Journal of Wildlife and Biodiversity3(2):52-62 (2019)

(http://jwb.araku.ac.ir/)

DOI: 10.22120/jwb.2019.106831.1065

Research Article

How perception of local people towards rhesus macaque (*Macaca mulatta*) can influence on decision-making of human-macaque conflict mitigation?

Ishita Ganguly*, Netrapal Singh Chauhan

*J1Block, Amity Institute of Forestry and Wildlife Science, Amity University, Uttar Pradesh, Sector 125, Noida, 201313, India.

*email: ishitaganguly23@gmail.com

Received: 12 Apri 2019 / Revised: 29 April 2019 / Accepted: 1 May 2019 / Published online: 4 May 2019. Ministry of Sciences, Research and Technology, Arak University, Iran.

Abstract

A field study was conducted to investigate perception of local people towards conservation of macaques and possible mitigation strategies can be opted to reduce human-macaque conflict in urban landscape. Questionnaire survey was designed to collect qualitative and quantitative information including 608 respondents in and around Asola-Bhatti Wildlife Sanctuary, India during 2016-2017. Our study result showed that there were 21 groups of rhesus macaques available in the study area and caused severe damage to the nearby localities and harassed a total of 466 numbers of individuals. Maximum number of conflict incidences (n=502) were recorded from Sanjay Colony, Bhatti mines area, designated as Site 1 due to maximum availability of food and shelter, large troop size (35-40 individuals) and lack of knowledge of local people. Minimum number of conflict incidences (n=157) were recorded from Surajkund area, designated as Site 7 despite of having multiple food resources because of small troop size (15-20 individuals) and conservation awareness of local people. In this study, we compared socio-cultural aspect of selected locations of study area, socio-economic characteristics of two extreme respondent groups from site 1 and site 7 and also distinguished different age groups of respondents and compared their opinion on mitigation of conflict in urban situation. In the conclusion, it can be said that attitude and perception of local people can contribute in conservation of rhesus macaques and in reducing risk of negative association during conflict. Perception of local people can be helpful in decision making and policy implementation in urban monkey population management.

Keywords: India, local people perception, management wildlife-human confilicts, primate conservation.

Introduction

Rhesus macaque, an old world primate has been considered as unique species not only for their wide geographical range, diversity, behavioural adaptations, social systems and ecological significance, but also for the kind of threats they were found to face for inhabiting with human societies in urban landscapes (Garber and Estrada 2009, Estrada *et al.* 2017). Previous study revealed that monkey population have adapted to human-modified habitat with access to abundant natural and anthropogenic food sources, near one another, and with suitable sleeping sites (Hoffman *et al.* 2012).

A critical factor that found to influence long-term survival of urban primate populations and their persistence in city-spaces is the attitude that citizens have toward them and their perspectives on the continued presence of nonhuman primates in their midst. Human-macaque conflict in urban environments has changed the status of the concerned species to that of a “pest” primate (Lee *et al.* 2005). The

rapid increase in numbers of rhesus macaque population in recent times has led to the increased competition with human for resources in urban areas (Srivastava 1999). In India, urban rhesus macaques were frequently encountered on roadsides, canals, railway stations and temples.

It was estimated that almost 48.5% of rhesus macaques were found to live in rural areas, towns, cities, railway stations and temples in Northern India where they share close association with human beings (Southwick and Siddiqi 2011). In Singapore, conflict between humans and long-tailed macaques (*Macaca fascicularis*) have been studied in detail and it was found that two-thirds of interactions occurred when a human was carrying food or food cues, and one-quarter occurred when a human provoked macaques (Sha *et al.* 2009).

Macaques have been seen to inhabit near roadside and human settlements and most of their diet was comprised of anthropogenic food from human source. Previous studies have been undertaken in different states of northern-India to show close association of monkeys with humans (Srivastava and Begum 2005, Imam and Yahya 2002, Medhi *et al.* 2007 and Southwick *et al.* 2005).

