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# STATUS AND EFFECTS OF FOOD PROVISIONING ON ECOLOGY OF ASSAMESE MONKEY (*MACACA ASSAMENSIS*) IN RAMDI AREA OF PALPA, NEPAL

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## ABSTRACT

The population status of Assamese monkey (*Macaca assamensis*) (McClelland 1840) and its interaction with the local people is poorly documented in Nepal. In 2014, we studied the population status, diurnal time budget and human-monkey conflict in Ramdi, Nepal by direct count, scan sampling and questionnaire survey methods, respectively. Two troops of Assamese monkey having total population of 48 with the mean troop size of 24 individuals were recorded in the study area. The group density was 0.33 groups / km<sup>2</sup> with a population density of 6 individuals/ km<sup>2</sup>. The male to female adult sex ratio was 1:1.75 and the infant to female ratio was 0.85. The provisioned troop of Assamese monkey in Ramdi spent less time in feeding and movement while higher time was invested in resting and grooming than the nonspecific populations in the wild habitats. The human-monkey conflict is high in Ramdi, primarily due to the crop-raiding from fields and even the storage; the major crops raided are maize, vegetables, pulses and fruits. The higher reproductive success in terms of infant to adult female ratio, increased human-monkey conflicts and lesser investment of the diurnal time in foraging and feeding by Assamese monkey troop of Ramdi might be associated with the food provisioning.

**Keywords:** Assamese monkey (*Macaca assamensis*), Ramdi, Behavior, Conflict, Group density.

## INTRODUCTION

Among the non-human primates, three species of monkeys have been reported from Nepal; Rhesus monkey (*Macaca mulatta*), Assamese monkey (*Macaca assamensis*), and Hanuman Langur (*Semnopithecus entellus*). Macaques/monkeys (genus *Macaca*; Primates: Cercopithecidae) are an ecologically extremely adaptive primate taxon that is distributed more widely than any other non-human primate genus (Schulke *et al.*, 2011). Assamese monkey is one of the less common primate species and is distributed patchily in Nepal (Chalise, 2013). The 'Nepal population' of Assam macaque differs in pelage color, morphometric indices and distribution range with their nearest conspecific populations (*M. assamensis pelops*) from adjacent countries like India and Bhutan; hence they have been doubted for the distinct subspecies status and considered as "*M. assamensis* Nepal Population" and warranted the need of

taxonomic revision (Chalise, 2005 & 2013; Molur *et al.*, 2003). Categorized as 'Near Threatened' by IUCN (Boonratana *et al.*, 2008), its Nepal population is one of the least studied primates that has been nationally listed 'Endangered' and protected by the National Park and Wildlife Protection Act-1973 of Nepal (Chalise, 2013; Chalise *et al.*, 2013).

The Assamese monkey is reported from mid-hills and high Montana forest, but their ecological and behavioral details are poorly known (Chalise *et al.* 2013). It is locally known as *Pahare Bandar* or *Kalo Banar* or *Kala-Ganda* (Chalise, 2010). It resembles to the rhesus monkey except having a brownish-grey to yellowish-grey coat, which is uniform in pelage, lacks a pinkish face and absence of red buttocks (Chalise, 2008); and heavier and larger than rhesus weighing more than 12 kg (Chalise, 2003). It has darker fur in exposed area while whitish blonde-haired to ashy white in abdominal and inner parts (Chalise *et al.*,

2005). Generally, adult Assamese monkey is of nearly 2 feet in head and body length while tail is one-third of it.

