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## ARTICLE

### **RHESUS MACAQUE *MACACA MULATTA* (MAMMALIA: PRIMATES: CERCOPITHECIDAE) IN A HUMAN-MODIFIED LANDSCAPE: POPULATION, ACTIVITY BUDGET, AND SOCIETAL PERCEPTIONS IN BANGLADESH**

Sufia Akter Neha, Mohammad Ashraf Ul Hasan, Mohammad Abdul Baki & Subrina Sehrin

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## Rhesus Macaque *Macaca mulatta* (Mammalia: Primates: Cercopithecidae) in a human-modified landscape: population, activity budget, and societal perceptions in Bangladesh

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**Abstract:** Rhesus Macaques are widely distributed and ecologically diverse primate species that attract special focus from the research and conservation approaches. We studied population, activity budget, and societal perceptions of Rhesus Macaque at Old Dhaka City, Bangladesh from March 2015 to February 2016. Total count was used to determine the group size and composition. Daily activity budgets of Rhesus Macaques were studied using scan sampling method. Questionnaire survey was conducted to know the attitudes of local people towards monkey conservation in the area. Seven groups with a total of 169 individuals were recorded. The population density was 15.5 individuals/ km<sup>2</sup> and group size ranged from 8 to 63 individuals. Rhesus Macaque spent most of their time in resting (38.5%) followed by feeding (25.7%), moving (18.4%), grooming (12.8%), and playing or object manipulation (4.6%). There was a significant variation in each behavioral activity among the age-sex classes. Questionnaire survey revealed that property damage was the main problem created by the monkeys. A significant majority of people (83.4%) held a positive outlook toward conservation of this species. Variables such as religion, education, and occupation of the respondents significantly influenced their opinion about conservation. These findings have implications for not only conservation and management interventions of Rhesus Macaque but also helpful for minimizing human-monkey interactions in urban areas.

**Keywords:** Behavioral activity, conservation, human-primate interactions, management interventions, questionnaire survey, urban landscape.

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**Author contributions:** SAN: conceptualization, investigation, methodology, resources, writing-original draft, formal analysis, validation, writing-review and editing, visualization. MAUH: conceptualization, investigation, methodology, resources, data curation, formal analysis, validation, writing-review and editing, visualization. MAB: writing-review and editing, supervision. SS: supervision

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## INTRODUCTION

Rhesus Macaques *Macaca mulatta* are one of the world's most widespread, abundant, and ecologically adaptive primate species. *M. mulatta* is distributed in Bangladesh, India, Pakistan, Nepal, Myanmar, Thailand, Afghanistan, southern China, and some neighboring areas (Green 1978). In Bangladesh, they are found in substantial numbers in a wide variety of habitats including semi-evergreen and evergreen forests in the northeastern and southeastern regions, moist deciduous forests in the central region, and Sundarbans mangrove forest in the south-west (Hasan et al. 2013; Hasan et al. 2016). Populations of macaques also inhabit human dominated landscapes in urban settings, roads, canal banks, villages, temples, and shrines (Southwick & Siddiqi 1994; Maestripietri & Hoffman 2012; Hasan et al. 2013; Jaman & Huffman 2013). They depend mainly on anthropogenic food sources and play a vital role in the culture and religion of some communities (Southwick & Siddiqi 1994). Old Dhaka city is one of the historical sites of Rhesus Macaque distribution in Bangladesh. Rhesus Macaques are considered as non-seasonal breeders and are often termed as 'weed species' in response to their capability of living in densely populated urban habitats (Teas et al. 1980; Richard et al. 1989; Southwick et al. 2005). This species is categorized as Vulnerable (IUCN Bangladesh 2015) and a total of 251 individuals in seven groups were reported in urban areas of Dhaka city (Hasan et al. 2013). Assessing the population status in urban landscape is necessary to understand the ecological needs of Rhesus Macaque and developing effective conservation strategies (Malaivijitnond et al. 2005; Lwanga et al. 2011).