Rhesus macaques are known to be very aggressive by nature, frequently encountered in Northern part of India, reportedly involved in damage to human properties, economic loss and in transmitting infectious diseases. Cross-species transmission of infectious pathogens during contact has become a significant global issue in public health domain due to human-nonhuman primate conflict (Conly and Johnston 2008). Interface between human and macaques in temples increased the risk of dissemination of emerging infectious agents globally. According to Devi and Saikia (2008) incidences of threatening and biting occurred during snatching food items and clothes from people and entering their houses. It was shown in previous study that women and children were targeted by monkeys more frequently; they were bitten and attacked more than adult men in Assam (Deb *et al.* 2014).

Population of rhesus macaques have been found to grow exponentially every year due to absence of natural predator and high birth rate. This phenomenon has led to the increase in monkey population and situation of man-monkey conflicts. Loss of natural habitat, forest fragments, rapid urbanization also responsible for growing human-macaque conflict (Mitra 2000). In India, the situation was found different than other country and rhesus macaques were often seen to be fed by local people in and around temples due to their immense religious faith from ancient times. Our aim of this study was to collect qualitative and quantitative information on population size of macaques in affected areas, food provisioning habits, condition of harassment and attitude and perception of local people towards macaques and mitigation of human-macaque conflict.

Material and methods

Study area

We collected samples from the localities near forest-urban edges and situated in and around Asola-Bhatti wildlife sanctuary, Delhi (latitude N 28° 33′ 39. and longitude E 77° 16′) from May 2016 to June 2017 (Fig. 1). Totally 7 localities were selected in and around the sanctuary based on their characteristic features (availability of resources, number of monkey troops, food provisioning,garbage disposal system, income group and education of local people).

We selected 7 sites including 1) Sanjay Colony, Bhatti mines area; 2) Pali road and Indian Eco Task Force Camp; 3) Asola farms and housing complex; 4) Sanidham and Kali temple area; 5) Guruji Ashram, Chattarpur; 6) (Faridabad-Gurgaon Highway; and 7) Surajkund area and Head office of Asola-Bhatti Wildlife Sanctuary. GPS coordinated were noted whenever groups of rhesus macaques were found. Group size and composition were recorded for each group.

