



Agonistic Interactions between Humans and Two Species of Monkeys (Rhesus Monkey *Macaca mulatta* and Hanuman Langur *Semnopithecus entellus*) in Shimla, Himachal Pradesh

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ABSTRACT The resolution of growing conflict between monkey and man requires quantitative data on the nature and context of man-monkey agonistic (aggressive-submissive) interactions particularly in the urban areas. The ethological approach was followed to study the effect of habitat, species, and season on agonistic interactions between humans and monkeys in the city of Shimla. Three way ANOVA revealed that the rhesus monkeys in the temple area interacted more agonistically with humans than the rhesus monkeys in the bazaar area, and from the Hanuman langurs in both the study areas. The habitat and season did not have significant effect on these interactions. Agonistic interactions between the monkeys and humans occurred mainly in context of space; food as a context for conflict had significance only in case of rhesus monkeys, but not for the Hanuman langurs. The intensity of agonistic interactions, in general, was low for both the species. The findings suggest that it is not the severity of attack by the rhesus monkeys, which is generally highlighted, but the overall dependence of this macaque on human resources is a matter of concern. Therefore, the strategies of conservation must be directed to minimize this dependence.

INTRODUCTION

The two kinds of monkeys, rhesus macaques (*Macaca mulatta*) and Hanuman langurs (*Semnopithecus entellus*), share food and space with humans in the rural and urban areas and are often reported in conflict with the humans (Jolly 1985; Singh 2000; Pirta 2002). The State of Himachal Pradesh, particularly Shimla, is inhabited by considerable populations of these two species of non-human primates (Ross et al. 1993; Pirta et al. 1997). The Forest Department of Himachal Pradesh has currently reported an alarming increase in the number of these two species of monkeys (Gulati 2004) which has probably led to increased competition for food and space among humans and monkeys. The monkeys have been reported snatching and stealing food articles, mutilating and tearing clothes, damaging human property and household articles, and harassing people on the roads (Gulati and Sood 2003). The cumulative increase in man-monkey conflict, and apathetic attitude of the concerned departments to solve this issue, are perhaps responsible for ensuing public protest to eradicate the population of rhesus monkeys in Shimla, and also from the rural areas of Himachal Pradesh (Anon 2007; Bisht 2007). One way to resolve this issue is to understand the context of agonistic interactions between humans and monkeys.

Behavioral studies on these two non-human primates in Shimla indicate that the rhesus monkeys were more agonistic toward humans as compared to the Hanuman langurs (Camperio-Ciani 1986; Pirta 1990; Kumar 1992; Sahoo 1993). The major contexts of agonistic behavior were human resources, particularly food and space. An important field study from Nepal had earlier reported that feeding from human resources enhanced agonistic interactions in the temple area at Kathmandu (Teas 1978). A viable strategy for the resolution of man-monkey conflict therefore could be to reduce the frequency of agonistic interactions between these two non-human primate species and human beings. This approach would require, first of all an objective evaluation of the intensity and context of these agonistic interactions. The two important contextual factors are habitat and season of the year. Secondly, it is also important to quantify the frequency of agonistic interactions on the dimension of intensity.

METHODOLOGY

Sample

Natural groups of rhesus monkeys (*Macaca mulatta*) and Hanuman langurs (*Semnopithecus entellus*) living in the city of Shimla (see Ross et al. 1993) were selected to study agonistic inter-

actions with the humans in two habitats, temple and bazaar. Four temple groups of monkeys, 2 rhesus (Jakhu Temple Monkey JTM, Jakhu Oakwood Monkey JOM) and 2 langur (Jakhu IGMC Langur JIL, Jakhu Shivalik Langur JSL) lived in the Jakhu temple area and four groups of monkeys, 2 rhesus (Summer Hill Monkey SHM, Advanced Studies Monkey ASM) and 2 langur (Advanced Studies Langur ASL, Boileuganj Langur BGL) lived in the bazaar area (Summer Hill area). The data on group size and group composition of eight groups of monkeys are given in table 1. The factorial design was employed to see the effects of habitat, species and season on the agonistic interactions. There were 2 levels of habitat (temple and bazaar), 2 levels of species (rhesus and langur), and 4 levels of season (summer, fall, winter, spring) following Pirta (1990). There were two groups of monkeys in each cell and the last factor (season) had repeated measures as same groups were observed in all the four seasons.