An important feature in studies of the behavioral ecology of a species is to evaluate the percentage of time spent in different activities throughout a day or year (Kabir 2002). Activity budgets is a method of quantifying behavior of how animals allocate their time in various activities that are crucial for survival, reproduction, and might help in the understanding of life history traits and environmental adaptations of animals (Bernstein 1968; Rodway 1998). Time is a limited resource that eventually impacts the behavior of various species (Pollard & Blumstein 2008). Primates usually change their daily behavior in response to ecological and social factors to ensure their survival (Jaman & Huffman 2008; Okekedunu et al. 2014). Numerous studies have investigated that activity budgets and feeding behavior vary in response to diet, habitat structure, distribution, and availability of food sources and individual

requirements (Peres 1993; Passamani 1998; Neha et al. 2020). Activity budgets for primates thriving in the human altered habitats are different from those in their natural habitat (Krebs & Davies 1993). Rhesus Macaques are one of the primates that are greatly influenced by human activities in manipulating their habitat (Hambali et al. 2012). We selected a group of Rhesus Macaques living commensally with humans where these macaques are opportunistically omnivorous, obtaining provisioned food along with a few garden plants from nearby public parks, to know how a species adapts under human-modified environmental pressures.

Primate populations are declining rapidly because of the devastation from habitat change and shrinkage of primary habitats, competition for food and space, hunting, pet trade, and body parts for traditional medicines (Wolfheim 1983; Mittermeier 1986; da Silva et al. 2016; Amano et al. 2021). However, expansion of human settlements, destruction of natural habitats and scarcity of food are the major challenges for the urban Rhesus Macaques. The severe ecological alterations as well as close interaction of macaques with humans have led to negative interactions. For example, provisioning food for the macaques in temples and the tendency of co-inhabiting with humans in urban settlements causes negative interactions between humans and primates (Beisner et al. 2015). Macaques often destroy home gardens and fruit trees in urban areas, seek shelter on the rooftops, and inside factory buildings causing damage to human properties. Also, they frighten people with a furious snarl, snatch away food items, and sometimes bite people. In contrast, they are occasionally electrocuted while crossing the utility lines, injured, and even sometimes killed by the residents. In many countries, monkeys have gained protection under traditional beliefs and religious context and are provisioned, protected and worshipped by the local people and temple authorities (Strum 1994). For instance, in Thailand and Japan, though monkeys are fed in a temple or in a village (Knight 1999), they are killed in some adjacent fields (Eudey 1994). Therefore, it is essential to evaluate the attitude of local people towards Rhesus Macaques which aid our understanding of human-monkey co-existence and be helpful to reduce the negative interactions.

Studies on Rhesus Macaque in Bangladesh have focused on population, distribution, competition among sympatric primates and genetic variation (Green 1978; Gittins 1980; Oppenheimer et al. 1983; Feeroz et al. 1995; Sultana 2012; Hasan et al. 2013, 2016; Naher et al. 2016; Neha et al. 2021). However, no studies have been



published relating to activity budget and opinions of local people about the conservation of Rhesus Macaques. The present study therefore focused on the group size and composition, activity budget, and societal perceptions of Rhesus Macaques. The aims of this study were to: (i) assess the population of urban Rhesus Macaque in Old Dhaka City, (ii) evaluate how they budget their time in different activities, and (iii) explore the attitudes of local people toward the conservation of macaques. This study is important to increase our knowledge on the ecology and behavior of Rhesus Macaque that occupy the human altered environment which leads to effective management strategies for their conservation in the area.

## MATERIALS AND METHODS

### Study area

Dhaka City is the capital of Bangladesh and is primarily divided into two parts- the historic Old Dhaka and New Dhaka. The study was carried out in the Old Dhaka City (23.722°N & 90.387°E, Figure 1) from March 2015 to February 2016, where Rhesus Macaques co-exist with humans in proximity. It is situated on the banks of the Buriganga River and covers an area of approximately 5 km<sup>2</sup> (Sultana 2012). The buildings and other constructions are ancient and are at high risk of crumbling down. The buildings are very close to one another that makes the roads narrow and congested to support large population of monkeys. The main planted trees in the parks and gardens include neem *Azadirachta indica*, white plumeria *Plumeria* sp., guava *Psidium guajava*, mango *Mangifera indica*, coconut *Cocos nucifera*, blackberry *Syzygium cumini*, jackfruit *Artocarpus heterophyllus*, and jujube *Ziziphus mauritiana*. The highest temperature at the study site was 39 °C in May, and lowest was 12 °C in January. The highest rainfall was recorded in August 2015 (337 mm) and lowest in March 2016 (54 mm).