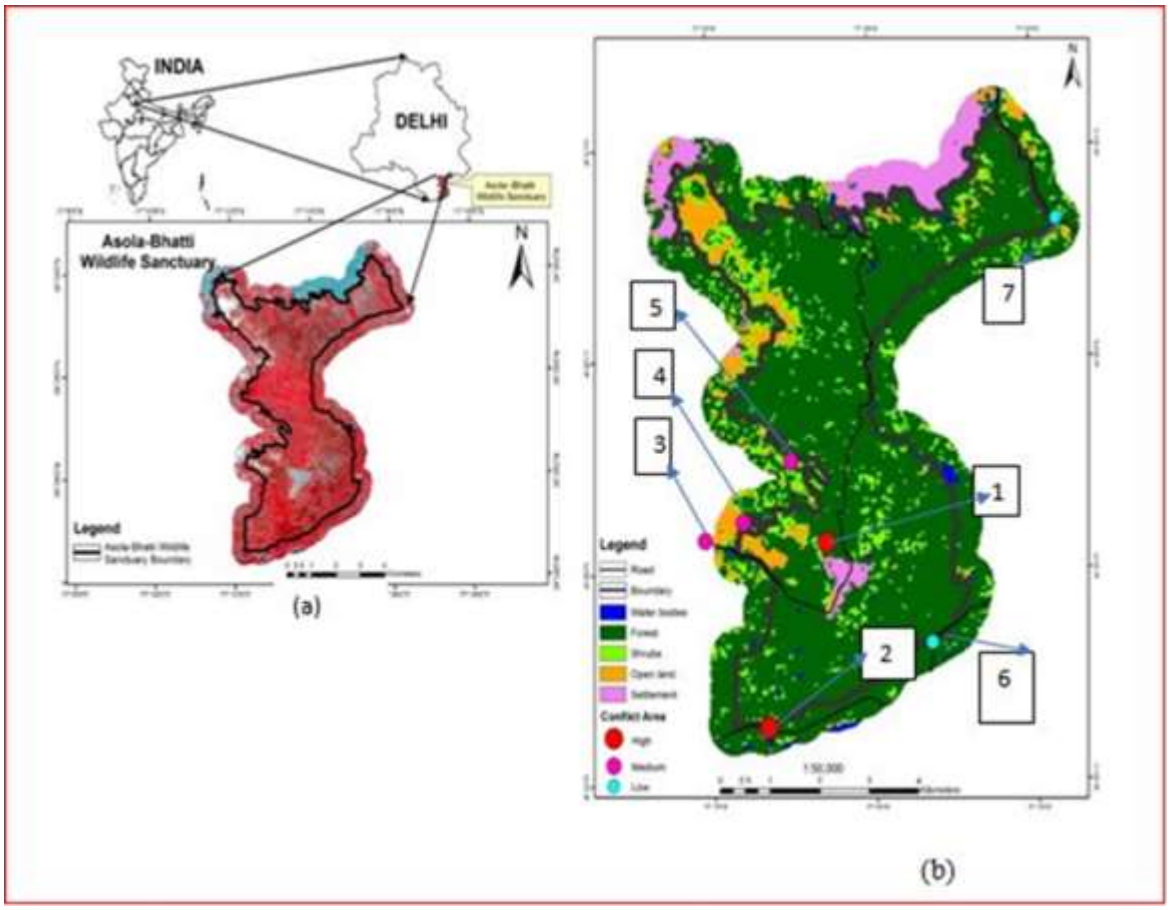

Figure 1. Location map of Asola-Bhatti wildlife sanctuary

Data collection

We walked through the road directly joined from forest to the urban settlements(16 transects were traversed totally) up to 10 km distance and questioned each participant included in this study. Rural to sub-urban to urban type of human settlements were found in and around this protected area. Population estimation of macaques was done by direct contact method (Barwer 1971). Observations on human-macaque interactions were conducted for 6 hrs on each day of survey during 2016-2017 and total 318 hours were spent on recording the interactions (Uddin and Ahsan 2018).

Questionnaires survey

Semi-structured survey was designed and questionnaire surveyincluded both qualitative and quantitative questions about the opinions, knowledge, and attitudes toward macaque to human interactions and vice-versa. We have included both female and male respondents' equallyin this study. Residents in the nearby localities surrounding Asola-Bhatti Wildlife Sanctuary and workers in the forest participated in the survey.

Results

Population size of money groups were counted in the selected localities. Number of groups of monkeys, group size and adult male to female ratio varied in each location (Table 1). A total of 21 groups of rhesus macaques were present in the nearby localities. Maximum number of groups of monkeys (4) was recorded from Sanjay Colony, Bhatti mines-Site 1 with maximum group size (35-40 individuals) and minimum size of monkey population (15-20 individuals) was recorded from Surajkund area, Head Office Asola-Bhatti Wildlife Sanctuary-Site 7 with 2 groups of monkeys. On average, adult male to adult female ratio was 1:1.5 in our study area.

Table 1. Population status of rhesus macaques in and around Asola-Bhatti Wildlife Sanctuary (2016-2017). (AM: Adult male individuals of rhesus macaques; AF: Adult female individuals of rhesus macaques)

Location of urban population	Co-ordinates	Number of groups	Group size	AM:AF
Sanjay Colony, Bhatti mines	N 28° 26′ E 77° 13′	4	35-40	1:1.59
Pali road and Indian Eco Task Force Camp	N 28° 26′ E 77° 13′	4	25-30	1:1.57
Asola farms and housing complex	N 28° 26′ E 77° 12′	2	25-30	1:1.54
Sanidham and Kali temple area	N 28° 25′ E 77° 13′	3	20-25	1:1.53
Guruji Ashram, Chattarpur	N 28° 26′ E 77° 12′	3	25-30	1:1.52
Faridabad-Gurgaon Highway	N 28° 27′ E 77° 13′	3	30-35	1:1.54
Surajkund area, Head Office Asola-Bhatti Wildlife Sanctuary	N 28° 29′ E 77° 16′	2	15-20	1:1.53

