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POPULATION CENSUS OF RHESUS MACAQUE AND HANUMAN LANGUR IN INDIA—A STATUS SURVEY REPORT

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INTRODUCTION

In the past excessive demand for monkeys, particularly of rhesus macaque, for biomedical and pharmaceutical research and other experimentation, have put a heavy strain on their population in nature in India. The rhesus macaque is and will continue to be the standard laboratory model for various scientific investigations. To meet this demand, large number of rhesus were being trapped and exported to other countries in the past. The past reports of the monthly statistics of Foreign Trade of India indicate that a good number of monkeys of Indian origin, particularly the rhesus, were exported to different countries. However, since 1978 there has been a total ban on the export of monkeys from India.

The fear expressed in many circles that our non-human primate populations are on the decline due to combinations of various factors, including export, generated the necessity for ascertaining the current population status of Indian non-human primates particularly the rhesus macaque and hanuman langur. To evaluate the status of non-human primates in the country, a survey of different states was undertaken just after the ban on export of monkeys was imposed. Field studies of non-human primates have been conducted from time to time in limited areas but a large scale population census of monkeys occupying different ecological niches of almost the entire country has never been undertaken. Southwick *et al* (1960 to 1983) have conducted population studies of rhesus macaque in northern India, particularly Uttar Pradesh, but they have not attempted to cover the entire range of distribution of rhesus in India, nor have they surveyed langur populations.

In India non-human primates occupy a large diversity of habitats ranging from dense forest in montane region to open land and human habitations. Under the present survey the parts of central, western, northern and some states of north eastern India were surveyed. A similar concurrent project was undertaken by Dr. G.U. Kurup of

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the Zoological Survey of India in southern India, viz, in Andhra Pradesh, Karnataka, Tamil Nadu and Kerala (Kurup, 1984).

Among all the primates, the rhesus macaque (*Macaca mulatta*) and hanuman langur (*Presbytis entellus*) have wide distribution in India. While the hanuman langur occurs throughout Indian sub-continent excluding some parts of the north eastern India, the rhesus macaque, though wide ranging in northern India and further east and south east, is replaced by bonnet macaque (*Macaca raidata*) in South India (Fig. 1). All the other species of monkeys have localised distribution in India. The present survey covered nearly entire distributional range of rhesus macaque in India, except some states in north eastern India.

Sampling Areas

Field work on this project involved a very large area in the northern, eastern, central and western India (nearly 2.67 million sq. km.) and it was physically impossible to cover the entire territory. Therefore, it was decided to undertake sample surveys of randomly selected areas of each state using the method of probability proportional to area. Care was taken that the study areas so selected from each state were representative of each type of ecolngical niche inhabited by non-human primates.

Areas of each geographical district within a division were cumulated and if 'T' be the total area of the division of 'n' small digits, then 'T' was multiplied with such highest multiple (m) that the product did not exceed 'n' digits. From the statistical table of biological agricultural and medical research (Fishers and Yeats) a random number 'R' was selected from random numbers table of 'n' digits. If the number 'R' was greater than 'T' then the remainder was taken after dividing 'R' by 'T' otherwise 'R' was taken as it was. This was referred to the cumulated column and the district was identified to which it corresponded. Using the above procedure, the districts that were selected from the different states for census were Baramula and Punch of Jammu and Kashmir state ; Bilaspur and Sirmur of Himachal Pradesh ; Ambala and Mohendragarh of Haryana ; Delhi ; Almora, Uttarkahsi, Pilibhit, Muzzafarnagar, Pratapgarh, Mirzapur, Etawah, Jhansi and Lalitpur, Unnao, Mathura and Deoria of of Uttar Pradesh ; Hoshiarpur, Sangrur and Amritsar of Punjab ; Bikaner, Ajmer, Udaipur, Jaipur, Sawai Madhopur and Jhalawar of Rajasthan ; Jhabua, Gwalior, Sidhi, Mandla, Raigarh, Betul and Bastar of Madhya Pradesh ; Vadodara and Junagarh of Gujarat ; Bhagalpur, Sahabad, Champaran and Singhbhum of Bihar ; Puri, Bolangir, Sundargarh of Orissa ; Midnapore, West Dinajpur and Darjeeling of West Bengal ; South district of Tripura ; South district of Manipur ; Jalgaon and Yeotmal of Maharashtra ; Adilabad, East Godawari and Vishakapatnam of Andhra Pradesh. Among the states in north-eastern India Assam, Arunachal Pradesh, Meghalaya, Mizoram and Nagaland could not be covered due to logistic reasons.

METHODS

After choosing the sampling units different census techniques were applied according to the nature of terrain involved. In the flat plains of the Indo-gangetic valley studded with villages, towns and cities and criss-crossed by network of roadways, the census areas were combed by using roads for locating and counting of the monkey groups. Roadside transects in 5 sq km grids were selected in open areas. Additionally, censuses were conducted in such habitats as villages, towns, cities, railway stations, temples, bazars, forests, hills and factories within the sampling areas. In forests, transects along roads, stream beds, game tracts and fire lines were used to locate monkey groups and, if sighted, they were counted and if visibility was poor their vocalisation and/or other sounds created by their activity were utilised for detection of monkey groups. In the hilly terrain it was not easy to use the same sighting and counting techniques that were applied in the flat plains and often the point method was used for census. This essentially consists of climbing the highest point on a hill or hillock to scan the surrounding areas to locate monkey groups if any, and if sighted, to trace and count them. This method was particularly used in some hilly tracts in Bihar, Tripura, Manipur and Uttar Pradesh. The roadside groups were classified as those which were exclusively occupying the trees and depended for their food and shelter entirely on the trees lining the sides of the road, and were away from the villages, towns, cities and forests.

