

Census Survey and Population Ecology of Hanuman Langur, *Presbytis entellus* (Dufresne) in South India

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Census cum population-ecological surveys on the three species of non-human primates viz. (i) Bonnet macaque, *Macaca radiata*; (ii) Rhesus macaque, *M. mulatta* (Zimmermann); and (iii) Hanuman langur, *Presbytis entellus* used as experimental models in biomedical research were carried out in southern India from 1977 to 1980 (Kurup 1981, 1983, and under publication). The results of the surveys conducted on the Hanuman langur in the rural and urban areas of four states of southern India, viz. Andhra Pradesh, Karnataka, Tamil Nadu and Kerala, are presented.

Key Words: *Presbytis entellus*, Population ecology, Demographic parameters

Populations of this species ranging in a semi-wild condition as commensal on human settlements in the countryside, as against their forest populations, used to be quite sizeable in the country. But of late, their status has been of increasing concern due to diverse interferences in their natural habitats by to increasing human population living under hard economic conditions. Recent usage of these species in biomedical research and the consequent indigenous trade in it was another contributory factor in depleting the countryside populations, most accessible for such purposes. Faced with this situation, the Government of India in 1976 restricted the total number of export of monkeys (all species) to 20,000 annually, and later, in 1977, imposed a total export

ban till an inventory of the resources available and an overview of its population ecology are available. The present surveys were initiated in this context.

Principles and Methodology

The principles and methodology designed for the census have been detailed earlier (Kurup 1981, 1983 and under publication). Briefly, to begin with, information on the presence of monkeys in the *panchayats* (village clusters, basic administrative units) of each block in a district, and also on pertinent environmental factors operating on the monkey population in the area, was obtained through an extensive mail questionnaire programme addressed to each block development officer of the four states involved. This provided valuable distributional data



Figure 1 Hanuman Langur, *Presbytis entellus* Female and young

otherwise unobtainable with this level of precision. Based on information thus gathered, direct sample surveys were carried out in *panchayats* of blocks selected at random in each district of each state, by specially trained census parties, collecting also additional socio-ecological information. Population figures, based on data thus generated were projected as under:

$$P = tz \frac{N}{100} \frac{(M 100)}{Q}$$

where P is the population estimate; t the mean troop per *panchayat*, z , the mean troop size; N , the total number of *panchayats* in

the state; M , the number of *panchayats* inhabited by monkeys, based on questionnaire answers received, and Q , the total number of answers received (However, for Kerala state, in view of the skewed and limited distribution of langur population there, a total count was adopted.)

Details of state-wise number of troops censused, mean troop per *panchayat*, and mean troop strength are given in table 1.

Results

Census Figures

Population and density figures for Hanuman langur estimated on the basis of the preceding

Table 1 Statewise number of Hanuman langur troops censused in southern India

State	Recorded	Full count	Mean troop size	Range	Mean troop/ panchayat
Andhra Pradesh	79	12	17.00±6.46	4-28	1.19
Karnataka	241	45	16.66±9.32	4-50	1.75
Tamil Nadu	21	—	—	—	1.33
Total/mean	341	57	16.63±8.30	4-50	1.42

Table 2 Statewise population and density estimates for Hanuman langur in southern India

State	Absolute nos.	Troop nos.	Density		
			Langur/ km ²	km ² / langur	km ² / Troop
Andhra Pradesh	41,341±2,794 (41,000)	2,432±164	0.20	5.00	87.00
Karnataka	40,508±2,860 (40,000)	2,431±172	0.25	3.96	66.00
Tamil Nadu	4,795±706 (4,800)	285±42	0.04	22.51	380.00
Kerala	954±63 (900)	57±4	0.03	29.39	492.00
Total	87,598 ±6,423 (90,000)	5,205 ±382	0.17	5.81	98.00

Figures have been rounded off in paranthesis

formula are given in table 2. Figures for Andhra and Karnataka (around 40,000 each) are similar; together they contain 93% of the total of 90,000. In Karnataka, although it is smaller in size, the density is the highest (one langur per 3.96 km² or one troop per 66 km²). The mean density for Andhra and Karnataka is 4.48 km² for a langur and 76.50 km² for a troop; this is significantly higher than that of the other two states (forested tracts have been excluded in calculating area of the states involved).