A total of 608 respondents were participated in the survey and answered the feedback questions and made remarks including male and female, both (Table 2). Overall percentage of female participants, n=350 (57.76%) was more than male respondents, n=258 (42.43%) in our study. Two categories of respondents were found during survey: (1) harassed by monkeys (n=466) and (2) not harassed by monkey nuisance (n=142). Chi-square test showed that there was significant difference in harassment of people in 7 different locations in our study area (df = 6, χ^2 value = 94.88, P<0.5). Maximum number of victims were recorded again from site 1 (93.81%) and minimum number of respondents were found to be harassed from site 7 (33.34%).

Human to rhesus macaque interactions took place mostly during feeding according to survey report. We surveyed the frequency of food provisioning to these macaques in the nearby localities. We investigated the frequency of monkey feeding at different sites and found high, medium and low frequency of responsesthrough survey report (Figure 2). High frequency of monkey feeding by people was recorded in Site 1, Site 2, Site 3 and Site 6. Chi-square test result showed that there was significant difference in frequency of feeding in 7 different locations (df = 6, χ^2 value = 21.16, P = 0.04).

Table 2. Reports of human - monkeis interactions in and around Asola-Bhatti Wildlife Sanctuary (2016-2017**)**

Respondents	Site 1 n (%)	Site 2 n (%)	Site 3 n (%)	Site 4 n (%)	Site 5 n (%)	Site 6 n (%)	Site 7 n (%)
Male	78 (40.2)	38 (42.22)	27 (36.98)	32 (47.05)	29 (42.64)	26 (40.62)	28 (54.9)
Female	116 (59.79)	52 (57.77)	46 (63.01)	36 (52.94)	39 (57.35)	38 (59.37)	23 (45.09)
Harassed	182 (93.81)	67 (74.45)	58 (79.45)	52 (76.47)	51 (75)	39 (60.93)	17 (33.34)
Not harassed	12 (6.18)	23 (25.55)	15 (20.54)	16 (23.52)	17 (25)	25 (39.06)	34 (66.66)