### Population survey

Total counts were used to survey monkey population (Southwick et al. 1961; Bibby et al. 1992) from dawn to dusk as the study area was small that could be fully covered. Since Rhesus Macaque is the only primate living in the area, the species is easy to identify. Survey was done from all the accessible roads and lanes. Roadways and pathways were walked on foot at a pace of 1 km per hour. Observers paced along roads stopping every 200 m to explore the area by observing visual and auditory cues. When a monkey group was sighted, we recorded

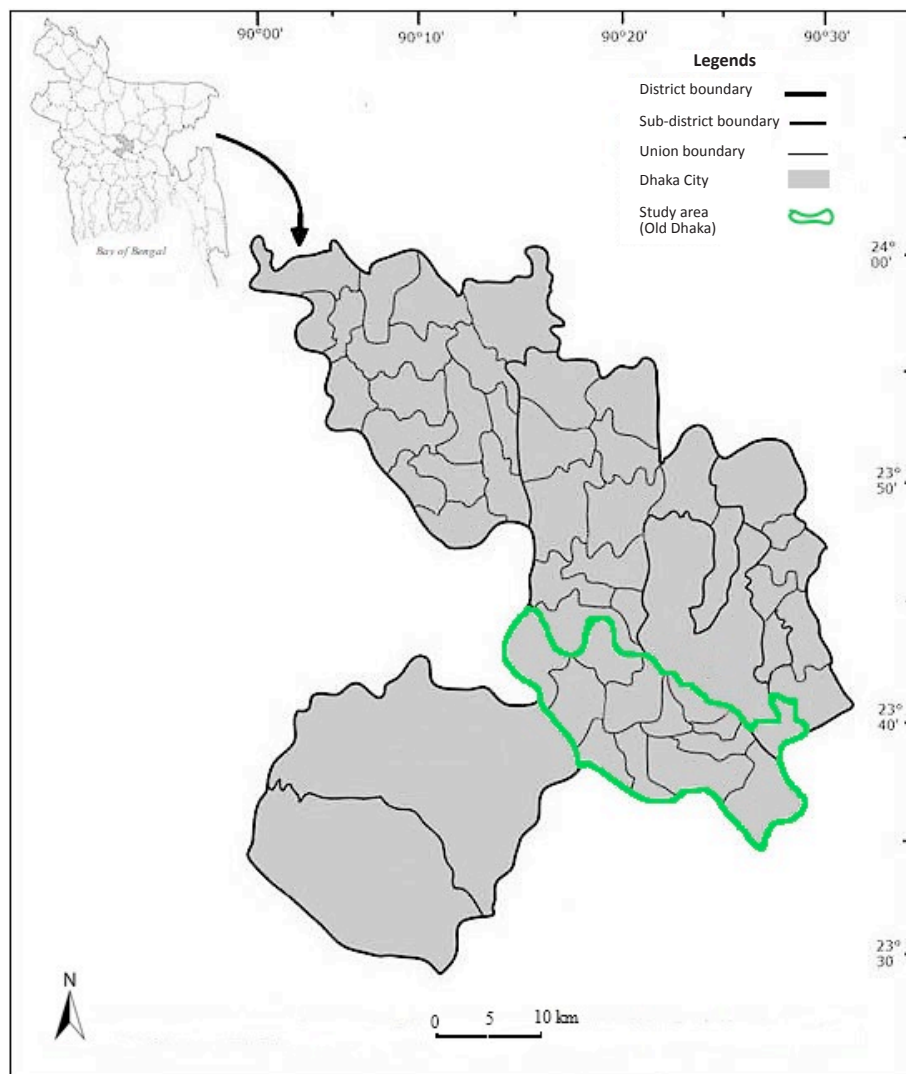
the information including their coordinates, group size and composition, age-sex classes, and individual characteristics like physical markings. Double counting was performed to minimize the bias in identifying age-sex of the groups. We offered provisioned food (bananas, breads, and nuts) to attract the monkeys in order to ease the counting. We also counted while respective authority offered provisioned foods in temples and factories. Individuals were classified based on their morphology (Stanford 1991).