The estimated total population of Assamese monkey in Nepal is 1,099 individuals in 51 troops in different habitat of mid-hills of Nepal (Chalise, 2013). They are diurnal animals found along the hills, valleys and upland river basin along the east-west mountainous range with diversified ecological zones (Wada, 2005). They are found in riverside hill-Sal forest area to mixed deciduous and evergreen forest of *Schima-Castanopsis*, *Elaeocarpus-Macaranga* forests in mid-hills and *Quercus-Pinus-Rhododendron* forests of lower Himalaya. They are arboreal, terrestrial and omnivorous animals which are seen doing their social and other activities in the ground with sluggish movement (Chalise *et al.*, 2005). Assamese monkeys live in multi-male and multi-female social troops, and they mate promiscuously with males disperse, whereas females are philopatric (Thierry, 2007).

Some studies have been conducted on population, distribution, behaviour and conservation of Assamese monkey at different forest fragments (Chalise, 2013). Due to the narrow habitat range, Assamese monkeys are facing strong negative impacts on their survival and the population is decreasing in many parts. Anthropogenic activities like deforestation, agricultural expansion, development projects of roads and hydroelectric power generation are reported as the major threats to this species (Chalise, 2013; Molur *et al.*, 2003). In many parts of Nepal, it has been observed as one of the major crop raiders and in some areas even retaliatory killings have been reported (Chalise, 2010). In this context, the extensive study about Assamese monkey is needed to establish baseline information for many parts of the country. The catchment areas of Kaligandaki River in Mid Hills have been described as one of the major potential habitat area for Assamese monkey (Paudel & Chalise, 2017). The Ramdi Area of Palpa and Syangja district is the transient zone between the tropical and sub-tropical climatic conditions and could provide the suitable habitats for this species. Therefore, this research aimed to explore the existing population of Assamese monkey in Ramdi area, document the general behaviour in semi-provisioned conditions and account the level of conflicts with human. The findings of this study might be valuable in conservation and management of such endangered primate in Nepal.

## MATERIALS AND METHODS

### Study Area

Ramdi area is in Darlamdada and Khanichhap VDCs of Palpa district and Malunga VDC of Syangja district. Palpa district has elevation range from 200 m to 2000 m above sea level (asl) and spans between 27°40'N to 27°57'N and 83°14'E to 84° 02'E (DDO Palpa 2013) while Syangja district has the elevation range from 366 m to 2512 m asl spanning between 27°52' to 28°13' North and longitude 83°27' to 83°46' east (DDO Syangja, 2013).

The holy place Ramdi on the bank of Kaligandaki River lies is in Darlamdanda between 27°55'N, 83°37'E / 27.91°N, 83.61°E. Ramdi is typical Mahabarata hill, mostly sub-tropical type of climate but partly temperate climate with rainy summer and dry winter. The southern side is sunny and much drier than northern forest side (DDO Palpa, 2013). The mean monthly minimum temperature of the area is 15.45°C and the mean monthly maximum temperature is 26.4°C. December, January and February are the coldest months while April, May and June are the hottest months (Source: Department of Hydrology and Meteorology, 2015).



**Fig. 1. Topographic map of Ramdi Area (Source: Survey Department of Nepal, 1995).**

Some of the common floras of this area are Sal (*Shorea robusta*), Chilaune (*Schima wallichii*),

Bhalayo (*Semecarpus anacardium*), Bel (*Aegle marmelos*), Fandir/Jamun (*Syzygium cumini*), Pipal (*Ficus religiosa*), Angeri (*Berchemiaedgeworthi*), Bar (*Ficus bengalensis*), Khanyu (*Ficus semicordata*), Khirro (*Sapium insigne*), Simal (*Bombas ceiba*), etc. The major mammalian fauna of the area includes Rhesus monkey (*Macaca mulatta*), Hanuman langur (*Semnopithecus entellus*), Common leopard (*Panthera pardus*), Barking deer (*Muntiacus muntjak*), Yellow throated martin (*Martes flavigula*), Jackal (*Canis aurens*), Jungle cat (*Felis chaus*), Porcupine (*Hystrix indica*), Forest rat (*Bandicotasp.*), Fox (*Vulpes vulpes*), Hares (*Lepus* sp.), Mouse (*Mus musculus*) etc. (DDO Palpa, 2013).