Having located monkey groups, the exact locality and the animals sighted were recorded alongwith their habitats and other relevant data. In each group the individuals were counted and the number of each age category, i.e. adult males, adult females, juveniles and infants were recorded. In addition to actual sighting and locating monkeys, and through auditory signals, information regarding the distribution of monkeys was also obtained from local people.

METHODS FOR ESTIMATION OF POPULATION

The estimate of population was made by applying the formula $N = ni/fi$, where 'N' was estimated population, 'n' was the number of animals in the 'i' th division and 'fi' was the corresponding sampling fraction as follows :

$$\text{Sampling fraction (fi)} = \frac{\text{Total sampled area of the district surveyed}}{\text{Total area of the division}}$$

Where authentic proof of the presence of monkeys was found the reports of the local people about these groups were also taken into consideration for the purpose of estimation of population. In such cases the average group size of the monkeys that were observed in the area was taken as the group size of the group reported by the local people.

Fig.1. APPROXIMATE RANGE OF DISTRIBUTION OF RHESUS MACAQUE AND HANUMAN LANGUR

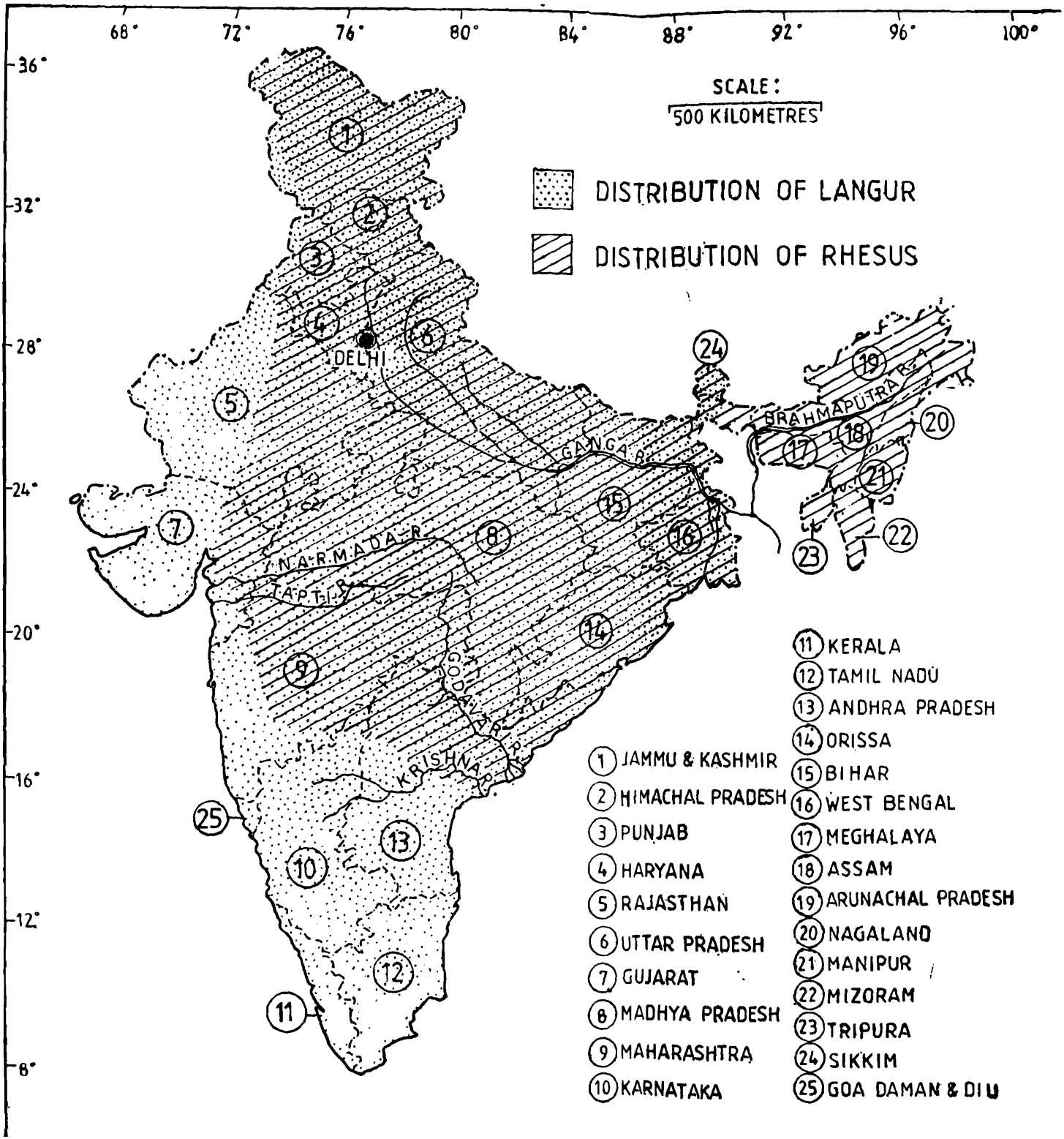

Fig. 2. Rhesus macaque (*Macaca mulatta*)

Fig. 3. Hanuman Langur (*Presbytis entellus*)