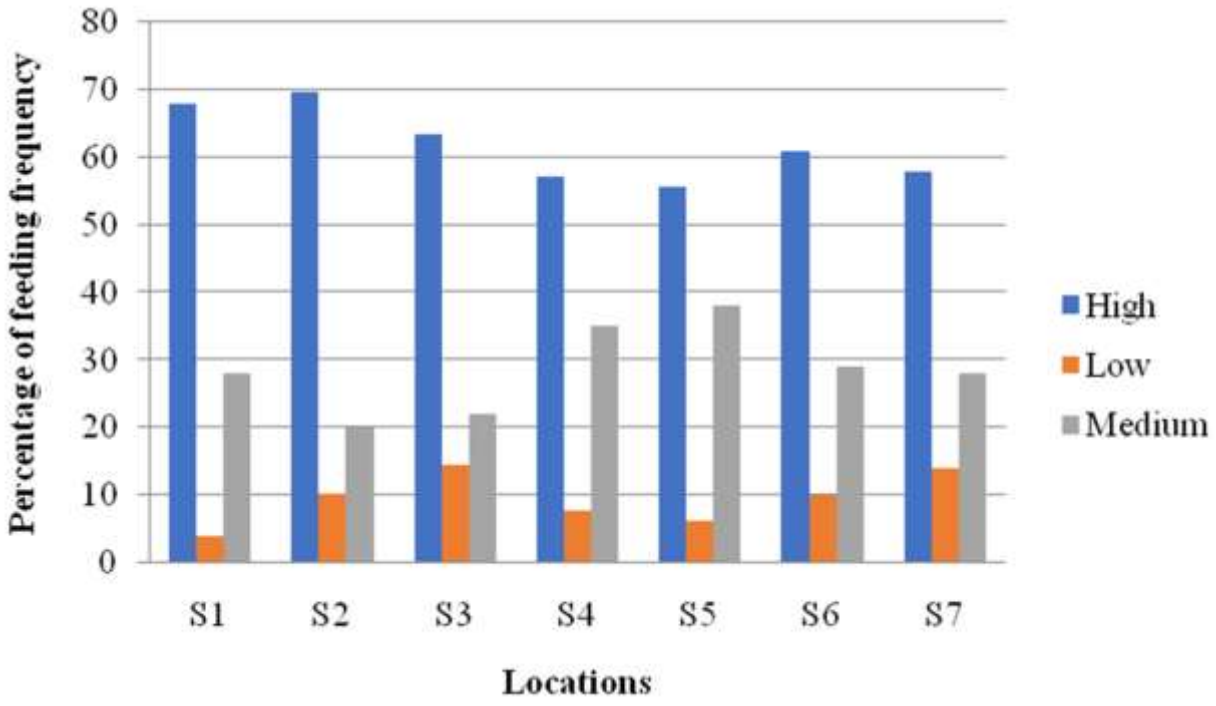

Figure 2. Frequency of monkey feeding in and around Asola-Bhatti Wildlife Sanctuary

We recorded a total of 1802 conflict incidences from 7 selected locations and carried out questionnaire survey to assess socio-cultural structure (Table 3).

We classified the opinions of respondents on possible solutions for mitigation of human-macaque conflict in urban situation into 3 sections; (1) Yes (%), (2) No (%), and (3) Neutral (%) (Table 4).

Table 3. Socio-cultural characteristics of 7 selected locations to study human-macaque conflict

Locations and number of incidences	Resources availability	Food provision-ing	Garbage disposal	Sanitation quality	Income group	Human perception
Site 1 (n=502)	Houses, open vegetable and fruit market, stationary shops	Daily	Open	Poor	<15,000pm	Eradication
Site 2 (n=264)	Plantation	Daily	Open	Medium	>30,000pm	Eradication
Site 3 (n=225)	Houses and stationary shops	Daily	Open	Medium	>30,000pm	Eradication
Site 4 (n=220)	Temple food, shops	Daily	Open	Poor	15,000-20,000pm	Eradication
Site 5 (n=213)	Temple, roadside food	Daily	Open	Medium	>30,000pm	Eradication
Site 6 (n=203)	Roadside food, shops	Daily	Open	Poor	15,000-20,000pm	Eradication
Site 7 (n=157)	Houses, roadside food and nursery	Daily	Open	Medium	>30,000pm	Partial reaction, Problem solution, conservation

Table 4. Summary of opinion of local people for mitigation of conflicts

Variables	Categories	S1	S2	S3	S4	S5	S6	S7
Facing problems due to increase in monkey population	Yes (%)	83	79	78	81	79	77	76
	No (%)	17	11	9	2	8	7	11
	Neutral (%)	0	10	13	17	13	16	13
Support elimination or eradication of monkey population	Yes (%)	95	87	85	88	82	81	79
	No (%)	0	0	0	0	0	0	12
	Neutral (%)	5	13	15	12	18	19	9
Translocation	Yes (%)	34	29	25	21	23	27	57
	No (%)	2	9	8	7	4	3	6
	Neutral (%)	64	62	67	72	73	70	37

Population control by male/female monkey pills, sterilization or immunization or vaccination	Yes (%)	9	11	13	16	18	22	69
	No (%)	3	5	6	8	9	10	7
	Neutral (%)	88	84	81	76	73	68	24
Culling	Yes (%)	87	84	81	78	83	79	48
	No (%)	1	3	4	7	5	6	49
	Neutral (%)	12	13	15	15	12	15	3
Implementation of electric fences and barriers	Yes (%)	23	19	15	14	16	17	21
	No (%)	12	17	18	12	19	17	15
	Neutral (%)	65	64	67	74	65	66	64
Education awareness campaigns and change in attitude and perception towards monkeys	Yes (%)	7	12	8	9	8	48	95
	No (%)	19	18	7.5	14	12	24	4
	Neutral (%)	74	70	84.5	77	80	28	1