### Behavioral sampling

Four age-sex classes of monkeys—an adult male, an adult female, a juvenile, and an infant—were studied from 0600 h to 1800 h for 5–6 days in each month, using instantaneous scan sampling method. These focal individuals were observed for 5 min followed by a 5 min break (Altman 1974). Two observers (Sufia Akter Neha and Mohammad Ashraf Ul Hasan) recorded the behavioral data. The first observer recorded the behavior of an individual of a group, and at the same time, the second observer observed another individual of different age-sex class of the same group. We made a total of 4,235 scans to record the five behavioral activities- resting, feeding, moving, grooming, and playing or object manipulation. Resting is defined when an individual desists all sorts of movements including sleeping or looking about. Feeding includes handling of food, manipulating, chewing, and swallowing food items. Moving is when a monkey travels from one place to other and changes its position. Grooming means removing or scratching dirt and other objects from hair or skin for the hygienic benefits in the form of grooming itself or being groomed. Playing behavior includes picking up stones, sticks, and other objects to manipulate them with hands, for example, hanging on tree branches, jumping, and mounting on the back of the mother as a means of non-threatening context which enables the social development within a group.

### Questionnaire survey

A structured questionnaire survey was conducted to collect data on attitudes of local people toward the conservation of Rhesus Macaque (Khatun et al. 2013; Ahsan & Uddin 2014). The interviewers visited the local residences, shops, nearby temples who have regularly encountered Rhesus Macaques and questions were administered individually to all the participants. In total, 210 respondents were interviewed representing various groups like shopkeepers, devotees, students, and housewives. Demographic (age, sex, religion,



**Figure 1.** Bangladesh (on the upper left) and its capital Dhaka (on the right) in which green polygon indicates the boundary of the study area (Old Dhaka) inhabited by seven groups of Rhesus Macaques. Source: modified from Sultana et al. (2018).

education) and socio-economic (occupation) profile of the respondents were incorporated while asking the questions. We considered the respondents who had attended school up to the 10<sup>th</sup> grade or more as educated and those who had attended school below the 10<sup>th</sup> grade as less-educated.

#### Data analysis

Chi square tests were performed to find out differences of age-sex classes in the groups as well as to assess the variations in the response of the interviewees. Kruskal-Wallis one-way ANOVA was employed to compare time spent for age-sex classes in each of the behavioral activities. To substantiate the Kruskal-Wallis tests, post hoc pair-wise comparisons were used to see the variation of time spent for each behavioral activity

between age-sex classes in the group. Statistical Package for Social Sciences (SPSS, v. 20) was used to analyze data, considering a p value  $\leq 0.05$  to be statistically significant.

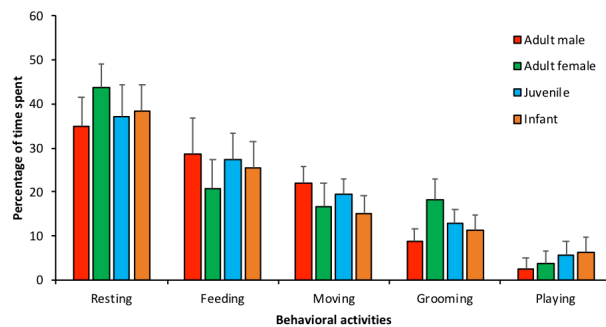
## RESULTS

#### Group structure

A total of 169 individuals were encountered in seven groups. The largest group (63 individuals) was recorded in Sadhana Awshadhalay and the smallest group (8 individuals) in Banagram (Table 1). Group size ranged 8–63 individuals (mean  $24.14 \pm 18.49$ ,  $n = 7$ ). Adults comprised 21.6% male and 48.15% female while non-adults comprised 25.93% juvenile and 4.32% infant of the population. The population density of Rhesus

