Group Composition and Population Density of Rhesus Monkey (*Macaca mulatta* (ZIMMERMANN)) in Northern India

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ABSTRACT. A field survey of road-side rhesus monkey of northern India was conducted during 1964–65 for the study of group composition and population density. In 1651 km distance covered during this survey, total of 83 groups of rhesus monkey were counted. Adult females were predominant over other members in the group and were twice the number of adult males in a group. Infants were more than double the numbers of juveniles and juveniles formed the smallest percentage in any group and showed a tendency of decline in their population. Percentages of group size varied from 2.50 to 28.09. Sex-ratios, proportions of infants and juveniles to adults, proportions of juveniles to infants and the population density in different zones and sectors have been discussed.

The rhesus monkey which was found in abundance some time past in certain parts of this country now shows a tendency of decline in its populations as indicated in the recent surveys of SOUTHWICK et al. (1961 a, b, 1966). Due to their availability, toughness, cheapness and easy handling in captivity these monkeys are used extensively in different experimental investigations.

To study abundance and behaviour a survey of these monkeys was conducted along the roads during 1964 and 1965 in certain parts of Uttar Pradesh, Punjab and Delhi. This paper deals with the group sizes, composition and abundance of the road side groups of these monkeys.

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SURVEY AREAS

The survey of the monkeys was restricted to road side of northern India and covered mainly parts of Uttar Pradesh, Punjab and Delhi. The survey was conducted from a slow moving automobile driven mainly along the main roads, and all the places on either sides of the roads; viz., villages, open and cultivated fields, shrubs, trees, temples, mango groves, canal banks, cities, etc. were thoroughly searched for the presence of rhesus monkeys. The survey was conducted mainly in the fore and afternoon with occasional breaks at about mid day on certain days. The methods of observation adopted were the same as given by SOUTHWICK and SIDDIQI (1966). The whole area covered by this survey was divided into different zones and again each zone was divided into different sectors to find out the group composition and popu-

Table 1. Zones and sectors covered during the survey.

Zone		Sectors	
A:	Part of U. P. and Delhi to Kanpur via Aligarh.	1. 2. 3. 4. 5.	Lucknow to Sitapur. Sitapur to Shahjahanpur. Shahjahanpur to Bareilly. Bareilly to Agra. Delhi to Kanpur.
B:	Agra to Delhi and the Delhi area.	1. 2.	Agra to Delhi. Delhi proper.
C:	Delhi to Delhi via Rewari, Patudi and Gurgaon and via Panipat and Rhotak.	1. 2.	Rewari, Patudi, and Gurgaon. Panipat and Rhotak.

lation density. The zones and sectors thus divided were mainly based on the distance between the two important cities. The different zones and sectors covered during this survey are included in the Table 1 and also indicated in the map.

Statistical tests of significance were employed to study the difference between two population groups. The mean difference was studied for significance by using FISHER's t test. In case of variance-ratios (F) showing significant difference a more exact test due to FISHER-BEHREN's was employed to examine the observed differences for significance.

The occupied zone of a group was supposed to be a circle as given by SUGIYAMA, 1964 and the population density was calculated accordingly.

GROUP SIZE AND ITS COMPOSITION

In a total distance of about 1651 km covered during the tour, 83 groups were counted. The data collected on the number of groups, the group size and composition during the survey are presented in Table 2. The group composition is further elaborated in Figure 1. This Table also shows their distribution pattern in different zones
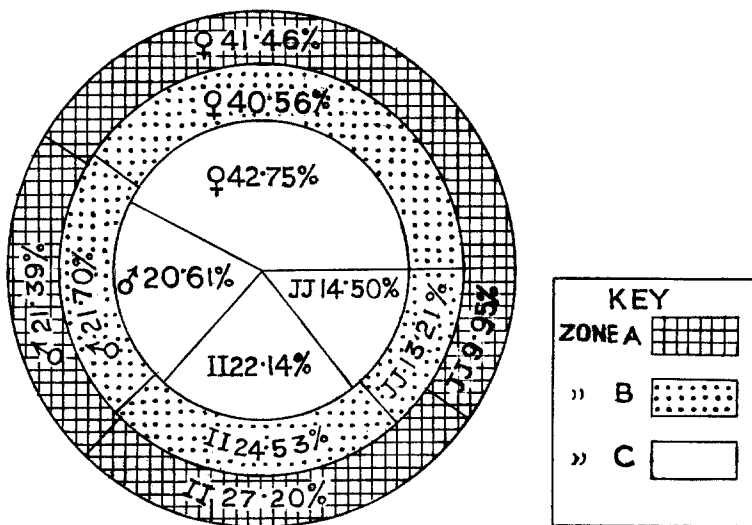

Fig. 1. Pie-chart showing the group composition of zones.

Table 2. Distances, number of groups, and composition of rhesus monkeys living on each sector of each zone.