Table 5. Comparison of socio-economic aspect of site-1 and site-7

Variables	**Site 1 (%)**	**Site 7 (%)**	**X^2**	**P value**
Education status:				
Graduate	14	89	112.60	P < 0.05
Undergraduate	86	11		
Employment status				
Employed	68	91	16.22	P < 0.05
Unemployed	32	9		
Income class				
Middle class	6	33	23.55	P < 0.05
Lower middle class	59	39		
Poor	35	28		

There was significant difference (P < 0.05) in opinion of people from 7 different locations but maximum difference was found between site 1 and site 7. Hence, we first compared the socio-economic criteria between two groups of respondents (Table 5) and result of chi-square test showed significant difference (P < 0.05) between the groups. Again, statistical comparison was made for these two groups of respondent on their perception on mitigation of conflict and possible solution of this problem (Table 6) and chi-square test showed significant difference (P < 0.05) in opinion of both the groups but there was no significant difference (P = 0.805) in both the groups on one particular opinion i.e., implementation of

electric fences and barriers around the sanctuary that monkeys would not be able to cross.

Discussion

Most of the primate species are confined to forest habitats and only a few species have adapted the urban life in human dominated landscapes and rhesus macaque is one of them (Sinha and Vijayakrishnan 2017). In this study, availability of food and shelter in nearby localities, food provisioning, poor

Table 6. Comparison of perception of local people of site-1 and site-7 groups in combating conflict between human and monkeys

Variables	**Site 1**			**Site 7**			**X^2**	**P value**
Age groups (year)	Yes %	No %	Neutral %	Yes %	No %	Neutral %		
0-15	14.25	36.8	31.8	19	12	9	34.98	P < 0.05
16-30	39	10	20.09	17	10	17		
31-45	18.25	10.2	12.99	25.2	19	25.2		
46-60	12	16	11.35	20.8	14	21		
61-75	16.5	27	23.77	18	45	27.8		
Support elimination of monkey population	95	0	5	79	12	9	12.70	P < 0.05
Translocation	34	2	64	57	6	37	15.03	P < 0.05
Sterilization or immunization	9	3	88	69	7	24	84.32	P < 0.05
Culling	87	1	12	48	49	3	62.74	P < 0.05
Electric fences and barriers	23	12	65	21	15	64	0.432	P < 0.05
Education awareness and conservation action plan	7	19	74	95	4	1	156.75	P < 0.05

sanitation, low income group in sub-urban areas and perception of people towards macaque were found to be important factors in the regulation of human-macaque conflict. Location of human habitations adjacent to the forest and feasibility of macaques to reach there made a marked difference in occurrence of conflicts. Sanjay colony, Bhatti mine area was found greatly affected due to its proximity to the forest boundary,availability of multiple food resources, lack of knowledge and awareness of local people towards macaques and need of their conservation in biodiversity. We estimated population size of monkeys in conflict prone areas and it was found that large population size range and presence of more number of groups caused maximum damage in the affected areas. Perception of local people towards macaques was not found sufficient for conservation. In another study, it was revealed that human aggressions towards primate species were based on the potential damage and economic loss caused by primates and that eventually change primate behaviour towards human beings (Beisner *et al.* 2015). Perception of farmers was also not found conservative towards macaques in previous study due to the nuisance caused by monkeys in agricultural fields (Khatun *et al.* 2013). In Haryana, due to religious faith people were always found to feed rhesus macaques and often found to get involved in unwanted conflict situation with monkeys. Our result showed that 71% people on average have fed monkeys and 29% people have not fed them regularly from all the study sites. Human-macaque conflict in the urban areas and temple sides and relationship of macaques with human has been documented in several studies in northern India (Riley 2007, Pirta 2009). Previous study reports showed that in India, almost 100 people get injured by monkeys in every day among which incidences of monkey bites were found maximum.Most of the people showed their interest in elimination or complete eradication of rhesus macaques from their respective localities instead of implementing any mitigation action plan. Questionnaire survey revealed that there was significant variation among opinion of respondents group from 7 different locations situated in and around the sanctuary due to difference in their socio-cultural and socio-economic background.