Districtwise Estimates

One advantage of selecting *panchayats* as the basic geographical unit of the census is that it is possible to project districtwise

langur populations of each state (table 3).

In Andhra Pradesh, the maximum population for any one district was in W. Godavari district (7,700) followed by Hyderabad (4,000), Adilabad (3,900) and E Godavari (3,800). The lowest population was in Guntur district (80) followed by Nizamabad (200). In Karnataka the highest population is in Dharwar district (5,100), followed by Shimoga (4,800) and N. Kanara districts (4,600). The least populated districts are Coorg (50) and Tumkur (60). In Tamil Nadu, the district of N. Arcot apparently contains the largest population (1,400), followed by Tiruchirappally (800) and S. Arcot (600). The least populated districts are Dharmapuri and Tirunelveli (50 each).

Table 3 Districtwise estimated population figures (as rounded off) for *Hanuman langur* in the states of Andhra, Karnataka and Tamil Nadu

Andhra Pradesh		Karnataka		Tamil Nadu	
1. Adilabad	3,900	1. Bangalore	NE	1. Chengalpatti	250
2. Anantapur	300	2. Belgaum	4,000	2. S. Arcot	600
3. Chittoor	300	3. Bellary	2,000	3. N. Arcot	1,400
4. Cudadpah	250	4. Bedar	1,100	4. Salem	500
5. E. Godavari	3,800	5. Bijapur	1,400	5. Coimbatore	150
6. W. Godavari	7,700	6. Chikmagalore	1,900	6. Thiruchirappalli	800
7. Guntur	80	7. Chitradurga	400	7. Thanjavur	150
8. Hyderabad	4,000	8. S. Kanara	2,200	8. Madurai	200
9. Karimnagar	2,500	9. Dharwar	5,100	9. Ramanathapuram	200
10. Khammam	900	10. Gulbarga	3,100	10. Tirunelveli	50
11. Krishna	400	11. Hassan	NE	11. Dharmapuri	50
12. Kurnool	1,100	12. Coorg	50	12. Kanyakumari	100
13. Mahaboobnagar	3,900	13. Kolar	800		
14. Medak	1,700	14. Mysore	500		
15. Nalgonda	450	15. Raichur	1,600		
16. Nizamabad	200	16. Shimoga	4,800		
17. Sreekakulam	2,900	17. Tumkur	60		
18. Visakapatnam	1,700	18. N. Kanara	4,600		
19. Warrangal	2,000				

Note: Districts not given are either new districts whose areas are here included under older district names or from where adequate questionnaire returns were not received

Taking southern India as a whole, the largest langur populations exist in W. Godavari, Dharwar, Shimoga, North Kanara, Belgaum, and Hyderabad areas in that order. While the areas falling in the Karnataka state form a contiguous whole, the areas in Andhra Pradesh are desparate, but the causes of such localizations are not known.

Demographic Parameters

Altogether 320 troops of the *Hanuman langur* were recorded in the surveys. Most had been actually sighted and censused in Karnataka and Andhra Pradesh. The troop composition of only 58 troops could be recorded fully. The others could either be counted only partially, or only as to troop size in terms of total number of members or merely recorded as 'present'.