EXTERNAL CHARACTERS OF RHESUS MACAQUE AND HANUMAN LANGUR

Rhesus Macaque : A medium-sized macaque with hind quarters of the body brighter (orange-red hue) than fore quarters ; short tail, less than half the length of head and body, uniformly haired ; head-body length measures 455-635 mm in male and 370-580 mm in female ; tail measure 200-317 mm in male and 163-284 mm in female ; body weight in male 5.6-14.5 kg and in female 3.0-10.7 kg ; crown hairs directed backwards from the brows and without a median parting ; face bare, light pink to reddish ; cheek hairs short, forming a whorl ; the upper back olive to greyish brown in colour ; loins, rump and base of tail orange-red and more brightly coloured than the fore quarters ; skin around ischial callosities naked ; under surface of body sparsely haired and paler than above ; females smaller and lighter than males ; new-born infants dark brown and almost black (Fig. 2).

Hanuman Langur : Large in size ; body grey, with long limbs ; sex skin well developed and does not show cyclic changes ; tail longer than head and body ; head and body measures 58-64 cm in length in male and 55-57 cm in female ; tail measures 85-105 cm in male and 79-88 cm in female ; body weight in male 9.0-20.9 kg and in female 7.5-18.0 kg ; in adult hairs of head behind the brows radiating from a frontal whorl, crown hairs rise into a crest or tuft ; eye brows well developed ; face black ; colour of the hands and feet black and the black colour varies from season to season ; tail longer than head and body, they differ in their tail carriage and show geographical and subspecific variations ; coat colour greyish black in nortnern India, paler in south and almost whitish in dry zone of south-east India ; females smaller and lighter than males ; brown natal coat colour present in infant in first few months of life and slowly it changes to normal grey colour (Fig. 3).

A. Statewise Results

Jammu & Kashmir : A total of 343 rhesus monkeys in 7 groups were sighted in the survey districts but only a few langurs were counted.* The social structure and habitat wise distribution of rhesus macaque are given in Table 1. The sex ratio of adult male to female was 1 : 6 : 5 and 20% of the adult females had infants. The local people reported the presence of langurs in the state but as only a few langurs were recorded this figure has not been included in the Table 1 and in the present estimate. Due to logistic difficulty caused by weather conditions and irregular terrain it was not possible to conduct a thorough survey of the two districts. The 343 monkeys in 7 groups were all forest dwellers. Langurs were also observed in the forest habitat. The population of rhesus monkey in this state was estimated to be about 13,000.

*One of us (K. K.) had, while touring Kashmir Valley in the summer of 1955, sighted a number of groups of hanuman langur in the hills adjacent to Shalimar garden near Braen village, and in the forest at Batakoot near Pahalgam. It appears that Hanuman langurs are not uncommon in certain parts of the Kashmir valley.

TABLE—1.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	7	33	213	55	42	—	343

Distribution	F	T	B	V	R	CT	H	FA	Rs	Total
M. mulatta	343 (7)	—	—	—	—	—	—	—	—	343 (7)

F=Forest ; T=Temple ; B=Bazar ; V=Village ; R=Roadside ; CT=City & Town ; H=Hill ; FA=Factory ; Rs=Railway Station

Figures in parenthesis represent number of groups.

Himachal Pradesh : The two districts that were surveyed under the project were heavily forested and presented considerable difficulty in locating and counting monkeys in the irregular terrain. Rhesus macaques actually sighted numbered 695 in 21 groups and 25 langur groups that were encountered contained a total of 533 individuals. The social structure and habitat wise distribution of rhesus and hanuman langur are given in Table 2. The adult male to female ratio of rhesus macaque was 1 : 4.69 and 42% of the adult females had infants. The sex ratio of adult male to female in hanuman langur was 1 : 5.23 and 40% of the adult females had infants. Population of rhesus and langur were estimated to be about 20,000 and 15,000 individuals respectively. In this state majority of the rhesus inhabited the forest. Only two groups were recorded from the temple and bazar habitats. All the 25 groups of langur were recorded from the forest habitat.

TABLE—2.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	21	67	314	173	131	10	695
Presbytis entellus	25	43	225	160	105	—	533

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	605 (19)	70 (1)	20 (1)	—	—	—	—	—	—	695 (21)
P. entellus	533 (25)	—	—	—	—	—	—	—	—	533 (25)

Haryana : In the two districts of Haryana a total of 22 groups of rhesus and 6 groups of langur were encountered. The social structure and habitat wise distribution of rhesus and langur are incorporated in Table 3. The sex ratio of adult male to female was 1 : 3.41 and 47% of the adult females had infants in case of rhesus ; and the sex ratio of adult male to female was 1 : 3.26 and 45% of the adult females had infants in case of langurs. The populations of rhesus and hanuman langur were estimated to be about 4,000 and 1,000 respectively. The rhesus monkey shared the habitats of forest, temple, bazar, village, roadside, city, town and hill but majority of the groups were recorded from the forests. The six langur groups inhabited the forests and the hilly terrain.

TABLE—3.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	22	39	133	81	62	8	323
Presbytis entellus	6	8	26	14	14	—	62

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	151	10	44	45	33	27	13	—	—	323
	(8)	(1)	(2)	(6)	(1)	(3)	(1)			(22)
P. entellus	27	—	—	—	—	—	35	—	—	62
	(2)						(4)			(6)

Punjab : Ten groups of rhesus were recorded in the 3 districts of Punjab. No langurs were sighted in any of the districts that were surveyed. The social structure and habitat wise distribution of rhesus are included in Table 4. The sex ratio of adult male to female was 1 : 3.10 and 66% of the adult females had infants. The population of rhesus macaque in Punjab was estimated to be about 5,000 individuals. Out of the 10 groups, 7 inhabited the forest and the rest 3 groups shared the bazar, village and roadside habitats.