Measures

Each agonistic interaction between a monkey group (rhesus monkey or Hanuman langur) and humans was recorded as an episode or encounter. It has three measures: the number of episodes; the intensity of episode, and, the context of episode.

An episode of agonistic interaction was defined as the display of aggressive behavior by an individual or individuals and an aggressive or submissive response by the victim (Thierry 1985; Pereira 1988). It ended when either of the participant(s) ceased to display agonistic behavior towards its opponent(s). An episode was recorded when an agonistic interaction between human and monkey was observed. In the preliminary observation sessions, the investigators found that human-monkey agonistic interactions ranged from five seconds to five minutes and

there occurred 0 to 15 agonistic interactions in an observation session of one hour, therefore the observation sheet consisted 15 horizontal lines to make tallies for episodes of agonistic interactions designated as E1, E2, and E3E15.

There were four columns for four levels of intensity of interactions depicted as L (low), S (slight), M (moderate), and H (high). Low intensity was recorded when monkey(s) glanced towards an approaching human(s) and immediately moved away (avoided) or stopped for a while to let the human(s) cross. Slight intensity was recorded when the monkey(s) threatened by opening mouth, roaring, screeching, snarling, stiffening of the posture or chased the human(s) without making physical contact. *Moderate intensity* was recorded when monkey or monkeys approached human(s) and snatched objects, grabbed their legs, pulled their clothes, mounted on their backs, mutilated their belongings accompanied by roars, snarls, and growls. *High intensity* was noted when the monkey(s) bit the human(s) which was accompanied by growls, snarls, screeches and roars.

In addition, context of agonistic interactions was also recorded for space (sp), shelter (sh), food (f), water (w), and social (so), and others (o) perspectives. *Space (sp)* was recorded when either the human(s) or monkey(s) wanted to cross the road or lane. *Shelter (sh)* was recorded when the monkey(s) were sitting on the roof or tree or any other place for resting or grooming and humans disturbed them. *Food (f)* was recorded when the monkey(s) threatened, chased, grabbed or snatched objects from the human(s). *Water (w)* was recorded when monkey(s) was drinking water and humans disturbed or chased it away. *Social (so)* was recorded when the human(s) threatened one or many member of the group of monkeys and others (o) was recorded when the context of agonistic interaction did not fall into any of the above mentioned categories.

Table 1: The size and composition of eight groups of monkeys.

Habitat	Species	Group	Male	Female	Juvenile	Infant	Total
Jakhu	Rhesus monkey	JTM	3	7	5	6	20
		JOM	4	7	5	5	21
	Hanuman langur	JSL	1	8	2	5	16
		JIL	2	7	4	4	17
Bazaar	Rhesus monkey	SHM	3	6	5	6	20
		ASM	3	6	3	6	18
	Hanuman langur	BGL	3	11	12	8	34
		ASL	3	11	8	7	29

Procedure

The agonistic interactions of rhesus monkey and Hanuman langur groups with humans were observed for a total of 320 hrs during one year. As there were eight groups of both the species, the observation sessions were balanced for both the species in the two habitats. In each season (Summer, Fall, Winter, Spring) these groups of either species were observed for 80 hrs, which were subdivided into 40 hrs (20 hrs for 2 groups of monkeys and 20 hrs for 2 groups of langurs) in each study area, that is, each group was studied for 10 hrs with equal morning and evening observation hours. The observations were made during the following period in each season: Spring: March 15 to June 14; Summer: June 15 to September 14; Fall: September 15 to December 14; Winter: December 15 to March 14.

For making observation, on a particular day, a group was searched either at Jakhu (temple) or at Summer Hill (bazaar). The observations were made in the open space where the interactions between the humans and monkeys were clearly visible. The observation began, when at least four members of group were visible. Agonistic interaction was recorded with context to space (sp), shelter (sh), food (f), water (w), and social (so), and others (o) perspectives according to their intensity.