**Table 1.** Group composition and age-sex ratio of Rhesus Macaque in Old Dhaka City.

Monkey groups	Adult male	Adult female	Juvenile	Infant	population size	AM:AF	AM:JU	AM:IN	AF:JU	AF:IN	JU:IN
Sadhana Awshadhalay	17	28	14	4	63	1:1.65	1:0.82	1:0.24	1:0.5	1:0.14	1:0.29
Rabidaspara Lane	6	14	4	2	26	1:2.33	1:0.67	1:0.33	1:0.29	1:0.14	1:0.5
Uttar Musondi	3	9	11	2	25	1:3	1:3.67	1:0.67	1:1.22	1:0.22	1:0.18
Radhika Mohan Bosak Lane	4	10	5	3	22	1:2.5	1:1.25	1:0.75	1:0.5	1:0.3	1:0.6
Suritola	2	7	3	1	13	1:3.5	1:1.5	1:0.5	1:0.43	1:0.14	1:0.33
Tanti Bazar-Shakhari Bazar	2	6	3	1	12	1:3	1:1.5	1:0.5	1:0.5	1:0.17	1:0.33
Banagram	1	4	2	1	8	1:4	1:2	1:1	1:0.5	1:0.25	1:0.5
Overall	35	78	42	14	169	1:2.23	1:1.2	1:0.4	1:0.54	1:0.18	1:0.33
$\chi^2$ value						1.96	5.52	2.52	5.01	1.11	1.72
p value						0.92	0.48	0.87	0.54	0.98	0.94

AM—Adult male | AF—Adult female | J—Juvenile | IN—Infant | \*—Significant at  $p \leq 0.05$ **Figure 2.** Variation of behavioral activities among age-sex classes of Rhesus Macaques.

Macaque was 15.5 individuals/ km<sup>2</sup>. The average ratio between adult males and adult females was 1:2.23, adults and non-adults was 1:0.5, and adult females and infants was 1:0.18. There was no significant variation in the proportion of adult males and adult females ( $\chi^2=1.96$ ,  $df=6$ ,  $p=0.92$ ), adult females and infants ( $\chi^2=1.11$ ,  $df=6$ ,  $p=0.98$ ), adult females and juveniles ( $\chi^2=5.01$ ,  $df=6$ ,  $p=0.54$ ), and juveniles and infants ( $\chi^2=1.72$ ,  $df=6$ ,  $p=0.94$ ) among the groups.

### Daily time budget

Rhesus Macaque spent most of their activity in resting (38.5% of the total scans,  $sd=+2.59$ ,  $n=1,631$ ), followed by feeding (25.7%,  $sd=+2.48$ ,  $n=1,088$ ), moving (18.4%,  $sd=+1.86$ ,  $n=779$ ), grooming (12.8%,  $sd=+3.06$ ,  $n=542$ ) and playing (4.6%,  $sd=+1.22$ ,  $n=195$ ). Behavioral activities among the age-sex classes of Rhesus Macaque varied during the study period (Table 2). A post hoc pair-wise comparison showed that adult females spent more time resting and grooming than adult males ( $p < 0.001$ ,

same value), juveniles and infants ( $p < 0.001$ , same value for all comparisons, respectively; Figure 2). But adult males spent more time feeding than adult females, juveniles, and infants ( $p < 0.001$ ,  $p=0.036$ ,  $p=0.014$ , respectively). Adult males also spent more time moving than adult females, juveniles and infants ( $p < 0.001$ ,  $p=0.026$ ,  $p < 0.001$ , respectively). Infants spent more time playing or being engaged in object manipulation than juveniles, adult females, and adult males ( $p=0.042$ ,  $p=0.0011$ ,  $p < 0.001$ , respectively).

### Demographic and socioeconomic profile of the respondents

A total of 210 respondents were interviewed during the questionnaire survey, of which 111 (53%) were men and 99 (47%) were women. The age of the respondents varied between 18 and 75 years. Hindus represented 56% of the respondents and Muslims represented 44%. Furthermore, 39.5% were educated, while 60.5% were less-educated. With respect to occupation, 31% were shopkeepers, 27% housewives, 23% students, and 19% devotees. The demographic and socioeconomic status did not vary significantly among the respondents in study areas concerning gender ( $\chi^2=8.71$ ,  $df=6$ ,  $p=0.074$ ), age class ( $\chi^2=2.52$ ,  $df=6$ ,  $p=0.421$ ), and education ( $\chi^2=5.37$ ,  $df=6$ ,  $p=0.274$ ) however, differed significantly in relation to religion ( $\chi^2=13.59$ ,  $df=6$ ,  $p=0.005$ ), and occupation ( $\chi^2=18.92$ ,  $df=6$ ,  $p=0.001$ ).