## METHODS

### Population Count

Population count of Assamese monkey in Ramdi area was carried out in 2014 from accessible roads and walking trails. Before the detail population census, the troops were recognized through continuous observation of individuals with their specific identifying characters like body size; special marking on the body, coloration and behaviors etc. and the population census was done by direct counting method. Troop composition was separated by direct counting the individuals in each group and age and sex were distinguished by their body color, body proportion, height and body size as explained by Roonwal and Mohnot (1977).

### Behavioral Observations

In order to assess the behavioral differences of semi-provisioned troop of Assamese monkey at Siddha Baba Temple area with that of wild troops described in previous studies, behavioral samplings were done by using the scan sampling method (Altman, 1974) and continuous average group scanning (Chalise, 2000, 2003 & 2005). Behaviors like foraging, feeding, resting, moving and grooming were recorded during scanning period of data collection. Assamese monkey troops were observed for 10 hours (from 07:00 to 17:00) every day in the months of January, February, March of 2014 and 12 hours (from 06:00 to 18:00) every day in the months of August, September, October in 2014 with the behavioral sampling for total 378 hours.

### Human-Monkey Conflict

A total of 100 respondents were randomly selected from the people living around the Ramdi

area for this study. Semi-structured questionnaires were used to get the information on human-monkey conflicts. The respondents were interviewed separately to ensure the independence of the individual response. The questionnaires were designed to obtain the people's perception on Assamese monkey population change in Ramdi and different aspects of crop raiding by the monkeys (frequency, time of the day, types of the crop damaged, amount of annual loss due to crop raid and methods adopted to prevent the crop raid).

### Data Analysis

The collected data was analyzed with the use of MS EXCEL 2007. The infant to female ratio of the monkey was calculated by dividing total number of infants by total number of adult females similarly sex ratio was calculated by dividing total number of adult male by total number of adult female (Chalise, 2003). The statistical significance of the difference in age-sex composition between the two troops was tested by paired t-test assessing its significance at the threshold of 0.05. The behavioral data for two seasons of the year were combined and analyzed. The data from behavioral sampling and questionnaire survey were analyzed by descriptive statistics (percentages, frequencies) and charts and table were used to present the data in most simplified and understandable form.

## RESULTS

### Population

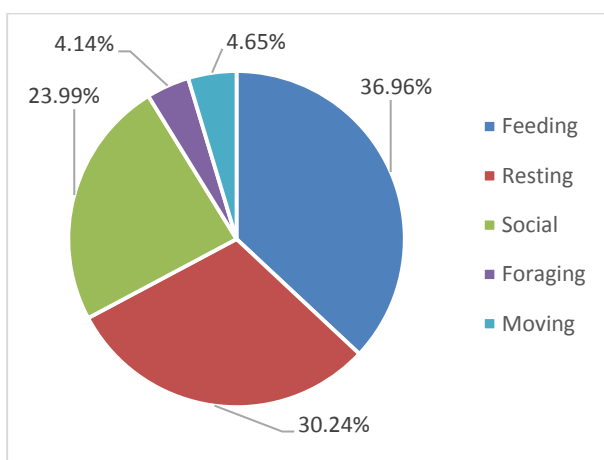
Population surveys throughout the study area (~8 km<sup>2</sup>) were carried out from all the accessible trails. A total of 48 individuals from two different troops of Assamese monkey were counted. Palpa troop-A consisted higher number of individuals (n= 27), than that of Syangja troop-B (n=21). The average troop size was of 24 individuals. There were 12.5% infants, 27.08% juvenile, 37.5% sub adult, 8.33% adult male and 14.58% adult females. There was no significant difference in age-sex composition between the troop-A and troop-B (t-value= 1.07, df= 7, P= 0.304). The adult sex ratio (male: female) from age sex group separated troops was 1:1.75, and infant to female ratio was found 0.85:1.00 (85 infants per 100 adult females) during the study period. The overall group density was 0.33 groups / km<sup>2</sup> with a population density of 6 individuals/ km<sup>2</sup>.