Analysis

The first measure was the mean number of agonistic interactions (number of episodes) between humans and monkeys in an observation session (Altmann 1974; Teas 1978). There were 10 observation sessions in one season for each group of monkeys, therefore, the score was calculated by dividing the sum of agonistic interactions between human(s) and monkey(s) by 10. These data were analyzed by employing 2 (temple : bazaar) x 2 (rhesus : langur) x 4 (summer : fall : winter : spring) analysis of variance, ANOVA. The intensity (Thierry 1985) and context of agonistic interactions (Pereira 1988) were analyzed by calculating their percentage for eight groups of monkeys.

RESULTS

Number of Man-Monkey Agonistic Interactions

The results of ANOVA are given in table 2

and table 3. The main effects of habitat and season on the number of agonistic interactions between humans and monkeys were not significant. The main effect of species on agonistic interactions between human and monkeys was significant [(F (1,4) = 59.62), p<.01]. The mean score of rhesus monkeys (M=10.86±3.73) was greater than the mean score of Hanuman langurs (M=3.74±1.44). The interaction effect of habitat and species on the number of agonistic interactions between human and monkeys was also significant [(F (1,4) = 14.33), p<.05]. The interaction effects of habitat and season, species and season, and habitat, species and season were also not significant.

Table 2: Mean and S.D. of agonistic interactions between humans and monkeys.

Variable	Group	N	Mean	S.D.
Habitat	Temple	4	8.39	±5.49
	Bazaar	4	6.08	±2.66
Species	Rhesus monkey	4	10.86	±3.73
	Hanuman langur	4	3.74	±1.44
Season	Summer	8	7.5	±4.12
	Fall	8	7.36	±5.37
	Winter	8	6.26	±4.72
	Spring	8	8.33	±4.18

Table 3: Summary of 2x2x4 ANOVA with repeated measures on the last factor.

Sources of variance	SS	DF	M	SF
Between SS	546.98	7		
A (Habitat)	42.66	1	42.66	6.59
B (Species)	385.72	1	385.72	59.62**
A X B	92.71	1	92.71	14.33*
Ss. W. Gr. (Error I)	25.89	4	6.47	
Within SS	53.21	24		
C (Season)	10.92	3	3.64	1.29
A X C	2.91	3	0.97	<1
B X C	3.9	3	1.3	<1
A X B X C	1.61	3	0.54	<1
C X Ss W.Gr.	33.87	12	2.82	
SS (Error II)				

*F_{.05} (1,4)= 7.71; **F_{.01} (1,4)= 21.20

Context of Agonistic Interactions

The percentages of agonistic interactions taking place in various contexts noted for both rhesus monkeys and Hanuman langurs are given in the table 4. Main context of agonistic interactions between humans and rhesus monkeys was space for all the four groups in both the habitats, fol-

Table 4: Context of agonistic interactions between humans and two species of monkeys (total encounters with percentages in parenthesis).

<i>Species</i>	<i>Space</i>	<i>Shelter</i>	<i>Food</i>	<i>Water</i>	<i>Social</i>	<i>Others</i>
Rhesus monkey	1401(81.79)	62 (3.62)	231 (13.49)	2 (0.12)	6 (0.35)	11(0.64)
Hanuman langur	475(79.03)	106 (17.64)	10 (1.66)	0 (0)	9 (1.49)	1(0.17)

lowed by food (which was more in temple than bazaar area) and shelter. In case of Hanuman langurs, maximum agonistic episodes took place for space, followed by shelter for all the groups in both the habitats.

Intensity of Agonistic Interactions

The percentages of agonistic interactions according to their intensity noted for both rhesus monkeys and Hanuman langurs are given in table 5. High intensity agonistic interactions were not observed for rhesus as well as langur groups. The agonistic interactions between humans and rhesus monkeys were mostly of low intensity (more in bazaar than temple area), followed by slight intensity (more in temple than bazaar area) and moderate intensity (more in temple than bazaar area) whereas Hanuman langurs interacted only with low and slight intensities, moderate intensity interactions were rare.