Troop size

Troop sizes of 58 troops that could be counted fully give a mean troop size of 16.73, SD 8.30 individuals (range 4–50). The statewide figures are given in table 4. The state averages are particularly close in spite of the much smaller number of troops counted fully in Andhra Pradesh, although the range is markedly different and limited in that state. Only two troops of 26 and 28 members could be met with there in the category of +25 troop size. In Karnataka, however, 7 troops

Table 4 *Troop size of Hanuman langur*

State	N troops	Mean	SD	Range
Andhra Pradesh	12	17.00	6.46	4–28
Karnataka	45	16.66	9.32	4–50
For total	57	16.73	8.30	4–50

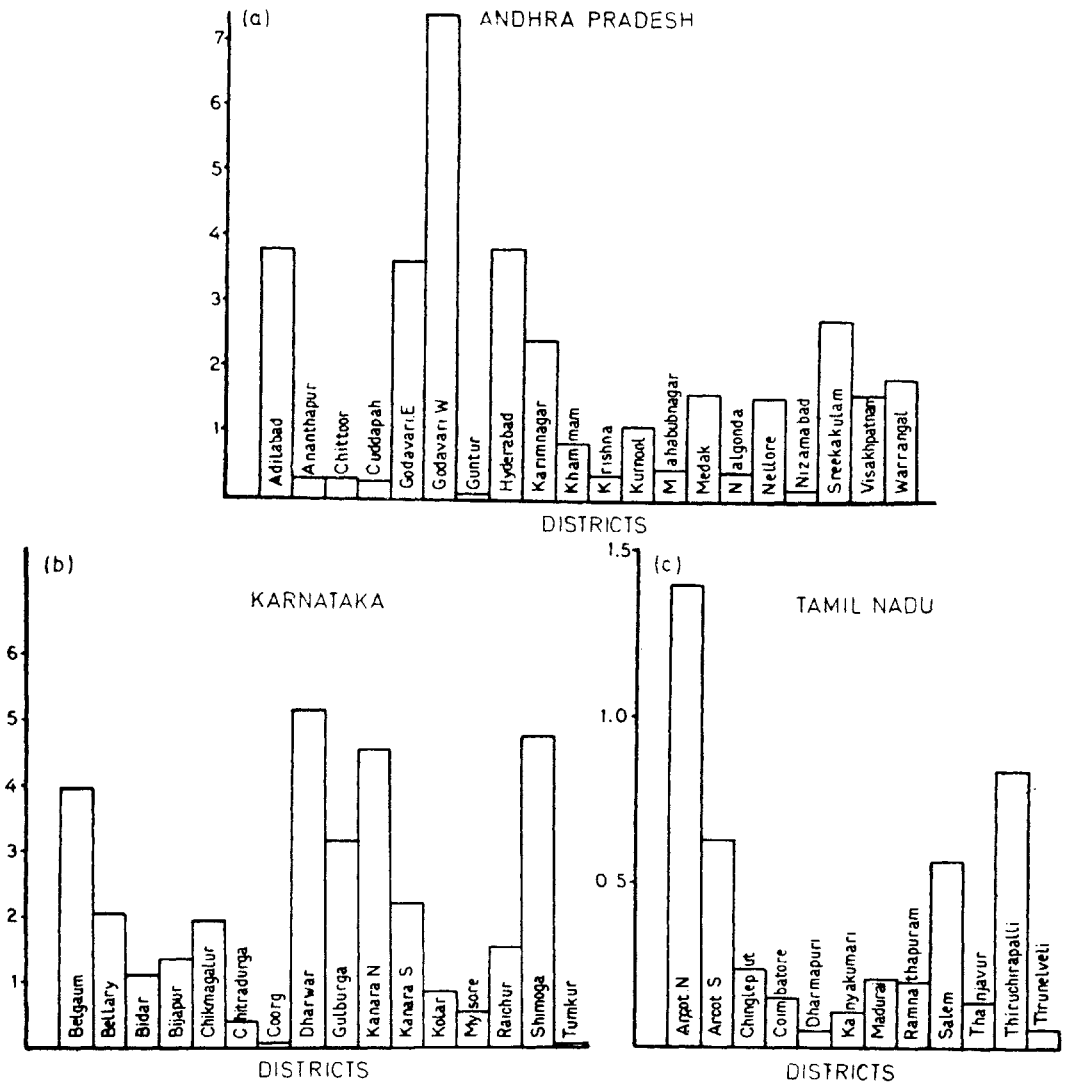


Figure 2 a-c Relative size of population of Hanuman Langur in various districts of a, Andhra Pradesh; b, Karnataka, and c, Tamil Nadu

were met with in this category, which is 15% of the fully-counted troops.