TABLE—4.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	10	63	195	98	127	36	519

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	449	—	40	26	4	—	—	—	—	519
	(7)		(1)	(1)	(1)					(10)

Delhi : In Delhi a total of 22 rhesus groups with 403 individuals were recorded but no langurs were observed. The social structure and the distribution of the 22 groups are given in Table 5. The adult male to female sex ratio was 1 : 4.09 and 90% of the adult females had infants. The population of rhesus in Delhi was estimated to be about 1,000 at a very conservative basis.

Delhi, the capital of India, has a good residential population of rhesus macaques. Occupying an outlier of the Aravalli chain of hills the undulating city of Delhi is now gradually being levelled into units of human habitation of different sizes and densities. The whole city is a big urban complex which can not be conventionally classified. The rhesus are mostly confined to the outer perimeter of the city studded with small rural habitations and slums or medium sized middle class townships. Of the total 22 groups of rhesus that were sighted roughly six occured in rural habitation or villages, 11 were recorded from the medium sized townships or city. The roadside trees and bazars contained 3 and 2 groups respectively. In the ancient ruins of Tughlaqabad Fort there is a fairly large group of rhesus macaques. The number of individuals in village locations was 80. The city contained 181 individuals while the 2 bazar groups contained only 20 individuals. The roadside groups had 122 individuals which indicate that the roadside habitats were preferred by rhesus monkeys in Delhi. Newspaper reports indicate that the macaques make occasional forays into the official complexes, sometimes creating funny situations.

TABLE—5.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	22	43	176	112	71	1	403

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	—	—	20	80	122	181	—	—	—	403
			(2)	(6)	(3)	(11)				(22)

Uttar Pradesh : The state of Uttar Pradesh is very well known for the concentration of rhesus monkey in India. The 12 districts that were surveyed under the project recorded a total of 171 groups of rhesus macaque and 149 groups of langur. The social structure and habitat wise distribution of these two species of non-human primates are included in Table 6. The ratio of adult male to female was 1 : 3.24 and 49% of the adult females had infants in rhesus population. In langurs the sex ratio of adult male to female was 1 : 3.50 and also 49% of the adult female had infants. The population of rhesus and hanuman langur were estimated to be about 68,000 and 45,000 respectively.

Uttar Pradesh is probably the state with the largest population of rhesus macaque inhabiting practically all the habitats but the population is distributed mainly in forests, temples, bazars, villages, roadsides, cities and towns. Three very diverse habitats, i. e. forest, temple and bazar are the most preferred habitats of rhesus macaque in Uttar Pradesh. Large number of groups have been encountered in human habitations like villages, towns and cities but with lesser number of monkeys per group. Road side groups were frequent but the group size was smaller. Like rhesus macaque, the langurs were recorded from almost all the habitats. However, in addition to forests majority of the population occurred in roadsides and villages, much less in towns and cities. A significant feature of langur population appears to be that the groups size does not vary much in different ecological habitats.

TABLE—6

Species	Total No. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	171	682	2,209	1,167	1,079	11	5,148
Presbytis entellus	149	444	1,555	682	689	42	3,412

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	1236	1379	825	582	393	706	13	12	2	5148
	(25)	(24)	(25)	(40)	(25)	(29)	(1)	(1)	(1)	(171)
P. entellus	1865	161	57	790	359	84	60		36	3412
	(62)	(5)	(2)	(47)	(22)	(5)	(3)	—	(3)	(149)

Rajasthan: The six districts of Rajasthan were intensively searched for the presence of monkeys. In this dry part of India, more langurs were recorded than rhesus. The social structure and habitat wise distribution of rhesus and hanuman langur are given in Table 7. In rhesus the sex ratio of adult male to female was 1 : 6.23 and 30% of the adult females had infants. The sex ratio of adult male to female was 1 : 3.06 and 34% of the adult females had infants in langur populations. The populations of rhesus and langur in this arid zone were estimated to be about 6,000 and 26,000 respectively. However, in recent survey of 1991 good populations of langur and rhesus macaque were recorded in Ranthombhor and Sariska Tiger Reserves. In Rajasthan the 23 rhesus groups with 637 individuals were recorded from habitats like villages, temples, cities, roadside trees, railway stations and bazars. It is worth noting that the largest group size occurred in temple habitat. The langur population in Rajasthan was predominant and a total of 105 groups with 2,850 langurs were

counted in the sampling areas. In Rajasthan, where the animals are generally protected, a good density of langur population was recorded. Majority of the langur groups were recorded from the forest and village habitats.

TABLE—7

Species	Total No. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	23	31	193	88	57	268	637
Presbytis entellus	105	421	1,287	609	444	89	2,850

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	—	372 (8)	98 (6)	58 (3)	23 (2)	79 (3)	—	—	7 (1)	637 (23)
P. entellus	1356 (44)	209 (5)	—	838 (34)	129 (5)	291 (15)	15 (1)	—	12 (1)	2,850 (105)

Madhya Pradesh : The seven districts that were selected for census in this state revealed the presence of more langurs than rhesus macaques. A total of 1,295 rhesus in 26 groups was recorded. The social structure and habitat wise distribution of rhesus and langurs are given in Table 8. The sex ratio of adult male to adult female, and female to infant, in rhesus macaque were calculated to be 1 : 3.38 and 1 : 0.37 respectively. The 264 langur groups contained a total of 7,539 individuals, and the sex ratio of adult male to female was 1 : 7.61 and 24% of the adult females had infants. The population of rhesus and langur were estimated to be about 25,000 and 78,000 respectively.