Table 5: Intensity of agonistic interactions between humans and two species of monkeys (total encounters with percentages in parenthesis).

<i>Species</i>	<i>Low intensity</i>	<i>Slight intensity</i>	<i>Moderate intensity</i>	<i>High intensity</i>
Rhesus monkey	1000 (58.38)	588 (34.33)	125 (7.29)	0 (0)
Hanuman langur	393 (65.39)	207 (34.44)	1 (0.17)	0 (0)

DISCUSSION

The main finding of the study is that the rhesus monkeys interacted more agonistically with humans than the Hanuman langurs in the temple as well as bazaar area. Rhesus monkeys are known for their aggressive behavior (Singh 1969; Teas 1978; Thierry 1985; Pereira 1988) which is related to their feeding strategy and fight interference behavior (Thierry 1985). Various studies conducted in Himachal Pradesh have reported that the rhesus monkeys resorted to increased feeding from human resources while Hanuman langur fed more on the natural vegetation (Kumar

1988, 1992; Pirta 1993; Ross et al.1993; Sahoo 1989, 1993; Pirta et al. 1997). In their preference for niche the rhesus monkeys are terrestrial, and get habituated to humans (Pirta 1992), thus their frequency of interaction with humans was more than the arboreal Hanuman langurs. Once a species constructs its niche in the urban area the aggressive behavior is likely to increase due to competition for food, space, and high density (Camperio-Ciani 1986). In this way the agonistic interactions of rhesus monkeys and Hanuman langurs with humans are differentially affected by the process of urbanization.

We found that in the temple area there were more agonistic interactions between humans and rhesus monkeys, than in the bazaar area. This fact has been reiterated in several studies and one of the factors that precipitate these interactions include the religious sentiments of Hindus (Teas 1978; Jolly 1985; Pirta et al. 1997). Our qualitative observations indicate that the rhesus monkeys in the urban area were engaged in snatching and stealing the non-edible objects of people as a strategy to obtain food in exchange. Monkeys were often observed taking away valuable things such as spectacles, mobile phones, hand purses or shoes from the passersby, and dropped when severely threatened or more often when given some edible thing. These observations indicate tactics of rhesus monkeys associated with the exchange of commodities (Drapier et al. 2005).

In the present study the main context of agonistic interactions with humans for both the species was space. Gumert (2008) has also observed that most of the agonistic interactions between humans and monkeys occurred for food and space. The context of agonistic interactions was food only in case of rhesus macaques, not in Hanuman langurs; the former are omnivores whereas as the latter are known as leaf monkeys (folivores). In a related macaque species, the lion tailed macaques, food has been reported to be the major cause of conflict with humans (Fuentes 2008; Sussman and Shaffer 2008). Food provi-

sioning by humans was found to have significant increase in intra-troop competition among individuals of a macaque group (Teas 1978; Rawlins and Kessler 1986; Sinha et al. 2005).

Most of the agonistic encounters between human and monkeys were of low intensity, followed by slight intensity. The moderate intensity agonistic interactions occurred only in rhesus monkeys; and high intensity agonistic interactions (i.e., cases of bites) were not observed during the study period. Though it has often been reported that rhesus monkeys cause intense harassment of people and frequently bite them, the present study suggests that these are rare cases. We agree with other investigators that there was false perception of risk from the monkeys in the minds of people. A thorough understanding of the potential risk and its perception by the people were important factors in planning any management strategy (Madden 2004; Gore et al. 2007). The primatologists are convinced that the monkey problem has arisen in India because of a positive desire to contact monkeys and disclose when these primates pose threat through bites, thefts of non-provisioning food and general health issues (Lee and Priston 2005; Walker et al. 2008).

Naturalistic observations on non-human primates provide the basic information on the behavior with regard to the context and intensity of social interactions (Hockings et al. 2008). It has importance for assessing the potential risk from a particular monkey species to humans. Thus the behavioral studies under naturalistic conditions (Pirta 2009) are recommended for developing sound management and conservation strategies to resolve the man-monkey conflict.

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