Troop types

Majority of 62 troops (72.58%) were of the unimale bisexual type. All-male troops were found only to the extent of 4.83%, and the number of individuals in all three cases was four (table 5).

Troop structure

A summary of troop composition of 57 troops (excluding one with less than five members) with regard to age and sex structure is given in table 6. There are about six females to one male. Of the females, 28% give birth during a given birth season. The birth season varies regionally in the Hanuman

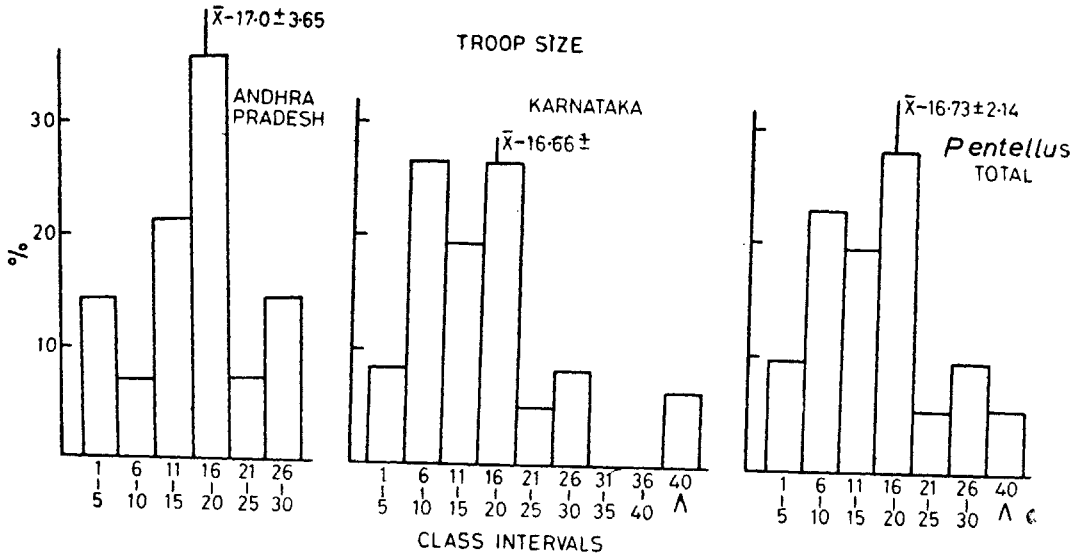


Figure 3 Relative percentage frequency of troop size of Hanuman langur in Andhra Pradesh and Karnataka state and totally for the species

Table 5 Representation of troop types in Hanuman langur

State	Multimale bisexual no.	%	All-male	%	Unimale bisexual no.	%	Total no.
Andhra Pradesh	2	15.38	1	7.70	10	76.92	13
Karnataka	12	24.48	2	4.08	35	71.44	49
For Total	14	22.58	3	4.83	45	72.59	62

Table 6 Summary of troop composition of Hanuman langur

State	No. of troops	M	F	Sa	J	I	Total
Andhra Pradesh	12	19	101	22	17	45	204
Mean		1.58	8.42	1.83	1.42	3.75	17
Percentage		9.31	49.51	10.78	8.34	22.06	100
Karnataka	45	66	405	73	106	100	750
Mean		1.46	9.00	1.62	2.35	2.23	16.66
Percentage		8.80	54.00	9.73	14.13	13.33	100
For total	57	85	506	95	123	145	954
Mean		1.51	8.87	1.66	2.15	1.54	16.73
Percentage		8.90	53.03	9.95	12.90	15.20	±8.30
SE		0.92	1.61	0.96	1.08	1.16	

M, Adult Male; F, Adult Female; Sa, Subadult; J, Juvenile; I, Infant

Table 7 Socioeconomic sex and age ratios of Hanuman langur troops (only of bisexual troops) (1:—)

