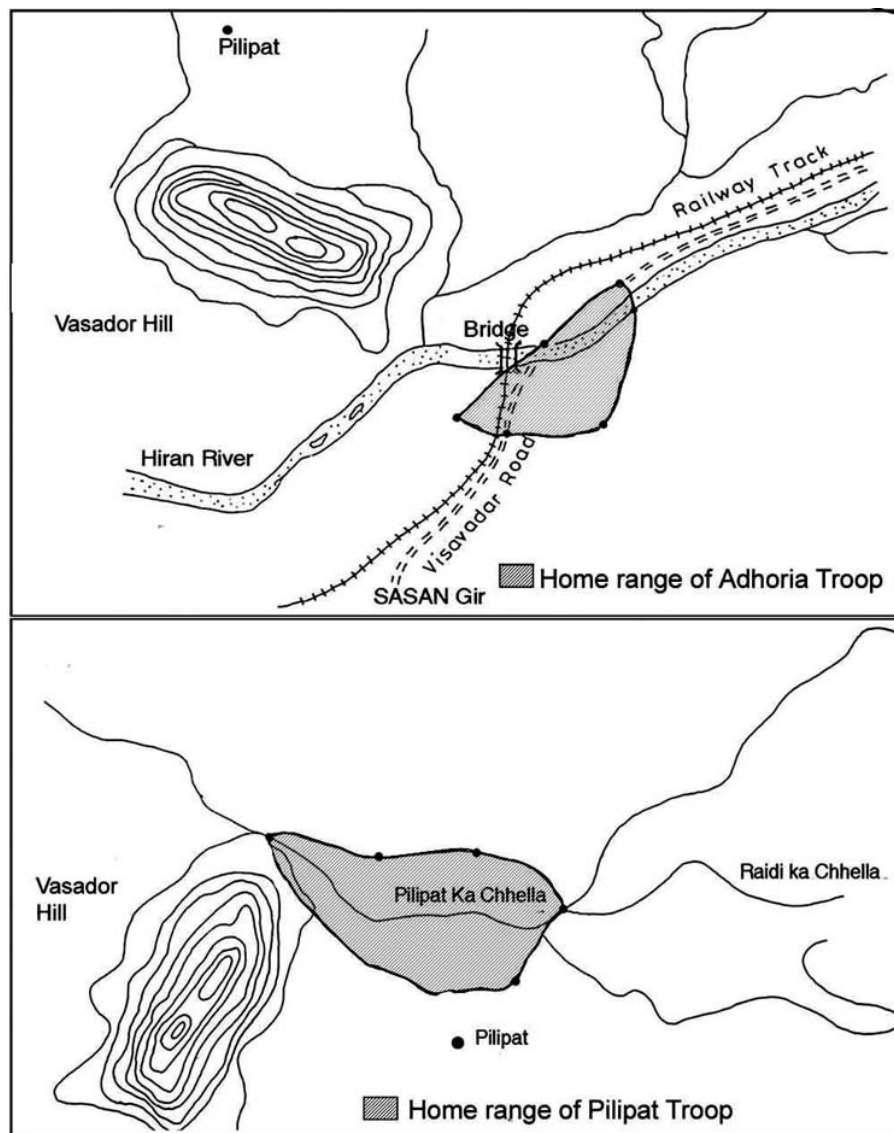


Figure 3. Home ranges of Adhoria and Pilipat Troops.

home range of Pilipat troop ran along the Pilipat River and stretched from left side of Vasador hill to the check dam near Kadeli Ness (Figure 3). During the present study, no overlap of the home ranges of two different troops was observed. The Pilipat troop made a clear-cut boundary (Pilipat River) with the Vasador troop. Pilipat troop never crossed the river near Vasador.

Hanuman langur defended their home range against the intruders. Once, the Adhoria troop intruded in the home range of Kankai check post troop, which comprised of a solitary male. The solitary male chased away the whole troop and tried to catch a single individual of Adhoria troop. The dominant male of Adhoria troop tried to protect the other members of

the troop. The solitary male chased the troop until they ran out of his home range.

DISCUSSION

Out of 11 troops documented by Rahman (1973) from Sanctuary West, 4 troops namely Talala troop, Chitrode troop, Karnya troop, and Sasan Railway station troop could not be located. The Sasan Railway Station troop comprised of a solitary male and perhaps position of this troop has been taken over by Sasan fence troop. Other 3 troops have disappeared due to habitat destruction. Presently these areas are heavily

cultivated and forested areas have been converted into mango orchards and cultivated land. The remaining seven troops persist at their original location. It means that langur in Gir forest shows a great stability in their distribution, because these troops persisted at their original position for almost 30 years.