The rhesus macaques were recorded from forest, village, temple, city and road side habitats. It is worth noting that in the forest habitat in Madhya Pradesh the group size of rhesus was bigger in comparison to other habitats. Of all the states the maximum number of langur groups were recorded from Madhya Pradesh. The habitat wise distribution of rhesus and langur showed that the forest habitat contained the maximum population of these two species in this state.

TABLE—8

Species	Total No. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	26	189	629	246	231	—	1,295
Presbytis entellus	264	541	4,117	1,890	973	18	7,539

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	1238 (21)	18 (1)	—	8 (1)	29 (2)	2 (1)	—	—	—	1,295 (26)
P. entellus	7067 (242)	9 (1)	—	219 (9)	217 (11)	—	27 (1)	—	—	7,539 (264)

Gujarat : The two districts that were surveyed in the state of Gujarat situated on the western part of India washed by the Arabian Sea. Only langur groups were recorded from census areas. Social structure and habitat wise distribution are recorded in Table 9, The survey of two districts revealed a total of 896 langurs in 20 groups. The sex ratio of adult male to female was 1 : 4.67 and 52% of the females had infants. The population of langur was estimated to be around 16,000. The habitat wise distribution showed that the maximum concentration is in the forest habitat. Gujarat, where animals are also given protection, the group size of langurs in different habitats was fairly large.

TABLE—9

Species	Total No. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Presbytis entellus	20	90	420	167	219	—	896

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
P. entellus	710 (13)	60 (2)	25 (1)	101 (4)	—	—	—	—	—	896 (20)

Bihar : The survey of four districts of Bihar revealed the presence of 27 rhesus and 56 langur groups. The social structure and habitat wise distribution of the two species are given in Table 10. The sex ratio of adult male to female in rhesus macaque was 1 : 2.29 and 48% of the adult females had infants. The sex ratio of adult male to female in hanuman langur was 1 : 4.18 and 38% of the adult females had infants. The population of rhesus and langur were estimated to be about 7,000 and 14,000 respectively. The rhesus occupied the forest, village, temple, city and road side habitats and the langur was recorded from forest, village, temple, city, roadside. mountain and bazar habitats.

TABLE—10

Species	Total No. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	27	56	134	86	64	6	346
Presbytis entellus	57	94	393	170	149	—	806

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	127 (9)	73 (3)	—	37 (4)	14 (3)	95 (8)	—	—	—	346 (27)
P. entellus	294 (17)	46 (4)	51 (3)	329 (24)	45 (3)	17 (2)	24 (3)	—	—	806 (56)

Orissa : A total of 24 groups of rhesus containing 1,096 individuals was counted in two out of three districts that were surveyed in Orissa. The adult male to female ratio was 1 : 3.3 and 53% of the adult females had infants in rhesus macaque. No rhesus monkeys were recorded in Sundergarh district, though the area was well forested. The local people in this district reported the occurrence of these monkeys, which were said to migrate to other areas during the lean dry period. The area is extremely mined for iron ore causing too much disturbances and the local "Behore" community in the area is also said to trap monkeys by nets and keep them in captivity to be eaten at leisure. The "Behore" are locally known as 'Makrkhora', which means monkey eaters.

Hanuman langur seemed to be slightly more abundant in Orissa. A total of 78 groups containing 1,220 langurs were observed in the three districts. The sex ratio of adult male to female was 1 : 5.27 and 40% of the adult females had infants in langur population. Social structure and habitat wise distribution of two species are given in Table 11. On the basis of survey conducted in the three districts, the estimated population of rhesus macaque and langur appear to be 7,000 and 8,000 respectively. The rhesus monkeys occupided the habitats of forest, village, temple, city and roadside and the langur was recorded from the forest, village, temple and roadside.

TABLE—11.

Species	Total No. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	24	126	419	324	224	3	1,096
Presbytis entellus	78	110	580	297	233	—	1,220

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	902	71	—	16	15	92	—	—	—	1,096
	(18)	(2)		(1)	(1)	(2)				(24)
P. entellus	576	31	—	533	80	—	—	—	—	1,220
	(37)	(1)		(32)	(8)					(78)

West Bengal : In West Bengal the three districts that were surveyed under the project indicate that macaques were negligible in the plains whereas the langurs were dominant. A total of 11 groups of rhesus macaques and 12 groups of Assamese macaque were recorded mostly from the Darjeeling district. The social structure and habitat wise distribution of rhesus macaque and langur are given in Table 12. The 12 groups of Assamese macaques, containing a total of 156 individuals including 30 adult males, had 42 adult females, 29 juveniles and 14 infants. Forty one monkeys could not be sexed. The sex ratio of adult male to female was 1 : 1.40 and 33% of

the adult females had infants in case of Assamese macaque, whereas 42% of adult females had infants in case of rhesus. It appears that the two macaques are not sympatric in nature. Assamese macaque was sighted in the montane terrain above 400 to 500 m.