State	M:F	Adult: young (A:Y) (M+F: Sa+J+I)	F:Sa+ J+I	F:J+I	F:I	F:Sa	F:J
Andhra Pradesh	5.32	0.70	0.83	0.61	0.44	0.21	0.16
Karnataka	6.13	0.51	0.59	0.41	0.24	0.18	0.26
Total	5.95	0.61	0.72	0.53	0.28	0.18	0.24

(1:—) = For 1 of first entity; : no. of second; ex, M:F 5.32 = 1M : 5.32F

langur. In Karnataka it is January–March (Sugiyama 1966) or December–April (Yoshiba 1967). The Karnataka surveys were conducted during November–December and, therefore, perhaps do not represent all births. However, the Andhra Pradesh Surveys were conducted during June–July–August and, therefore, should represent all births in the preceding birth season two or three months previously.

Figures for infants and F:I ratio are higher for Andhra which indicate 44% births. However, the sample is small.

Socioeconomic ratio of troops

All the sex ratios (table 7) point to the unhealthy status of the populations. The Adult:Young ratio particularly shows at a glance that this is a dwindling population of the inverted pyramid type (Kurup 1981).

Population ecology

Sub-habitats. Of the 102 troops for which sub-habitats could be recorded in Karnataka 71.15% occupied village and cultivated periphery (32% in village itself, 22.11% in the surrounding fields and 17% in gardens and groves). Only two troops were met with on major roadsides, three in fallow land or hills and two in temples.

In Andhra Pradesh, however, 32% of the troops were actually forest troops, which visit and stay around the village during particular crop seasons (table 8).

The only significant interstate difference is in the forest and hill category. Obviously in Karnataka the country populations are more adapted to a commensal life, whereas many of the populations that live around human habitation are primarily forest fringe populations, which go to the countryside only during favoured crop seasons. A rather low incidence of roadside populations is another noteworthy factor.

Proximity of water and habitations

The incidence of troops with regard to nearness to water sources and human habitation could be recorded for 105 and 106 troops respectively (table 9). Three-quarters of the population live within a km of some water source, while a quarter has water less than 200 meters away. Similarly, for proximity to human habitation, while two-thirds of the troops could be found to live within a km from the nearest village, only

Table 8 Sub-habitat distribution of Hanuman langur populations (Percentage)

State	Village and cultivated periphery	Forests, hills	Temples	Roadside
Andhra Pradesh	63.80	31.94	1.38	2.77
Karnataka	71.15	2.50	5.24	8.26
For species	85.06	10.34	4.60	7.66

Table 9 Proximity of Hanuman langur troops to water and human habitations (percentage)

State	N	Proximity			N	Habitation		
		Close	Near	Far		Close	Near	Far
Andhra Pradesh	14	100	—	—	14	46.66	46.66	6.68
Karnataka	91	15.38	83.53	1.09	106	13.18	82.41	4.4
For species		26.66	72.38	0.96		17.92	77.35	4.73
S E		±4.31	±4.36	±4.36		±3.72	±4.06	±2.06

N = Sample size

18% live very close to villages and about 5% away from villages.

Occupation trees

Tree species on which the troops were located were recorded for 141 troops (table 10). They were grouped into three groups, viz. *Tamarindus* spp., *Ficus* spp. and other species. The other species usually involved coconuts, arecanuts and other palms, bamboo, mango, neem, and a few unidentified species.

Interstate differences are not considered here in view of the small sample size ($N = 14$) from Andhra Pradesh. Mostly, *Tamarindus indicus* and *Ficus benghalensis* are the species involved in these groups, while numerous species make up other species. In this sense, *Tamarindus indicus* is the single species most frequently favoured, but then its relatively more frequent presence compared to that

of *Ficus* species is to be also considered. Tree usage also differ, depending on the fruiting season.

Troop dispersion diameter

Troops tended to disperse in a much wider area in Karnataka than in Andhra Pradesh (table 11). The maximum linear distance from the nearest to the farthest member was 50m.