### Societal perceptions toward Rhesus Macaques

Based on the questionnaire survey, on an average 55% people in the city area claimed property damage (e.g., entering residential buildings, damaging rooftop



**Table 2.** Kruskal-Wallis one-way analysis of variance output for age-sex classes in each behavioral activities of Rhesus Macaque.

	Activities	H	df	p
Age-sex class	Resting	43.16	3	< 0.001
	Feeding	16.32	3	< 0.01
	Moving	21.71	3	< 0.01
	Grooming	39.58	3	< 0.001
	Playing	24.05	3	< 0.001

**Table 3.** Perception of respondents towards Rhesus Macaque at Old Dhaka City.

	Variables	Categories	Response %
1	What problems do you face by monkeys?	a) Damage to property b) Food/cloth stealing c) Monkey bites	54.6 38.9 6.5
2	How do you mitigate conflict with monkey?	a) Strike with stick b) Throw stone c) Use of fence/grills	12.4 61.4 26.2
3	Do you observe any changes in monkey population?	a) Increase b) Decrease	43.8 56.2
4	What is the threat to Rhesus Macaque?	a) Loss of habitat b) Food scarcity c) Electrocution	52.7 32.9 14.4
5	Do the local people show religious sympathy?	a) Yes b) No	62.5 37.5
6	How do we need to initiate conservation activities?	a) Keep them as it is now b) Restrict some places for them	24.2 75.8
7	What is your opinion towards monkey conservation in your area?	a) Positive b) Negative	83.4 16.6

gardening, and disconnecting electricity, satellite, & telephone cable) was the main problem created by monkeys, whereas nearly 40% people believe food and cloth stealing were the serious problems. In contrast, a few people (6.5%) agreed that monkey bite was another problem faced by the local people (Table 3). To minimize monkey menace, many people (61.4%) threw stones, while roughly one quarter of the respondents (26.2%) used fence and iron grills and more than one in 10 people (12.4%) struck them with a stick. Just over half of the people (56.2%) stated that the monkey population has decreased in Old Dhaka City, however, more than two-fifths of the respondents (43.8%) did not agree with this. Around half of the local people (52.7%) believed that habitat loss was the main threat to monkey, whereas just under a third of the respondents (32.9%) considered food scarcity was one of the major threats. Electrocution was also reported by less than a fifth of the respondents (14.4%). A large amount of people (62.5%) from local

**Table 4.** Respondents viewpoint to conservation of Rhesus Macaque in the study area.

Variables	Attitude towards conservation		Chi-square test		
	Positive % (n)	Negative % (n)	$\chi^2$	Df	p
<b>Gender</b>			0.52	1	0.71
Male	88.4 (98)	11.6 (13)			
Female	91.2 (90)	8.8 (9)			
<b>Age class</b>			0.26	1	0.58
Adult	90.6 (99)	9.4 (10)			
Young	86.1 (87)	13.9 (14)			
<b>Religion</b>			14.67	1	0.0001
Muslim	72.3 (67)	27.7 (25)			
Hindu	85.5 (101)	14.5 (17)			
<b>Education</b>			11.35	1	0.002
Educated	92.3 (77)	7.7 (6)			
Less-educated	74.6 (95)	25.4 (32)			
<b>Occupation</b>			8.78	3	0.014
Shopkeepers	67.7 (44)	32.3 (21)			
Housewives	73.7 (42)	26.3 (15)			
Students	81.2 (39)	18.8 (9)			
Devotees	90.0 (36)	10.0 (4)			

area have had religious attachments with monkeys, especially the Hindu communities, but less than two-fifths of the people (37.5%) did not feel this way. Three quarters of people (75.8%) in the city area asserted that the government should take necessary steps by shifting the monkeys to other places and restrict some places for them, while rest of the respondents (24.2%) argued to keep them where they are now.

Despite several problems created by monkeys, a significant majority of people (83.4%) had a positive attitude toward the conservation of monkeys. The variation in respondent attitude towards conservation of Rhesus Macaque were significantly explained by three of the five independent variables: (1) religion ( $p=0.0001$ ), (2) education ( $p=0.002$ ), and (3) occupation ( $p=0.014$ ) (Table 4). Hindus and educated people supported conservation and considered monkeys to be a part of the local culture and heritage and believed that the species should be safeguarded for future generations. Additionally, students and devotees had a higher opinion of monkey conservation than their corresponding counterparts (Table 4). They felt that monkeys resembled human beings and had recreational and aesthetic values.