Langurs were quite abundant in this state. The sex ratio of adult male to female was 1 : 4.15 and 14% of the adult females had infants. On the basis of the information that have been collected from the survey of three districts it was estimated that the rhesus population was about 2,000 and langur was more than 6,000. However, in a recent survey (1991) of the three districts ; Hooghly, Howrah and North 24-Parganas, a good population of langurs was recorded. In Hooghly district a total of 33 groups with 367 langurs, in Howrah district a total of 29 groups with 432 langurs and in North 24 Parganas a total of 17 groups with 189 langurs were counted. The distribution of macaque in West Bengal* presents a very poor picture and it appears thai rhesus are found only in isolated pockets. The 23 groups of rhesus and Assamese macaques which were recorded solely from Darjeeling district contained a total of 254 monkeys of which 20 groups with 231, and 3 groups with 23 monkeys, were observed in the forest and roadside habitats respectively, The 12 groups of Assamese macaque with 156 individuals were recorded from the forest of Darjeeling district. However, the langurs are quite abundant in West Bengal.

TABLE—12.

Species	Total no. of group	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	11	29	28	22	11	8	98
Presbytis entellus	60	132	548	163	75	20	938

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	98	—	—	—	—	—	—	—	—	98
	(11)									(11)
P. entellus	33	20	—	813	72	—	—	—	—	938
	(3)	(1)		(52)	(4)					(60)

Tripura : This tiny state is situated in the eastern part of India and it does not have hanuman langurs. In this part the langurs have been replaced by capped langur (*Presbytis pileatus*) and Phayre's leaf monkey (*Presbytis phayrei*). The other non-human primates that are found in this state are rhesus, pig-tailed and stump-tailed macaques, slow loris and hoolock gibbon. The Phayre's leaf monkeys occur only in Tripura

*In the city of Calcutta there is a well known group of rhesus macaques in the Hastings area which appears to be the mascot of the Jawans. In the Indian Museum complex there used to be a good colony of rhesus which was gradually decimated and finally eliminated through human interference.

and south Cachar of Assam within the Indian limits. Probably it also occurs in Mizoram. In some places all these species occur in the same forest and their home ranges overlap. Many parts of Tripura are still well forested and out of the three districts only the south district fell under the sampling unit. The social structure and habitat wise distribution of rhesus are given in Table 13. The 33 groups of rhesus macaque that were sighted during survey contained 937 monkeys. The sex ratio of adult male to female in rhesus macaque was 1 : 3.38 and 40% of the adult females had infants. The estimated population of rhesus macaque in this state was more than 6,000. Though this state is much smaller in size in comparison to other states of India, it seems to have a very good concentration of rhesus macaque and diversity of non-human primate fauna. The majority of the rhesus population was recorded from the forested areas. The recent survey of all the districts of Tripura revealed that the rhesus macaque is present in good numbers in all the districts (Mukherjee and Chakraborty, 1990).

TABLE—13.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	33	128	433	203	173	—	937

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	674 (23)	—	—	225 (8)	38 (2)	—	—	—	—	937 (33)

Manipur : The non-human primates of this state seem to contain rhesus and Assamese macaques, hoolock gibbon and capped langur. The south district which fell under the sampling unit was surveyed. Due to prevalent practice of hunting monkeys for food by many ethnic groups and extensive 'Jhooming' (shifting cultivation) in the area, the monkeys are mostly concentrated in deeply forested and practically inaccessible valleys with the result that it is difficult to locate and count them. The estimated population of rhesus macaque in this state was roughly to the order of 2,000 individuals. Most of the non-human primates were recorded from the forested areas.

Maharashtra : In the sampling areas of Maharashtra no rhesus macque was observed but 40 groups of langur with 1,221 individuals were recorded. This reveals abundance of hanuman langur population in this state. The social structure and habitat wise distribution of hanuman langurs are given in Table 14. Five all male groups with 58 langurs were recorded during the survey. The sex ratio of adult male to female was 1 : 3.49 and 28% of the adult females had infants. It was estimated that the population of langur in this state was more than 25,000. A small resident group of rhesus was also sighted by one of us (K. K.) at Lonavala in 1976. Local inquiries revealed that it was the progeny of few individuals, discarded by some madari (nomadic people who use pet monkeys for roadside entertainment). Though in the sampling areas in

Maharashtra visited by the survey teams no rhesus was sighted, this macque is by no means absent in this state, One of us (K. K.) has sighted a number of rhesus groups at Nagpur in the Telankheri area, with one group inhabiting a temple. In western Maharashtra the rhesus is replaced by bonnet monkey.

TABLE—14.

Species	Total no. of gaoups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Presbytis entellus	40	147	513	223	146	192	1,221

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
P. entellus	902 (21)	23 (1)	—	266 (16)	30 (2)	—	—	—	—	1,221 (40)

Andhra Pradesh : In the limited districts of Andhra Pradesh which fell within the census area fairly good number of rhesus and langur groups were observed. The distribution of rhesus macaque in Andhra Pradesh was recorded as far south as the river Krishna which supercedes the earlier reports which state the Tapti in the north and Godavari in northeast are the limits of distribution of rhesus macaque in peninsular India.

The social structure and habitat wise distribution of rhesus macaque and hanuman langur are given in Table 15. In langur twenty individuals in 3 groups were unisexual all male groups. The sex ratio of adult male to females was 1 : 2.43 and 25% of the adult females had infants in case of rhesus monkeys ; and in case of langurs the sex ratio of adult male to female was 1 : 3.05 and 22% of the adult females had infants. The estimated population based on the data collected in the field was about 25,000 rhesus and more than 6,000 langurs. According to Kurup (1984) the estimated population of rhesus in Andhra Pradesh is 50,000, a figure twice as much as our estimate calculated on the basis of actual counts. Most of the rhesus and langur groups were recorded from the forested habitats.