**Table 1: Population of Assamese monkey in Ramdi area.**

Categories	Palpa Troop ‘A’	Syangja Troop ‘B’	Total Population
Adult Male	2	2	4
Adult Female	4	3	7
Sub adult Male	4	3	7
Sub adult Female	6	5	11
Juvenile Male	4	2	6
Juvenile Female	4	3	7
Infant Male	1	1	2
Infant Female	2	2	4
Total	27	21	48
Average troop size	24 individuals per troop		
Sex ratio	male: female = 1:1.75		
Infant to adult female ratio	0.85 infant per adult female		

**Behavior**

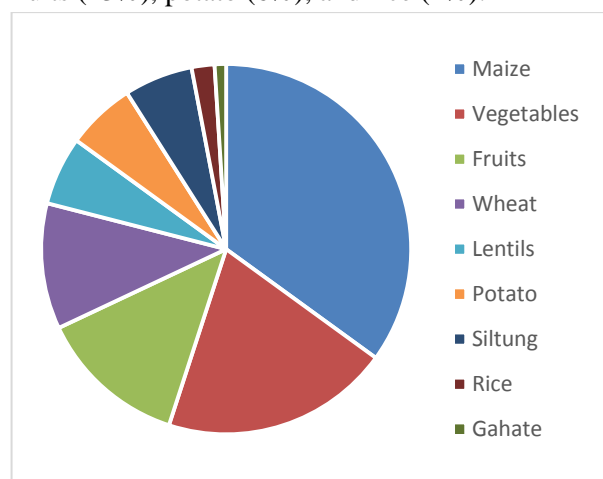
The Palpa troop ‘A’ (n=27) of Siddha Baba temple area, Ramdi was selected as focal troop for studying behavior. Out of the 378 hours of time spent in the jungle, the focal troop was connected for 318 hours and 7 minutes to study the diurnal activity pattern and time budget. Among the five types of behavior (feeding, moving, resting, foraging and grooming) studied, maximum time (117 hours 36 minutes, 36.96%) was invested in feeding behavior which was followed by resting (96 hours 13 minutes, 30.24%), social behavior (76 hours 19 minutes, 23.99%), foraging (13 hours 10 minutes, 4.14%) and movement(14 hours 49 minutes,4.65 %).



**Fig. 2. Diurnal activity budget of Assamese monkey in Ramdi area.**

**Human-Monkey conflict**

All of the respondents i.e. 100% (N = 100) considered monkey as the nuisance. Majority of respondents (66%) who were directly involved in agriculture reported crop raiding as the major problem. Crops mostly raided by monkeys included maize (35%), vegetables (20%), pulses (13%), fruits (13%), potato (6%), and rice (2%).



**Fig. 3. Respondents' view on percentage of crop damage by monkey in Ramdi Area.**

Food scarcity, as reported by 78% respondents was the major cause for increasing human-monkey conflicts in the Ramdi area. Only 19% (N = 100) of the total respondents said they have given food for monkey while 37% (N = 100) reported they had seen the artificial provisioning by other people. In

an average 35 pilgrims/visitors at the Siddha Baba temple provided food to the monkey at the rate of approximately 200 grams per person per day that accounted about 259 grams of supplement food per monkey per day. The provisioned food included rice, wheat, maize, gram, peanut, banana, orange, apple etc. According to 59% respondents, monkeys are mostly active in morning time i.e. 5 AM-11AM and they create problems to local residents. Stone throw-catapult was reported by the 97% respondents and was also observed to be the most effective method to ward off monkeys. Other methods like scolding and charging, screening of the house, stick charging etc. are also used to ward off monkeys.