## DISCUSSION

Rhesus Macaque at Dhaka City has shown significant variation in terms of population size and composition over the last 40 years. Akonda (1976) found 11 groups of Rhesus Macaque comprised of 196 individuals which increased to 229 individuals in 11 troops by Oppenheimer et al. (1983). Further a decrease in population was observed to 196 individuals in 11 groups by Feeroz et al. (1995). After a long gap of 17 years, Sultana (2012) reported 178 individuals in 10 groups and Hasan et al. (2013) recorded 251 individuals in seven groups. The present study identified seven groups with a total of 169 individuals. The reason for such fluctuations might be due to the different study methods or the area considered for the study. Moreover, demographic trends of the population are interconnected with habitat structure which influence the response of that population (Green 2003). Still, the possible reasons for the decline of the Rhesus Macaque population in this study area could be the consequences of habitat loss, felling of food trees, electrocution, and human disturbances. The largest group was found in Sadhana Awshadhalay area (17 adult males, 28 adult females, 14 juveniles, and 4 infants) as the Rhesus Macaques in this area mostly depend on the provisioning of food supplied by the local people. Visitors and factory people also provide shelter to these macaques. In contrast, the smallest group we recorded was in Banagram (1 adult male, 4 adult females, 2 juveniles, and 1 infant) which was due to the fact that the people of that area were unfriendly toward macaques and there was a lack of provisional food resources. Group size ranged from 8 to 63 individuals that differed from other studies: 4 to 59 individuals (Sultana 2012); 24 to 59 individuals (Hasan et al. 2013). This is because of intra-specific variation in group size relying on history of the group and occasional dispersal into the other groups (Menard 2004; Md-Zain et al. 2010). However, the number of females is higher than their male counterpart in each group. This could be because female monkeys are philopatric, remaining in the group throughout their life, while males may depart their natal families upon reaching maturity (Hasan et al. 2013).

The proportion of time spent on behavioral activities varied between populations of macaques due to habitat differences and age-sex specific physiological factors (Brent & Veira 2002; Jaman & Huffman 2008). We found the most observed daily activity from the study group was resting and feeding (38.5% and 25.7%, respectively). This study was supported by Jaman & Huffman (2013), that showed Rhesus Macaque spent 46.1% and 22.4% of their active time on resting and feeding compared to other

activities. Jaman & Huffman (2008) also found that resting time was longer in captive Japanese Macaques. Time spent resting and feeding in urban Rhesus Macaque was longer due to regular supply of higher quality provisioned food, for example, fruits, vegetables, nuts, breads, biscuits, and chick-peas offered by the local people and visitors. Additionally, they ate from plant sources such as young leaves, flowers, fruits, seeds, shoots, and insects. Due to limited access to natural foraging sites, the urban macaques frequently rested after taking provisioned food by adopting lower energy search strategy to meet their metabolic requirements of a smaller amount of food in a limited amount of time (El Alami et al. 2012; Jaman & Huffman 2013). Rhesus Macaques commonly rested on the branches of trees, the roof of the buildings, graveyards and parks. Moving was the behavior recorded to have the third highest proportion in this study which is inconsistent with other macaque studies observed elsewhere (Hambali et al. 2012; Md-Zain et al. 2010; Okekedunu et al. 2014). This may be because monkeys in forest settings were mainly frugivorous, occupied more space and thus, spent most of their time searching for fruits in comparison with monkeys living commensally with humans. When the energetic demands were met, provisioned Rhesus Macaque were engaged in grooming to strengthen their social bonds-similar to other groups conducted in India and Nepal (Teas et al. 1975; Malik & Southwick 1988). Playing is a part of learning the ways of social relations and performing actions more successfully (Kipper & Todt 2002; Naples & Rothschild 2015). Playing with objects and water, pulling each other's tail and swinging on the tree branches have been observed in the study groups.