TABLE—15.

Species	Total no. of groups	♂♂	♀♀	JJ	II	Unclassified monkeys	Total
Macaca mulatta	42	375	911	575	241	40	2,142
Presbytis entellus	30	61	186	70	40	40	397

Distribution	F	T	B	V	R	CT	H	FA	RS	Total
M. mulatta	1,108 (23)	—	—	108 (3)	835 (15)	91 (1)	—	—	—	2,142 (42)
P. entellus	278 (20)	7 (1)	—	24 (2)	59 (4)	29 (3)	—	—	—	397 (30)

B. Habitat wise : Overall analysis of habitat concentration of rhesus and hanuman langur indicates that they are concentrated in the forest habitat more than in other habitats. In case of rhesus monkeys about 50% have been sighted in forested areas. This represents a significant change from 20 years ago when Southwick, Beg and Siddiqui (1965) estimated that only 12% of the rhesus population lived in forest areas. The main difference have been the sharp decline of rhesus in agricultural areas, especially villages, roadside, and canal bank habitats (Southwick, Siddiqui and Oppenheimer, 1983).

The next most suitable habitat that was found to contain more rhesus was temple, having about 14.08% of the total population. The other habitats like roadside trees, cities, villages and bazars show the population distribution of 10.80%, 8.99%, 8.37% and 7.40% respectively. Social situation like factories, hilly terrain and railway stations have a very low percentage of rhesus population (0.36%).

Likewise 68.63% of langur population inhabited the forests. The next suitable habitat for langur was found to be the village with 19.69%, and the roadside, temple and city habitats contained 4.99%, 2.85% and 2.12% of the population respectively. The other habitats like hilly terrain, railway station and bazar had comparatively poor langur population (1.72%).

POPULATION ESTIMATE OF RHESUS AND HANUMAN LANGUR

	Rhesus	*Langur*
Jammu & Kashmir	13,000	*
Himachal Pradesh	20,000	15,000
Punjab	5,000	—
Haryana	4,000	1,000
Delhi	1,000	—
Uttar Pradesh	68,000	45,000
Rajasthan	6,000	26,000
Gujarat	—	16,000
Madhya Pradesh	25,000	78,000
Bihar	7,000	14,000
Orissa	7,000	8,000
West Bengal	2,000	6,000
Tripura	6,000	—
Manipur	2,000	—
Maharashtra	—	25,000
Andhra Pradesh	25,000	6,000
Total	1,91,000	2,40,000

* Due to insufficient data of Jammu and Kashmir the estimate has not been done, possibly there are sizeable populations of Hanuman langurs in this State. (cf. Footnote on p. 352)

Based on the survey conducted in the selected districts of 15 states and Delhi it can be estimated that there are about 200,000 rhesus macaques and 250,000 hanuman langurs in extra peninsular India and part of peninsula.

In a similar survey conducted by Kurup (1984) in southern states of India (Andhra Pradesh, Karnataka, Tamil Nadu and Kerala), the estimated population of Hanuman langurs for these states is 90,000 and of rhesus macaque 50,000 (in Andhra Pradesh only). Kurup's estimate compared with ours appear to be on the higher side. This can possibly be explained by very orthodox and conservative approach adopted by us, which has relied mostly on actual sightings and count. Our population estimates are rather on the low side. There is every likelihood that more intensive surveys in future may reveal higher populations than estimated by us in the present survey.

Southwick (1960) estimated 2,000,000 rhesus monkeys in whole of India. However, Southwick, Siddiqi and Oppenheimer (1983) in recent surveys indicate that the population of rhesus macaque has declined substantially in northern India. Uttar Pradesh still has the greatest rhesus abundance of all the places surveyed under the project. Among other states Jammu and Kashmir, Himachal Pradesh, Madhya Pradesh and Andhra Pradesh has the greatest abundance of rhesus population, whereas the other states like Rajasthan, Gujarat, Bihar, Orissa, Himachal Pradesh, Uttar Pradesh and Maharashtra have fairly good populations of langurs. During our survey we did not sight langurs in Jammu and Kashmir, Punjab and Delhi. Likewise rhesus was not seen in Gujarat. This could be shotcoming of our survey, and we think more intensive svrveys will reveal their presence in states where we found them absent.

Population Abundance of Rhesus Macaque and Hanuman Langur in Different Forest Types

Among the major forest types the rain forests which are mostly located in the north eastern part of India, have the largest diversity of non-human primate species in the Indian sub-continent. The dominant langur species of the Indo-gangetic plain and peninsular India, *Presbytis entellus*, is absent from Assam, and adjacent hill states. One does not know for certain the eastern most limits of distribution of hanuman langur in north eastern India, but perhaps the Sankosh river seperating West Bengal and Assam may be the dividing line. In the present census the extension of hanuman langur in its distribution to the eastern part of India was observed only upto West Bengal. Presuming that this species evolved some where in the northern India, its eastward extension might have encountered resistance in Assam and further east where at least three species of leaf monkeys, viz., capped langur, golden langur and Phayre's leaf monkeys were established. Of these three the most wide spread is the capped langur which bears the same zoogeographic relationship to the hanuman langur in North India as the bonnet macaque bears to rhesus in South India. The capped langur

has habits and habitats similar to those of hanuman langur and if they co-existed in north eastern India they could have competed for food and roosting trees. This may explain why the hanuman langur which is so well distributed elsewhere in India including the hills of the north has not been able to penetrate into the north eastern part of India.