Zone	Sector	Distance (km)	No. of groups	Adult ♂	♀	Juvenile	Infant	Total
A	1	93.34	9	13	19	2	7	41
	2	83.68	12	21	57	6	34	118
	3	83.68	4	6	13	0	10	29
	4	254.27	21	43	86	41	66	236
	5	465.10	19	46	75	11	47	179
B	1	209.21	6	19	32	13	21	85
	2	25.75	2	4	11	1	5	21
C	1	193.11	4	15	35	14	17	81
	2	243.00	6	12	21	5	12	50
Total		1651.14	83	179	349	93	219	840

and sectors. It is apparent from this Table that the maximum concentration of these monkeys are in zone A and in the sectors 2, 4, and 5 of this zone. The distance covered in these sectors showed great variations and in the sector 2 though the distance covered was much less than the other two, the concentration of monkeys was comparatively much in this sector. Similarly a comparison of the sectors 4 and 5 indicates that though the distance covered in the latter sector was much more than the former but the concentration of the groups in the sector 4 was more than the sector 5. This Table also indicates that the population of juveniles was much less in comparison with the other members. The distribution pattern of groups and members in different fields and sectors are also indicated in the graph.
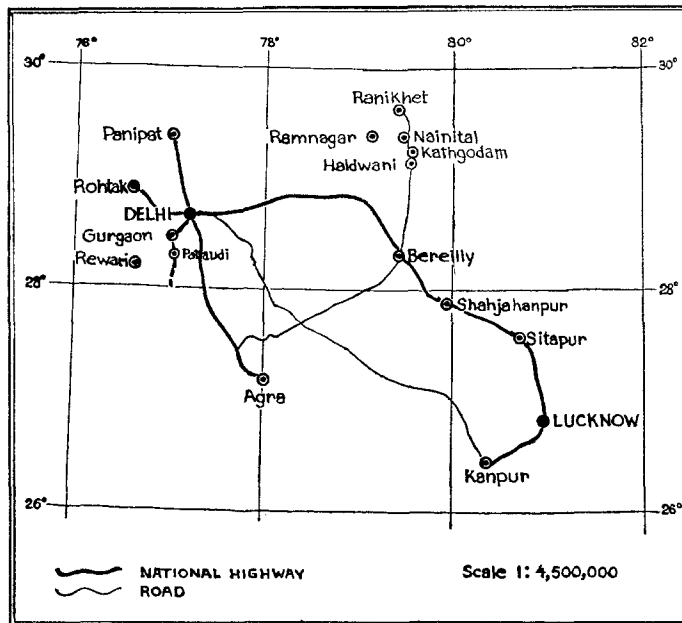
Fig. 2. Map showing the places covered during the survey.

PERCENTAGE VARIATIONS

Further analysis of the data regarding the percentage distributions of different members in each group is given in Table 3. It is evident from this Table that the adult females predominate over other members. The adult females were twice the number of adult males and the infants were also more than double the juveniles' population. The juveniles were minimum in number in any group. The infants population were slightly more than the adult males. The percentages of group size varied from 3.45 to 28.09 in the zone A, 2.50 to 10.12 in the zone B and 5.96 to 9.64 in the zone C. It is apparent from these two Tables that there is a big gap in the population of juveniles in comparison with that of the other members of the population. In the decline of the population, juveniles were affected to maximum.

Table 3. Percentage variations of different sectors and zones and member types of rhesus monkeys (percentage is based on Table 2).

Zone	Sector	Adult ♂	♀	Juvenile	Infant	Total number
A	1	1.55 (%)	2.26 (%)	0.24 (%)	0.83 (%)	4.88 (%)
	2	2.50	6.79	0.71	4.05	14.05
	3	0.71	1.55	0.00	1.19	3.45
	4	5.12	10.23	4.88	7.86	28.09
	5	5.48	8.93	1.31	5.59	21.31
B	1	2.26	3.81	1.55	2.50	10.21
	2	0.48	1.30	0.12	0.60	2.50
C	1	1.78	4.17	1.67	2.02	9.64
	2	1.43	2.50	0.60	1.43	5.96
Total		21.31	41.54	11.08	26.07	100.00

RATIOS

From the foregoing paragraphs it is clear that the female population was double that of male and the juveniles showed tendency to decline in its populations. The point has been further elaborated in Table 4 in form of sex-ratio and proportions of infants and juveniles to adults and juveniles to infants. The sex-ratio varied from 1.46 to 2.75

Table 4. Sex-ratio and proportions of infants and juveniles to adults and juveniles to infants.

