

## PRIMATE COMMENSALISM : THE RHESUS MONKEY IN INDIA

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## ABSTRACT

Population surveys of rhesus monkeys in north central India showed 88 % of the total population sampled in commensal or semi-commensal habitats in 1959-60, and 86 % in 1990-91. In the latter surveys, there was a significant shift from semi-commensal into commensal, and a minor increase in forest-dwelling, non-commensal populations. Over the 30-year span, group sizes increased in five habitat categories, whereas they declined in village and urban habitats despite a general increase in these populations. Rhesus populations in India are increasing again after substantial decline, and are adapting to human population pressure by increased commensalism.

Key words : Commensalism, India, rhesus *Macaca mulatta*, population.

## INTRODUCTION

The rhesus monkey (*Macaca mulatta*) in India is probably the world's best example of primate commensalism. The term « commensal » is defined by Webster's 20th Century Unabridged Dictionary as : « (1) one who eats at the same table, (2) and animal or plant living with another for support, or sometimes for mutual advantage, but not as a parasite ».

Richard, Goldstein, and Dewar (1989) have referred to the rhesus as a « weed » macaque, one that has evolved in close association with people, and one that thrives in disturbed environments. Many studies in India, Pakistan, Nepal, and throughout the range of the rhesus in Asia confirm this point of view. Rhesus occur most commonly in agricultural areas, around villages, in towns, cities, and temples, and along roadsides and canal banks (Mukherjee and Mukherjee, 1972 ; Roonwal and Mohnot, 1977 ; Shukla, Seth and Seth, 1984 ; Southwick, Beg and Siddiqi, 1965). In such habitats, rhesus generally rely on human sources of food, either agricultural crops or food handouts by local people. One study of rhesus food habits in the northern Indian plains indicated that a roadside group at Chatari

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received 83 % of its food by direct handouts from people, 10 % from nearby agricultural crops, and only 7 % from natural vegetation (Siddiqi and Southwick, 1988). In the same study, a canal bank group only 15 km distant occupying an adjacent forest patch received 29 % of its food from people, 17.5 % from crops, and 53 % from natural vegetation.

This emphasis on the close association of rhesus macaques with people must not obscure the fact that rhesus also live in forest areas away from people, and subsist entirely on natural vegetation. Lindburg (1976) found that rhesus in forests around Dehra Dun consumed more than 100 species of native vegetation which constituted virtually all of their diet. Our own forest studies in Corbett National Park showed that rhesus there were very shy of people, and were never seen to take crops or food from people (Southwick, Beg and Siddiqi, 1961a, 1965).

In many forest areas, however, rhesus show a tendency to behave as an « edge » species, coming often to forest openings near villages, roads, and croplands (Edwin and Chopra, 1984 ; Teas *et al.*, 1980). Some of the rhesus groups in the Asarori Forest near Dehra Dun studied by Lindburg, Pirta, and Makwana spent the majority (58 %) of their night time lodgings during one two-week period along two roadsides passing through the forest (Makwana, 1978).

This study compares population surveys over a 30-year interval from 1959-60 to 1990-91 to evaluate relative percentages of rhesus in commensal, semi-commensal and non-commensal habitats.

## METHODS

Commensal habitats in this study are considered to be villages, towns, cities, temples, and railway stations where monkeys are in close and frequent contact with people throughout the day.

Semi-commensal habitats are roadsides, parklands (not National Parks or extensive forest parks), and canal banks where monkeys and people are in some human contact, but not as consistently or frequently as in the full commensal habitats mentioned above. In our original studies in 1959-60, we classified all of these as commensal, but we think it is preferable to make some distinction. In semi-commensal habitats, monkeys can get away from people in parts of their home range, and this is usually not possible in village, town or temple settings. Still the separation of commensal and semi-commensal relations is hazy and involves some subjective interpretation. Commensal monkeys rely more completely on humans for food than semi-commensal monkeys.

Non-commensal habitats are forest areas, where monkeys are usually shy of people and not reliant on them at all for food. This is not always a sharp distinction, since some forest groups live on the edge of forests and occasionally raid croplands and village gardens. Also some forest groups may come to forest roads where they can get food from people travelling the roads, so the distinction is not always 100 %.

In our study, groups were assigned to one of the three categories above on the basis of their primary home range affiliation. In both study periods, 1959-60 and 1990-91, systematic surveys were done in five habitat types spanning the three

major categories : villages, towns, roadside, canal banks, and forests. Survey methods have been described in previous publications (Southwick, Beg and Siddiqi, 1961, 1961a, 1965).