Correlates of larger troop size

Troops of 25 and more members form only 9% of the troops recorded. While almost all of them had water sources close by, most

Table 10 Tree occupation preference of Hanuman langur (percentage)

State	<i>Tamarind</i> species	<i>Ficus</i> species	Other species
Andhra Pradesh	6.66	—	93.34
Karnataka	36.50	22.22	41.22
For species	33.33	19.85	46.82
SE	±3.96	±3.35	±4.20

ANDHRA PRADESH

KARNATAKA

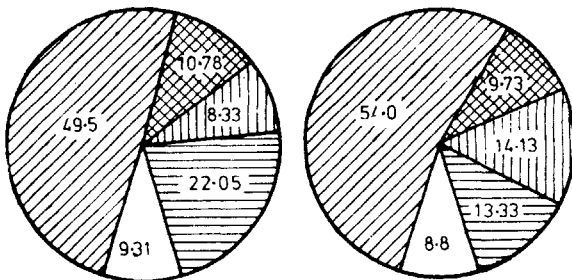


Figure 4 Troop composition of age/sex class (in percentage) of Hanuman langur in Andhra Pradesh and Karnataka state. Clockwise: female, subadult, juvenile, infant, male

Table 11 Troop dispersion diameter of Hanuman langur populations

State	Maximum m	Mean m
Andhra Pradesh	150.00	53.00
Karnataka	500.00	110.00
For species	500.00	102.00

of them were found near and around human habitation rather than living inside them or in close proximity. The preference for occupation trees is not significant. However, the mean troop dispersion diameter of 207 for the larger troops appears significantly higher than the species mean of 102m.

Distribution

Hanuman langurs are distributed throughout the region covered under the present census (see Map). They are found in practically every district in Andhra Pradesh, Karnataka and Tamil Nadu. In Kerala, however, they are absent from the western coastal districts, and country populations, including forest fringe populations, could be located only in the three districts of Palaghat, Malappuram and Cannanore. However, forest populations could be present, in addition, in the eastern portions of Trivandrum, Quilon, Idukki and Wayanad districts along the border with Tamil Nadu. But by and large, and especially compared to the bonnets (*Macaca radiata*), the langur is more of a forest species in Kerala and Tamil Nadu where it is very rare to meet them in the countryside, unlike in Karnataka and Andhra Pradesh. In the two latter states, also they are nowhere as common as the bonnets. In fact, in Karnataka actual rural or urban troops could be met with only in North Kanara, Dharwar and Bellary and districts to the north. South of this line of districts,

langurs could be found only in forested hilly tracts away from human habitations. In Andhra Pradesh, the countryside populations are met still north, from West Godavari district and northeast along the E Godavari, Vishakapatnam and Srikakulam districts. In other areas they are more in the nature of forest populations, occasionally or seasonally visiting the countryside and, therefore, hard to come by.

Discussion

The mean troop size of 16.73 ± 8.30 obtained in the present surveys may be compared with 15 for 38 troops (range 9–24) recorded by Yoshida (1967) in Dharwar (table 13). Excepting Dharwar, other localities are in North India and of another subspecies, the nominate *P. entellus*. There is also the fact that they are mostly forest populations of very sharply circumscribed ecological study sites. If all records are considered, troop size ranges from 8 to more than 125 individuals (Vogel 1977).

As regards the frequency or percentage of different types of troops, available records involving more than 10 troops are given in table 14 for comparison. The percentages of unimale bisexual troops are nearly similar for the present surveys and those from Dharwar, the only other south Indian locality.