On the contrary the rhesus macaque which has a wide distribution in whole of extra peninsular India and parts of the peninsula is very abundant in Assam and adjacent hill states. In fact this is one of the most wide spread species of macaques in South and South East Asia, extending from Afganistan in West through Pakistan and North India to Assam, Bangladesh, Myanmar, Thailand and South China, but in the Indian peninsula it has not spread into far south. The bonnet macaque, another species of non-human primates, endemic to south India is well established there.

There are, however, indications that the rhesus macaque which was said to occur north of Tapti and north east of Godavari, has penetrated south of Tapti to the Dang's forest in Gujarat and in south west it has infiltrated beyond Godavari to the Krishna delta where in some places it is allopatric with bonnet macaque. (Fooden *et al* 1981, Saha, 1984).

As far as the abundance of rhesus monkeys in different forests is concerned roughly 50% of the observed rhesus macaque populations inhabit the rain forests, moist evergreen and deciduous forests, whereas the remaining 50% occupy other habitats. In case of hanuman langur, the position is reversed. Most of the rain forests of north-eastern India occur in Assam region from where the langur is absent. Nearly eighty two percent of hanuman langur populations occur outside the rain forest tracts, whereas only 18% inhabitat the moist evergreen forests.

The tropical and sub-tropical moist and dry deciduous forests contain the majority of rhesus population, whereas the residual habitats contain a small percentage of rhesus population in the same area. By and large these forests have greater abundance of hanuman langurs. In the moist deciduous forests the langur population occupies 92% whereas the 8% inhabitat the other residual habitats.

In the peninsular India, the pattern of abundance of rhesus populations broadly conforms to that in the moist deciduous belt of north. The representation of rhesus monkey groups in this habitat is 44% in forests and 56% in residual habitats. In case of hanuman langurs 57% occur in the dry deciduous forested areas and 43% in the residual areas.

Unlike in north and penisular forests, the rhesus populations in the arid and semi-arid tract of Rajasthan and parts of western India mostly occur outside forests, whereas in the case of langur it is just the reverse. Thus in the arid and semi-arid tracts 24% of rhesus populations occur in the forests mostly of scrub jungles and

xerophytic vegetation and 76% occupy non-forested niches. Of the hanuman langur population 55% inhabit the arid and semi-arid forest while the remaining 45% occupy the non-forested habitats.

Current data on the population of non-human primates in the temperate forests is scanty and no generalisation is possible at this stage beyond stating that both the rhesus macaque and hanuman langur are not uncommon in these forests.

Discussion

Inspite of rich diversity of non-human primate species in India, detailed field studies of these animals have not been made till the middle of this century. In the first half of the present century only a few field studies of non-human primates in India were carried out though anecdotal notes and reports by naturalists abound. Notle (1955) probably published the first account that deals with the social structure, ecology, behaviour etc., of the bonnet macaque of South India. Serious field studies of non-human primates in India started with the pioneering work of Phyllis Jay, Southwick and Sugiyama in the mid fifties and sixties but these were restricted to a few species and also in restricted pockets. In recent years primatologist have started paying more attention to various species of non-human primates particularly those found in the south and north-eastern parts of India. The two common species i.e. the rhesus macaque and hanuman langur have been well studied in the field by various workers. The field studies on other species of macaques, leaf eating monkeys and hoolock gibbon are now in progress by a number of workers and it is hoped that more information about non-human primates of India will be available in the near future.

So far no attempts has been made to study and to estimate the population of non-human primates, particularly the rhesus macaque and hanuman langur, in the entire country. In the present census attempt is made to cover a vast area of the country to study their distribution, abundance, status, social structure, etc.

This study reveals, when compared with the whatever little information that is available, that there is a real decline in the population of rhesus macaque in most parts of the country. The earlier census when compared with the present study reveals that the rhesus monkeys are more abundant in the States of Uttar Pradesh, Jammu and Kashmir, Himachal Pradesh, Madhya Pradesh, Andhra Pradesh and Tripura, whereas the langurs are more in the states of Uttar Pradesh, Rajasthan Madhya Pradesh, Bihar, Orissa, Gujarat, Himachal Pradesh and Maharashtra.

Rhesus population in Uttar Pradesh was supposed to be about 5 to 10 millions about four decades back. Southwick, Beg and Siddiqui (1961) estimated 800,000 to 1,000,000 rhesus monkeys in Uttar Pradesh and about 2,000,000 in whole of India. Present estimate indicates that there are about 70,000 rhesus macaque in Uttar Pradesh and a total of about 200,000 in the census states. Previous to this survey no estimate of langur population has been made.

Southwick, Siddiqi, and Oppenhaimer (1983) in recent surveys indicated the sharp decline in rhesus population in northern India. They pointed out that roadside populations declined by 77%, canal bank populations decreased by 76%, village populations declined by 89% and in towns the decline in population was 24% over the past 20 years. In some places they have noted the decline in rhesus population to the tune of more than 90%. This supports the findings of the present census that there is a decline of rhesus macaque population in India. This also indicates that there is need for continuous monitoring of some of the populations to know the future demographic trend and to evolve suitable conservation and management programme of non-human primates in India.

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