Temples and railway stations were sampled systematically in 1959-60, but only occasionally in 1990-91. Cities and parks were sampled opportunistically in both surveys. The forest surveys used similar procedures in 1959-60 and 1990-91, but were in different locations : Corbett National Park and Naini Tal in 1959-60, and Sariska and Keoladeo-Bharatpur in 1990.

We cannot say that our survey methods are precisely comparable between 1959-60 and 1990-91, nor do they assuredly provide completely accurate and unbiased views of habitat distribution in these two study periods. There are several reasons for this. In the first place, many environmental changes occurred in India over this 30-year interval. India's population expanded from 375 million to over 840 million, and cities and towns grew to even greater percentage gain. Many rural areas of 1960 became suburban or industrial sprawl by 1990.

Agriculture developed intensively and extensively, the Green Revolution had a major impact, and many forest areas were converted to farm lands. Other natural forests were replaced with eucalyptus, casuarina, sal, sheesham or teak in more homogeneous stands.

Also during this 30-year interval, our annual population studies showed that the rhesus population declined substantially, in the order of 90 %, but for approximately 10 years now, many populations have been growing. Trapping for export was banned in 1978, and other changes affecting the monkey-human relationship occurred as well. Some of these will be discussed later.

For many reasons, we had to modify survey procedures in 1990-91, but in both surveys we made every attempt to remain as objective and systematic as possible. We feel, therefore, that the results are comparable, though we cannot be dogmatic that they are precisely accurate representations of habitat distribution. The problem is one of balancing sampling time and effort in different habitats. Rhesus are more visible and easily found in agricultural areas and along roadsides than in forests or in cities. On the other hand, there is much more land area to cover in agricultural habitats than in forests, parks, or cities. Because structural complexity and observability varied greatly in these different habitats, it is not meaningful to assign square kilometer figures to all the diverse areas sampled. We tried to solve this dilemma by proportioning our field time in each habitat according to the relative areal extent of that habitat in the landscape of our study area in northern India. This meant that approximately 75 % of our field time was spent in agricultural areas, including villages, roadsides and canal banks ; approximately 20 % in forests and parks ; and approximately 5 % in towns and cities. We believe that this approach provides a reasonably accurate picture of rhesus distribution and commensalism.

## RESULTS

In our 1959-60 surveys, we classified all rhesus groups which had some daily contact with people as commensal. This included village, town, roadside, canal bank, temple, and railway station groups, and this included 97 % of all rhesus which we found. Only 349 (3.3 %) of our 1959-60 population sample of the 10,603

rhesus monkeys were located in forest habitats, but due to the extent of forests in northern India at that time, we estimated that forests contained 12 % of the total rhesus population. Thus, the estimated percentage of our survey population which occupied known commensal habitats was 88 %.

According to our new separation of commensal and semi-commensal habitats, we reclassify the 1959-60 survey as 31.3 % commensal, 56.7 % semi-commensal, and 12.0 % non-commensal (Table I). This reflects the majority of rhesus observed in roadside and canal bank habitats, now considered semi-commensal.

In 1990-91, our field surveys located only 3,059 monkeys. Of these, 1 484 were in commensal habitats (48.5 %); 1 135 in semi-commensal habitats (37.1 %), and 440 (14.4 %) in non-commensal habitats (Table I).

TABLE I

*Observed Habitat Distributions of Rhesus Populations in Northern India, 1959-60 and 1990-91. Percentages of total population observed in different habitats.*

HABITAT TYPE : Survey Years	COMMENSAL				SEMI-COMMENSAL			NON- COMMENSAL Forest
	Village	Town- City	Temple	Rly. Sta.	Road- side	Park	Canal Bank	
1959-60	8.2	8.2	5.9	9.0	58.7		6.6	3.3
59-60		31.3				65.3 56.7*		3.3 12.0*
1990-91	9.4	29.9	3.8	5.4	20.7	1.7	14.6	14.4
90-91		48.5				37.1		14.4

\* Semi-commensal and non-commensal percentages recalculated accord to criteria used in 1990-91.

Both the numbers of groups in different habitats and average group sizes showed interesting changes. Although there were significantly fewer monkeys in most habitats in 1990-91 than in 1959-60, there were relatively more groups in towns and cities — 36.2 % of all groups in the 90-91 sample compared to only 6.1 % of all groups in the 59-60 sample. Relatively more groups in our 90-91 survey sample were also found in villages and along canal banks, while relatively fewer in the sample were found along roadsides and in railway stations (Table II). Not all of these changes are understandable — they will be discussed later.