## DISCUSSION

### Population

This study explored the population status of Assamese monkey in Ramdi area of Palpa and Syangja districts and the diurnal behavior of semi-provisioned troop inhabiting around Siddha Baba temple was observed. Two troops of Assamese monkey with the mean troop size of 24 individuals (range 21-27) were found inhabiting the Ramdi area, one troop on the eastern side and another on the western side of the Kaligandaki River. The average troop size of Assamese monkey in Ramdi area is higher than other studies in Nepal, for examples- Wada (2005) reported it 19.1 with the range of five to 34 from the survey along multiple rivers in Nepal, while Chalise (2013) reported it to be of 21.55 with the range of one to 35 from different forest fragments and Chalise et al. (2013) reported the average troop size of 23.71 in Shivapuri Nagarjun National Park. The group density of this study was 0.33 groups/km<sup>2</sup> with a population density of 6 individuals/km<sup>2</sup>. There is less adult male population than adult female (sex ratio 1:1.75) and the ratio is more near to that of Assamese monkey (1:1.6) in Makalu Barun National Park (MBNP) (Chalise, 2003). In Ramdi, there were 12.5% infants, 27.08% juvenile, 37.5% young, 8.33% adult male and 14.58% adult females. Unlike this ratio, Chalise et al. (2013) reported 56.9% adults and 43.1% immature. The population composition of Assamese monkey in Ramdi is different from other studies because they are probably the only groups in Nepal which live in religious place and are habituated with people where they find waste food easily.

The infants to adult female ratio was 0.85 in Ramdi during this study, which is more than Chalise et al.

(2013); according to them each adult female had 0.67 infants in Shivapuri Nagarjun National Park. Female reproductive performance is often limited by foraging conditions as food provides the energy needed to maintain regular reproductive cycles and reduce the costs of reproduction (Harcourt, 1989). Abundance of high-quality food sources has been observed to lead to shortening of the weaning process facilitating subsequent conception (Lee, 1987). Borries et al. (2001) also explained the provisioned primate groups to have higher birth rates, shorter lactation periods and shorter inter-birth intervals compared to un-provisioned groups. Higher infant to female ratio or the birth ratio in the Ramdi troops of Assamese monkey may be the consequence of partial food provisioning.

### Behavior

The semi-provisioned Assamese monkey of Siddha Baba temple area spent 36.96% of time in feeding and only 4.14% in foraging activities; while they spent 30.24% diurnal time in resting and 23.99% in social behavior like grooming. In the wild, Assamese monkey spend greater percentage of time in foraging and feeding activities; for example- 43.4% in LNP (Chalise, 2010), 44% in MBCA (Chalise, 2003), 47% along Kaligandaki river bank (Paudel & Chalise, 2017), which is higher than this study i.e. 36.96%. Chalise et al. (2013) studied a habituated Assamese monkey troop in Shivapuri Nagarjun National Park and found 46% of the diurnal time invested in foraging/eating, 19% in resting, 16% in locomotion, 12% in sleeping, 6% in grooming and 1% in playing. On the other hand, the Assamese monkeys of Ramdi spent 30.24% of time in resting followed by 23.99% in social and 4.14% in foraging and 4.65% in moving in this study which differs markedly from the previous studies of monkey in Nepal (Chalise, 2003 & 2010). Chalise (2010) had recorded 18.5% in resting, 31.7% in moving and 3.4% of time in grooming behavior in LNP, similarly, Chalise (2003) had recorded 18% in resting, 25% in moving and 13% in grooming in MBNP. In contrast to this, Zhou et al. (2007) reported an average of 39.6% of time spent in resting, 33.2% in moving, 18.3% feeding, 7.5% in social behavior and 1.4% in other behaviors. They further reported the significant seasonal variations in time investment with the increase in time investment on feeding during dry season than in rainy season. It is obvious that in natural habitat they should invest much more time to acquire food than to spend in other social activities (Chalise et al., 2005). In Ramdi, the troop of Assam monkeys

in temple area get food from the Hindu pilgrims, in addition they also raid the crops from the fields and storage of local people. Because of getting the human food with higher concentration of nutrients, they invest less time in foraging, feeding and movement while they have the spare time to invest on resting and grooming.