On average, 85.28% respondents supported immediate eradication or elimination of monkeys from human society and rest remained unanswered or neutral, 30.85% of the respondents supported the idea of translocation of monkeys in forests area situated far from human locality and 69.15% people could not response in that question. However, on average 22.57% people supported the idea of sterilization, immunization or vaccination of the macaques in order to control their proliferating population. Interestingly 77.14% respondents agreed to the idea of mass killing or culling of monkey population to stop human-non-human primate conflict in which maximum respondents were from site 1, Sanjay colony where average education status and conservation awareness level of people were very poor. On average, only 26.71% people thought that education awareness campaigns and conservation action programmes could be helpful for mitigation of conflict situation in urban areas. Monkeys have been forced to adapt the urban life due to deforestation and it should be human responsibility to conserve this species although ‘least concerned’ for the need of biodiversity management in urban ecosystem and sustainable development.

Conclusion

In this study, our result showed that minimum number of conflict incidences happened in site 7, where socio-cultural, socio-economic characteristics and education level of local people was much higher than site 1, where maximum number of conflict incidences occurred. So, it can be said that change in attitude and perception of localities in urban areas towards rhesus macaques and knowledge

of significance of primates in biodiversitycan effectively reduce human-macaque conflict and the risk of negative interactions between human and non-human primate in a significantly lower degree. Biodiversity conservation awareness of local people is required in decision making and policy implementation for long-term survival management plan of rhesus macaques in Asola-Bhatti Wildlife Sanctuary in future.

Acknowledgements

We would like to thank Mr. A.K. Shukla, Chief Wildlife Warden of Delhi Forest and Wildlife Department to issue permit for working in the field area, Mr. S.K Muan Giete, Deputy Conservator of Forest, South Division, Delhi for providing support and smooth conduct of field research. We are thankful to World Wide Fund for Nature-small grant programme, (WWF-India) for providing funding support in accomplishment of field work and research facility.

References

Barwer, M. (1971). Daily activity pattern study of rhesus monkey. Journal of Animal Behaviour, 72(4):165-169.

Beisner B.A., Heagerty A., Seil S.K., Balasubramaniam K.N., Atwill E.R., Gupta B.K., Tyagi P.C., Chauhan N.P., Bonal B.S., Sinha P.R., McCowan B. 2015. Human–wildlife conflict: proximate predictors of aggression between humans and rhesus macaques in India. American journal of physical anthropology 156(2): 286-294.

Conly J.M., Johnston B.L. 2008. Canadian Journal of Infect Disease and Medical Microbiology. 1(19): 12-14.

Deb P., Rai P.K., Bhattacharjee P.C. 2014. Human-Monkey Conflict and its Associated Problems at Badarpurghat, Karimganj, Assam (India). Issues and Trends of Wildlife Conservation in Northeast India. pp. 199-202.

Devi O.S., Saikia P.K. 2008. Human-monkey conflict: a case study at Gauhati University Campus, Jalukbari, Kamrup, Assam. Zoos Print Journal 23(2): 15-18.

Estrada A., Garber P.A., Rylands A., Roos C., Fernandez-Duque E., Di Fiore A., Nekaris K. A. I., Nijman V., Heymann E.W., Lambert J.E., Rovero F., Barelli C., Setchell J.M., Gillespie T.R., Mittermeier R.A., Arregoitia L.V., De Guinea M., Gouveia S., Dobrovolski R., Shanee S., Shanee N., Boyle S.A., Fuentes A., K. MacKinnon K.C., Amato K.R., Meyer A. L. S., Wich S., Sussman R.W., Pan R., I. Kone I. and Li B. 2017. Impending extinction crisis of the world's primates: why primates matter. Science Advances. 3(1): e1600946.