In terms of group sizes, five habitats showed increases in average group sizes (roadsides, canal banks, forests, railroad stations, and temples), while two habitats showed decreases in average group sizes (villages, towns and cities). The most dramatic increases in group sizes in samples with adequate sample sizes occurred

TABLE II

*Rhesus Groups Observed in each habitat in Northern India, 1959-60 and 1990-91. Percentages of Group Samples.*

HABITAT TYPE Survey Years	COMMENSAL				SEMI-COMMENSAL			NON- COMMENSAL Forest
	Village	Town- City	Temple	Rly. Sta.	Road- side	Park	Canal Bank	
1959-60	7.8	6.1	2.3	13.0	64.0		5.7	1.1
59-60		29.2				69.7		1.1
1990-91	20.7	36.2	1.7	4.3	20.7	1.8	12.9	1.7
90-91			62.9			35.4		1.7

in forest, roadside and canal bank habitats (Table III). In these three habitat categories, group sizes increased an average of 77 %. The spectacular increase of 189 % in the sizes of railway station groups was based on a small sample of only 6 groups in 1990-91, including one of 93 monkeys in the Ramganga South Station near Bareilly, northeast of Aligarh. This is atypical, and not representative of such groups.

Group sizes declined an average of 26 % in village and town-city groups (Table III). This suggests these groups are being harassed and broken up by people. The rhesus population is responding by producing more groups of smaller sizes.

TABLE III

*Group Sizes of Rhesus Monkeys in Different Habitats, Comparison of 1959-60 and 1990-91.*

HABITAT TYPE Survey Years	COMMENSAL				SEMI-COMMENSAL			NON- COMMENSAL Forest
	Village	Town- City	Temple	Rly. Sta.	Road- side	Park	Canal Bank	
1959-60	17.4	22.4	41.9	11.4	15.1		19.0	49.8
1990-91	11.3	18.5	43.5	33.0	26.4		31.3	94.5
Percent Change	- 35 %	- 17 %	+ 4 %	+ 189 %	+ 75 %		+ 65 %	+ 90 %

## DISCUSSION

The most striking finding of this study of rhesus commensalism is that approximately the same percentages of the population over a 30-year span are in the category of commensal or semi-commensal habitats, 88 % in 1959-60 and 86 % in 1990-91. This shows a relatively stable pattern of human/nonhuman primate association considering the remarkable changes in rhesus populations which have occurred in this 30 year period (Southwick and Siddiqi, 1989 ; Southwick and Lindburg, 1986).

Within this general pattern, however, the 1990-91 surveys show a greater shift from the semi-commensal to the commensal habitat. Complete commensalism increased from 31.3 % of the population in 59-60 to 48.5 % in 90-91, while semi-commensalism decreased from 56.7 % to 37.1 % (Table I). At the same time, the non-commensal population increased slightly from 12 to 14 %.

According to our samples, commensal monkeys now represent the largest percentage of rhesus in north central India, nearly one-half (48.5 %) of all rhesus observed (Fig. 1), and over one-half of all groups (62.9 %). This would certainly be different in the northwestern and northeastern corners of India, but we feel it is representative of the north central Gangetic plains and adjacent hills, the agricultural heartland of India.

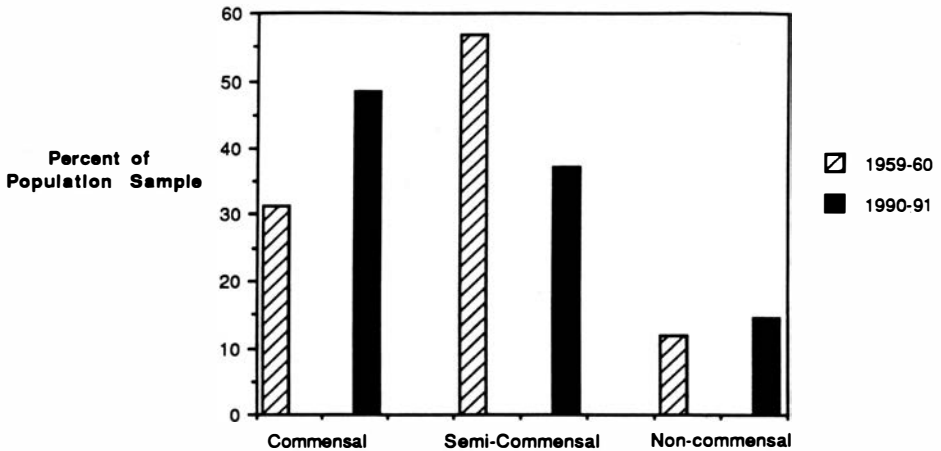


Figure 1. — Percentages of Commensalism, Semi-Commensalism and Non-Commensalism in rhesus of north central India, 1959-60 and 1990-91.