Similarly, comparative figures for sex and natality ratios recorded previously for

Table 12 Correlates of langur troop size of more than 25 members

State	N Troops	No. of 25+ troops	Water			Habitation			Trees			Troop diameter (m)
			Close	Near	Far	Close	Near	Far	<i>Tamarind</i>	<i>Ficus</i>	Others	
Andhra Pradesh	14	3	3	—	—	1	2	—	—	—	3	120
Karnataka	120	9	8	—	—	—	6	3	7	4	1	250

¹roop diameter: distance from nearest to farthest member of the troop

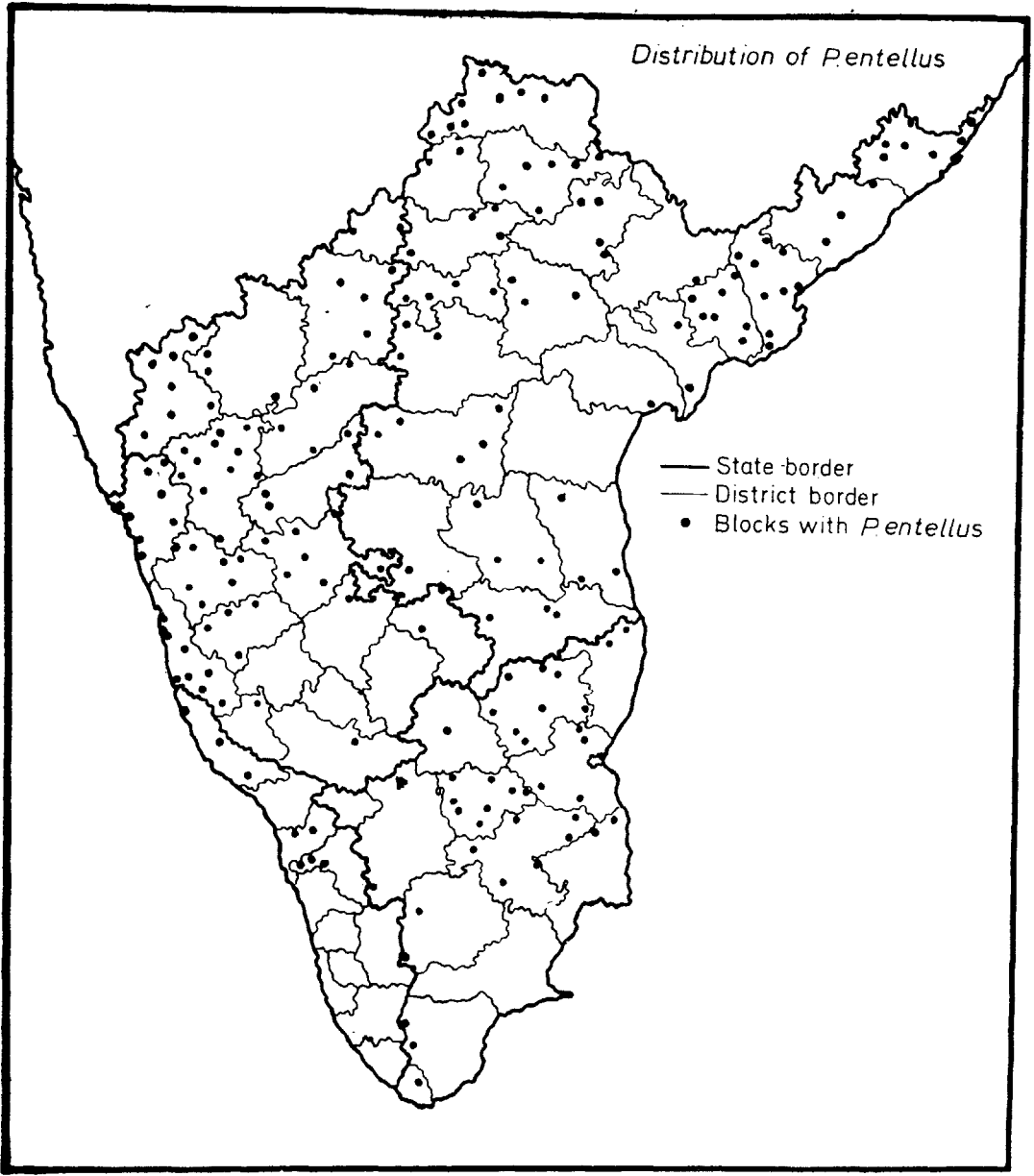


Figure 5 Distribution of Hanuman langur in southern India. Spots represent blocks in the districts with langurs