Zone	Sector	$\frac{♀}{♂}$	$\frac{I*}{A**}$	$\frac{J***}{A}$	$\frac{J}{I}$
A	1	1.46	0.22	0.063	0.29
	2	2.71	0.44	0.077	0.18
	3	2.17	0.53	0.000	0.00
	4	2.00	0.51	0.318	0.62
	5	1.63	0.39	0.091	0.23
B	1	1.68	0.41	0.255	0.62
	2	2.75	0.33	0.067	0.20
C	1	2.33	0.34	0.280	0.82
	2	1.75	0.40	0.152	0.42
Mean		2.05	0.40	0.145	0.38
± S. E.		± 0.16	± 0.03	± 0.038	± 0.09

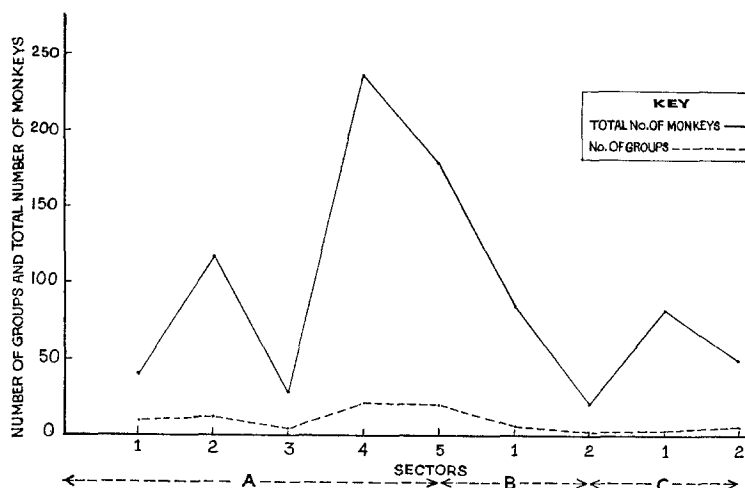*I: Infant.   **A: Adult.   ***J: Juvenile.

Fig. 3. Distribution of groups and total number of monkeys in different sectors within zones.

in different sectors with a mean of 2.05 $\pm$ 0.16. The ratio of infants to adults varied from 0.22 to 0.53 with a mean of 0.40 $\pm$ 0.03 and the proportion of the juveniles to adults was found upto 0.318 with a mean of 0.145 $\pm$ 0.038. Similarly the proportion of juveniles per infant was found upto 0.82 with a mean of 0.38 $\pm$ 0.09. The difference between infant and juvenile ratios to adult is statistically significant (at 0.1 % level of probability). The result is corroborated by the magnitude of the ratios of juvenile to infant.

POPULATION DENSITY

It is apparent from Table 5 that the population density of these monkeys was maximum in the zone A with the minimum occupied distance per group. The population density in the zone C was minimum with maximum occupied distance per group. The distance covered in the zone A was maximum and more than double the distance covered than in zone C whereas the population density is about 6 times as high as that of zone C. A comparison of zone C with B indicates that in this case though the distance covered in the former zone was about twice than that of latter, the population density was less than half. So a comparison of the data indicates that

Table 5. Population density of rhesus monkeys in northern India.

Zone	Distance (km)	No. of groups	Total No. of monkeys	No. of monkeys per group[1]	Occupied distance per group (m)[2]	Occupied area per group[3] (Ha)	Group density[4] (km²)	Population density heads[5] (km²)
A	980.07	65	603	9.28	15078	17862.58	0.00560	0.0520
B	234.96	8	106	13.25	29370	67774.24	0.00148	0.0196
C	436.11	10	131	13.10	43611	149433.80	0.00067	0.0088

1) $\dfrac{\text{Total No. of monkeys}}{\text{No. of groups}}$ 2) $\dfrac{\text{Distance}}{\text{No. of groups}}$ 3) $\left(\dfrac{\text{Occupied distance per group}}{2}\right)^2$

4) $\dfrac{100}{\text{Occupied area per group}}$ 5) No. of monkeys per group $\times$ Group density

Table 6. Population density of Zone A.

Sector	Distance (km)	No. of groups	Total No. of monkeys	No. of monkeys per group	Occupied distance per group (m)	Occupied area per group (Ha)	Group density (km²)	Population density heads (km²)
1	93.34	9	41	4.56	1037111	8451.00	0.011833	0.0540
2	83.68	12	118	9.83	697333	3820.66	0.026173	0.2573
3	83.68	4	29	7.25	2092000	34385.88	0.002908	0.0211
4	254.27	21	236	11.24	1210810	11518.84	0.008681	0.0976
5	465.10	19	179	9.42	2447895	47080.67	0.002124	0.0200

the first two zones have been well utilized by these monkeys whereas there is still space left to accommodate more groups in the last zone.

Table 5 showed that the population density was maximum in the zone A and as the distance covered in this zone was also more than the other two zones so a further analysis of the different sectors of this zone was made and the result presented in Table 6. This Table indicates that the maximum population density was in the sector 2, though the distance covered in this sector was minimum and the same as in sector 3. Sector 5 showed the lowest in population density in comparison to other sectors whereas the distance covered was maximum. This indicates that there is still space left for these monkeys in this sector. These two Tables clearly show that the availability of space may not play any role in the population density in these monkeys but it indicates that the difference in population density in different sectors may be caused by ecological conditions and the protection provided by the people.

It is also clear from this study that the main factor of decline in the population of these monkeys is the marked shortage of juveniles. Deforestation for cultivation, changes in the attitudes of the people towards these monkeys and the export in large number in the past have caused further decline in their population.

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