We believe this reflects at least four major factors influencing the rhesus population of India : (1) human population growth which has inevitably forced humans and rhesus into closer ecological associations, (2) other environmental changes, including the growth of towns and urban sprawl, (3) more protection from trapping due to the export ban on monkeys, and (4) general economic growth in India which has greatly increased agricultural production and allowed rhesus to exist in close commensalism.

These changes mean that more rhesus by necessity live in towns and cities because urban growth has spread outward into the countryside. The relative freedom from trapping for export (some rhesus are still trapped for biomedical research within India) has greatly benefited forest populations, and any group which has a relatively adequate habitat. Thus, group sizes in five out of seven habitat categories have increased. Group sizes decreased only in village, town and city habitats where monkeys are still harassed considerably because they are bothersome. Village, town and city monkeys are chased frequently by children, adults, and dogs, and groups are split up. Malik and Johnson (1991) have shown that trapping results in fissioning and new group formation. Possibly lesser forms of disturbance by humans such as stoning and chasing also result in group fissioning. Rhesus monkeys survive in urban environments by adaptation and thievery, but they are more or less always at odds with the local human population. In temples, rural settings, and forests, they are not subject to such frequent harassment by people ; hence, their groups can indeed be larger.

Another type of evidence that demonstrates the commensal habit of rhesus macaque is the outcome of a translocation study which we undertook in 1983. With the dual purpose of re-establishing rhesus in a forest patch along a canal bank where a group had been completely trapped and removed in the 1969's, and at the same time reducing the size and agricultural damage brought by an excessively large rhesus group living in a mango grove about 30 km away, in 1988 we trapped a subgroup of 20 monkeys from the large mango grove site and relocated them to the canal bank forest patch (Siddiqi and Southwick, 1993 ; also described briefly in Strum and Southwick, 1986). This group moved restlessly for several months, but finally settled permanently to establish a home range about 2 km away adjacent to a village at a point where a bridge crossed the canal.

The site the monkeys selected for their permanent location was busy with human traffic, and from our standpoint not as desirable a habitat as the more secluded forest patch that we had selected as the best habitat. The forest patch area even had abundant agricultural crops nearby, so plenty of food was available in both the forest and surrounding fields. We could only conclude that the monkeys preferred the more disturbed habitat near the village and the canal bridge where they were in frequent daily contact with people. One could say, of course, that the monkeys merely reverted to a habitat type more like the one they had come from, and had we transplanted forest monkeys, they would have been more likely to stay in the forest patch where we put them. This is possibly true, but such a conclusion would then demonstrate that commensalism is a self-perpetuating habit in rhesus macaques.

## SUMMARY AND CONCLUSIONS

Population surveys of rhesus monkeys in north central India over a 30-year interval have shown that 85 to 88 % of the population live in commensal or semi-commensal habitats. Commensal habitats include villages, towns, cities, temples, and railway stations. Semi-commensal habitats include roadsides, local parks, (excluding National Parks), and canal banks. Only 12 to 14 % of our population sample lived in non-commensal habitats ; i.e. forests. These percentages would differ in more forested regions of northwestern and northeastern India.

Changes in the 30-year period included a shift of more groups from semi-commensal to commensal, a slight increase in the percentage of forest groups, and increases in average group sizes in most habitat categories, especially in forests, roadsides, and canal banks. Group sizes decreased in villages, towns and cities, although the relative populations in these commensal habitats increased greatly.

These changes occurred along with substantial declines in the overall rhesus population between 1959 and 1979, with partial, but incomplete, recovery throughout the 1980's and early 1990's. India's rhesus populations are now benefiting from freedom of trapping for export, and from India's general economic improvement. They are, however, being forced to live commensally with increasing human populations and major environmental changes which force more human contact.

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### RÉSUMÉ

Deux recensements effectués en 1959-1960 et en 1990-1991 ont permis d'analyser la structure des populations de singes rhésus (*Macaca mulatta*) dans la partie centrale de l'Inde du Nord. La proportion de la population totale des rhésus vivant en situation commensale ou semi-commensale est passée de 88 % à 86 % entre les deux recensements. Le dernier recensement montre un passage significatif du semi-commensalisme au commensalisme, ainsi qu'un accroissement des populations non commensales vivant en forêt. Sur les 30 années, la taille des groupes s'est accrue dans 5 types d'habitat, déclinant dans les habitats urbains et villageois alors même que cette partie de la population est en croissance. Après un recul significatif, les populations de rhésus augmentent à nouveau en Inde et s'adaptent à la pression de la population humaine par un commensalisme accru.

Mots-clés : Commensalisme, Inde, rhésus *Macaca mulatta*, population.

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