In all troops, females are found to be more numerous than males. The possible reason may be that langur troops are lead by the dominant or alpha male and chased out other subordinate males. The average troop size of 18.7 was considerably less than the value (30.4) reported by Rahman (1973) for Gir forest. The decrease in troop size may be due to splitting of troops. The troop size was similar to values from Jodhpur (Mohnot 1971, TS=18), Kumaon hills (Vogel 1977, TS=23), Mount Abu (Hrdy 1974, TS=24), Orcha (Jay 1965, TS=18.7), Kanha (Kankane 1980, TS=17.5) and in Madhav National Park (Kankane 1984, TS=21.2). But it differed significantly from Sariska, Kaukori and Nepal, where the average troop size has been reported to be 64, 54 and 52, respectively. The population density, which was estimated by road transect, (13.3 langur km⁻², Khan J.A. unpublished data) differed with that of Madhav National Park, Orcha, Singur, Sariska, Kumaon hills and Polonaruwa, where densities have been reported to be 4.5, 2.6, 6.8, 4.6, 104, 97 and 58, respectively.

Apart from number of animal in the population or group, sex ratio is the most important demographic variable that influences the choice of strategies open to an individual animal. The male:female sex ratio of 1:3.2 at Gir forest is quite similar to that at Madhav National Park (1:3.3), Simla (1:3.7), Sariska (1:2.6) and Kaukori (1:3.3).

Like other colobines, langur is usually classified as folivorous, but studies conducted at the Gir forest and Jodhpur suggested this to be a narrow concept. Langur utilized fruits, flowers, leaves, bark, gum, insect larvae, sand and ticks. Rahman (1973) reported that langurs were feeding on insect larvae in Gir forest but during the present study it could not be confirmed. However langurs were observed feeding on ticks during grooming activity.

Langurs were found to feed on 41 different plant species in Gir. Langurs were reported to consume 37 plant species at Dharwar (Yoshiba 1967), 84 plant species at Jodhpur (Mohnot 1974), 45 plant species at Madhav National Park (Kankane 1984), 208 plant species at Jodhpur (Srivastava 1989). Rahman (1973) also reported 41 plant species being consumed by Gir langurs.

Large numbers of plant species consumed by langur suggested that langurs were not selective in their diet and consumed whatever plant material was available to them in their habitat. However some plants were preferred or avoided in Gir. Such selection or avoidance may be due to their palatability and nutritional status of individual plant species.

The species and plant parts chosen for food varied from area to area and season to season. In Gir forest, langur preferred the leaves, flowers, fruits of the *Carissa congesta*, leaves and flowers of *Combretum ovalifolium*, fruits and leaves of *Ficus glomerata* and *Garuga pinnata*, fruits of *Holoptelea integrifolia*, leaves of *Morinda tinctoria* and *Luffa echinata* while in eastern Rajasthan it preferred the leaves and fruits of *Zizyphus jujuba* Tourn. and leaves of *Anogeissus pendula* Edgew (Vogel 1971 and 1977). The plants most preferred in Rajasthan were *Prosopis juliflora* DC., *Ficus benghalensis* Linn., *Ficus religiosa* Decne., *Salvadora persica* Wall., *Acacia senegal* and *Zizyphus nummularia*. *Ficus benghalensis*, *Ficus religiosa*, *Acacia senegal* Willd. and *Zizyphus nummularia* DC. were preferred in Rajasthan but these plant species were not preferred in Gir forest. *Terminalia crenulata* Linn. was eaten in proportion to its availability in winter (present study) while Rahman (1973) reported that Hanuman langur preferred it in monsoon in Gir. This clearly suggests that preferences for plant species and parts vary spatio-temporally.

Home range has been known to vary from 0.07 km² to 13 km² in bisexual troops whereas these are more extensive (7-22 km²) in all male troops (Jay 1965, Sugiyama et al. 1965, Yoshiba 1968, Vogel 1971). Srivastava (1989) reported that home range varied with troop size at Jodhpur. The home range varied from 0.9 km² to 1 km² and again exceeding to 1.5 km² as the troop size increased from 22 to 29. The home range of Pilipat troop (24 individuals), 0.44 km², was bigger than that of Adhoria troop (17 individuals) measuring 0.28 km². These findings are in agreement with those of Clutton-Brock and Harvey (1977) who suggested that larger groups may occupy bigger ranges than smaller groups in primates in general though this may not be always the case.

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