Table 13 Recorded mean troop size of *Hanuman langur* (involving more than 10 troops) from various locations

Locality	Mean troop size	Range	N Troops	Source
Dharwar (Karnataka state)	15	9-24	38	Yoshiba (1967)
Gir Forest	30	—	11	Rahaman (1973)
Raipur	29	12-61	16	Sugiyama (1976)
Jodhpur (Rajasthan)	18	8-82	22	Mohnot (1971)

Table 14 Recorded frequency of different troop types in *Hanuman langur*

	Multimale bisexual %	Unimale bisexual %	All-Male %	N troops	Source
Andhra Pradesh	15.38	76.92	7.70	13	Present surveys
Karnataka	24.48	71.44	4.08	49	-do-
Mean for above (Present surveys)	22.58	72.59	4.83		
Simla (Himachal Pradesh)	?	42.00	?	12	Sugiyama (1976)
Dharwar	?	74.00	?	38	Yoshiba (1967)
Raipur	?	56.00	?	16	Sugiyama (1976)
Jodhpur	?	100.00	?	22	Mohnot (1971)

above areas are given in table 15. The mean natality value of 58 analysed troops is given as 0.4 (or 40%) by Vogel (1977). However, natality figure obtained for Karnataka in the present surveys represents a low figure as the surveys were conducted

Table 15 Sex and natality ratios of *Hanuman langur* troops (only of bisexual troops) recorded

Locality	M:F (1:-)	F:I (1:-)	N
Andhra Pradesh	5.32	0.44	13
Karnataka	6.13	0.24	49
Mean (Overall)	5.95	0.28	11
Gir Forest (Gujarat state) (Rahaman 1973)	6.25	0.29	11
Raipur, (Madhya Pradesh) (Sugiyama 1976)	5.70	0.39	16

just before the birth season. On the contrary, the surveys in Andhra Pradesh were conducted just after the birth season and although this ample is small, natality obtained there fairly corresponds to the figure cited by Vogel (op. cit.).

The natality rate of 44% obtained here also tallies well with the view of Ripley (personal communication, quoted by Roonwal & Mohnot 1977) that half the females of a well established group have infants each year. The birth interval for a female is stated to be about 20-24 months (Jay 1965) which also agrees with the above view. The weaning or lactation period of about 10-15 months (Trivers 1974) is a major contributory factor here.

Demographic parameters recorded in the present surveys indicate a low reproductive profile for the langur. Female langurs

apparently reproduce only biannually and not annually and the majority of groups are of the unimale type which means that only a solitary adult male is available for impregnation. The ratio of F:J reflects potential recruitment to the population if mortality factors do not operate. F:Sa ratio on the other hand shows the actual rate of recruitment to the breeding population after accounting for whatever mortality factors that have operated so far. Both these ratios are depressed, suggestive of very low replenishment and heavy post-infantile mortality. The compositions of bisexual troops over a period of time recorded by Mohnot (1971) and Hrdy (1974) show drastic changes and depletion particularly affecting the young and immature section of the population. According to Hrdy (1977), about half the langurs born at Mt. Abu during the study period of five years died during infancy. In one troop there was 83% infant mortality. In fact, two of Abu troops showed 33 and

10.5% reduction in troop size over a four-year period. The wellknown feature of infanticide is a relevant factor as also influences of feeding and social changes brought about by the replacement of the leader male, all of which make the reproductive process in the Hanuman langur relatively complex and variable. Vogel (1977) remarks that the most unbalanced socio-economic sex ratios are found wherever a unimale bisexual organization of troops is prevailing.

So, unlike the other two species also covered in the census programme (Kurup 1981, 1983), the Hanuman langur populations in the countryside appears to be declining. This is clearly illustrated by the F:Sa ratio of 0.18 which means an average troop with 6 adult females might produce to ultimately add only one breeding individual to the troop and this rate is obviously less than the likely rate of adult mortality. Populations can therefore only decline.

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