Fuentes A. 2006. Human Culture and Monkey Behavior: Assessing the Contexts of Potential Pathogen Transmission between Macaques and Humans. American Journal of Primatology, 68 (1): 880-896.

Garber P.A., Estrada A. 2009.Advancing the study of South American Primates. In: South American Primates: Comparative Perspectives in the Study of Behavior, Ecology and Conservation, P. A. Garber, A. Estrada, J. C. Bicca-Marques, E. W. Heymann and K. Strier (eds.). Springer, New York. pp. 5–19.

Hoffman M., Tali S., and O'Riain J.M. 2012. Monkey Management: Using Spatial Ecology to Understand the Extent and Severity of Human–Baboon Conflict in the Cape Peninsula, South Africa. Ecology and Society 17(13).

Imam E., Yahya H.S.A. 2002. Management of monkey problem in Aligarh Muslim University, Uttar Pradesh.Zoos' Print Journal. 17 (1): 685–687.

Khatun U.H., Ahsan M.F., Roskaft E. 2013. Local people's perceptions of crop damage by Common Langurs (*Semnopithecus*

entellus) and human-langur conflict in Keshabpur of Bangladesh. Environment and Natural Resources Research 3(1): 111–126.

Lee BPY-H., Chan S. 2011. Lessons and challenges in the management of long-tailed macaques in urban Singapore. In: Gumert MD, Fuentes A, Jones-Engel L (eds) Monkeys on the edge: ecology and management of long-tailed macaques and their interface with humans. Cambridge University Press, Cambridge. pp. 307–313

Lee C., Phyllis C., Priston N.E.C. 2005. Human Attitudes to Primates: Perceptions of Pests, Conflict and Consequences for Primate Conservation. In Commensalism and Conflict: The Human–Primate Interface, edited by James D. Paterson and Janette Wallis. pp. 1–23.

Medhi R., Chetry D., Chokrovorty B., Bhattacharjee P.C.2007. Status and diversity of temple primates in northeast India.Primate Conservation. 22(1): 135–138.

Mitra S. 2000. Assamese macaque *Macaca assamensis*. Twilight. 22(1): 51-53.

Pirta R.S. 2009. Biological and ecological bases of behaviour. In: G Misra (Ed.): Psychology in India: Basic Psychological Processes and Human Development. Delhi: Pearson. 1(1):1-67.

Riley E.P. 2007. The human–macaque interface: conservation implications of current & future overlap and conflict in Lore Lindu National Park, Sulawesi, Indonesia. American Anthropologist, 109(1):473–484.

Sha J. C. M., Gumert M.D., Lee B. P. Y-H., Jones-Engel L., Chan S., Fuentes A. 2009. Macaque–Human Interactions and the Societal Perceptions of Macaques in Singapore.American Journal of Primatology. 71(1): 825–839.

Southwick C.H., Malik I., Siddiqi M.F. 2005. Rhesus commensalism in India: problems and prospects. In: Paterson JD, Wallis J (eds) Commensalism and conflict: the human–primate interface. American Society of Primatologists, Norman. pp. 241–257.

Southwick C.H., Siddiqi M.F. 2011. India's rhesus populations: protectionism versus conservation management. In: Gumert MD, Fuentes A, Jones-Engel L (eds) Monkeys on the edge: ecology and management of long-tailed macaques & their interface with humans. Cambridge University Press, Cambridge. pp. 275–292.

Srivastava A., Begum F. 2005. City monkeys (*Macaca mulatta*): a study of human attitudes. In: Paterson JD, Wallis J (eds) Commensalism and conflict: the human–primate interface. American Society of Primatologists, Norman. pp. 259–269.

Uddin M.M., Ahsan M.F. 2018. Do Rhesus monkeys (*Macaca mulatta*) damage the unpalatable crops during conflict with human? A case study from Rampur village of Narsingdi District in Bangladesh. Journal of Wildlife and Biodiversity 2(2): 1-5.