### Human-Monkey Conflict

In many parts of the distribution range, anthropogenic habitat alteration has forced the nonhuman primates into conflict interactions with humans and their livelihood activities, especially through crop raiding (Priston *et al.*, 2012). Crop damage caused by raiding primates is one of the most widespread and common examples of human-primate conflicts in the areas where local people are mainly subsistence farmers (Hill, 1998). When the supply of natural food is not enough, high quality and easily digested human food is a good alternative form of nutrition for primates, which could be the most important cause of the intensity of crop raiding (Khatun *et al.* 2013). In Ramdi area, 66% respondents (N = 100) highlighted crop raiding as the major problem caused by Assamese monkeys while grabbing/taking of food materials and clothes was reported by 47% respondents. Almost similar to our study, Mc. Court (2005) reported 92% respondents of Hetauda found suffered from crop damage by rhesus monkeys. Among different crops, damage of maize (35%) was found to be the highest followed by vegetables (20%) which is almost consistent with the results of Chalise (2001, 2003). Chalise and Johnson (2001) reported that crop depredation proportion by monkeys varied with crops. In MBCA, they recorded highest loss of maize (32%) followed by potato (24%), rice (14%), fruits (12%), millets (11%), wheat (4%), buckwheat (2%) and pulses (1%). Crop raiding is an essential component of the ecology of primates inhabiting human settlements (Naughton-Treves *et al.*, 1998) but it is likely to minimize the tolerance of subsistence farmers towards conservation of such crop-raider threatened primate species (Khatun *et al.*, 2013). This fact may be useful in predicting the vulnerability of the Assamese monkey survival in Ramdi area. Artificial provisioning causes changes in the diet, home range and habitat and even the behavior of the monkey (Southwick *et al.*, 1976). In Ramdi area monkey are habituated to human because of provisioning of foods, therefore their diet, home range, habitat and behavior are also changed. Most of the respondents believe the scarcity of food, increase in monkey population, loss of habitat,

behavioral changes of monkeys due to artificial provisioning by Hindu pilgrims etc. as the major causes of monkeys turning into crop-raiders. Monkeys living in the habitat with fewer wild food resources are more likely to utilize human settlements and areas around them with dependence on crop foods (Yamada & Muroyama, 2010). The food provided by the Hindu pilgrims in temple areas of Ramdi might have caused behavioral changes and increased their dependence to provisioned food rather than foraging from the wild. The food supplied in the temples (about 259 grams per monkey) may be not be enough and to meet the nutrients requirement the monkeys enter the crop fields, orchards or even the grain storage houses instead of foraging the wild food, which increase the conflicts with local people. The detail assessment of the habitat quality and its management would minimize the human-monkey conflicts and it will be helpful in conservation of the endangered and protected Assamese monkey in Ramdi.

### CONCLUSION

Ramdi area was found inhabited by two troops of Assamese monkeys with the mean troop size of 24 (Range 21-27), the group density of 0.33 groups / km<sup>2</sup> and a population density of 6 individuals/ km<sup>2</sup>. There was less adult male population than adult female (sex ratio 1:1.75). Monkeys of Ramdi spent less time in feeding, foraging and movement but invested higher time in resting and social behaviors when compared with the wild troops. Human-monkey conflict in Ramdi was found to be a serious social problem which may be due to the proximity of the forest to the settlement, artificial provisioning in the nearby temples, availability of palatable crops, abundance of safe hiding sites on the rocky outcrops on the bank of Kaligandaki River. We conclude that the food provisioning to the Assamese monkeys in Ramdi area has changed the general behavior and reproductive success, and raised the human-monkey conflicts.

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