Our result showed differences in activity pattern of Rhesus Macaque among age-sex classes. Adult males spent more time feeding and moving in comparison with the rest of the group. The plausible reason for this might be that adult males undertook raids on houses, gardens and garbage bins and took over the provisioned food, continued to feed voraciously while leaving the leftover food for others. Juveniles and infants also fed more because they require more nutrients for their development and maturation (Watanuki & Nakayama 1993). The adult males are physically dominant over others and were observed moving frequently to protect their territory from neighboring groups. Adult females spent more time resting and grooming. Similar results have been reported by Jaman & Huffman (2013). As feeding is inversely related to resting, thus spending less time feeding which allowed them to rest for a longer period of time. Moreover, adult females were seen to groom other females and infants after feeding and

while resting. Mothers often groom their infants which strengthen the kinship among them. Besides, subordinate females usually groom higher ranking adult females in order to maintain hierarchy. This finding is related to those conducted by Md-Zain et al. (2010) and Hambali et al. (2012). It is also found that females groom males after mating, which has been observed in other primates such as marmosets where male marmosets were groomed by females in favor of sharing food and to gain protection (Lazaro-Perea et al. 2004). Playing behavior is commonly performed by juveniles and infants. In addition, mothers of Rhesus Macaques were also observed to play with their babies. Females often play with their young as a means of practicing survival related activities as well as keeping them safe from the predators (Hambali et al. 2012; Naples & Rothschild 2015).

Our study from the questionnaire survey revealed that the majority of the people had positive attitudes towards conservation of the Rhesus Macaque. Similar results have also been reported for other primate studies (Khatun et al. 2012; Hasan et al. 2018). The attitude towards Rhesus Macaque conservation varied significantly among the respondents of different religion, education and occupation. Religious attachment of the Hindu community with Rhesus Macaques influenced their inclination to conservation. This is because they consider monkeys as sacred animals to be conserved. Therefore, cultural and religious sympathy can increase tolerance and conservation of primates in rural and urban areas (Pirta et al. 1997; Hill 1998). Educated people were more compliant with supporting conservation of monkeys. This is due to the fact that the educated people who belonged to a higher land-holding status were less concerned about the monkey menace as their economic status was secure compared to the lesser-educated or low land-holding people. Khatun et al. (2012) also noticed that the positive attitude of local people in Keshabpur, Bangladesh towards conservation of common langurs were associated with land-holding status of the respondents. It was observed that temple authorities especially devotees and people who have visited the temple provided food to macaques and offer shelter in the temple premises. Moreover, young people and students were also seen to feed macaques from their window and balcony, which may be regarded as a popular pastime. These findings suggest that the factors influencing the local people's attitudes are crucial for the conservation of Rhesus Macaques in this area.

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## Articles

**On the impact of earthquake-induced landslides on Red Panda *Ailurus fulgens* (Mammalia: Carnivora: Ailuridae) habitat in Langtang National Park, Nepal**  
– Yogesh Rana Magar, Man Kumar Dhamala, Ajay Mathema, Raju Chauhan & Sijar Bhatta, Pp. 19191–19202

**Rhesus Macaque *Macaca mulatta* (Mammalia: Primates: Cercopithecidae) in a human-modified landscape: population, activity budget, and societal perceptions in Bangladesh**  
– Sufia Akter Neha, Mohammad Ashraf Ul Hasan, Mohammad Abdul Baki & Subrina Sehrin, Pp. 19203–19211

**Factors affecting the species richness and composition of bird species in a community managed forest of Nepal**  
– Bishow Poudel, Bijaya Neupane, Rajeev Joshi, Thakur Silwal, Nirjala Raut & Dol Raj Thanet, Pp. 19212–19222

## Communications

**A large mammal survey in Koyli Alpha Community Wildlife Reserve and its surroundings in the Great Green Wall extension area in Senegal**  
– Anna Niang & Papa Ibnou Ndiaye, Pp. 19223–19231

**Blackbuck *Antelope cervicapra* (Mammalia: Cetartiodactyla: Bovidae) estimates in human-dominated landscape in Aligarh, Uttar Pradesh, India**  
– Mujahid Ahamad, Jamal A. Khan & Satish Kumar, Pp. 19232–19238

**Diet of Leopards *Panthera pardus fusca* inhabiting protected areas and human-dominated landscapes in Goa, India**  
– Bipin S. Phal Desai, Avelyno D'Costa, M.K. Praveen Kumar & S.K. Shyama, Pp. 19239–19245

**First record of interspecies grooming between Raffles' Banded Langur and Long-tailed Macaque**  
– Zan Hui Lee, Andie Ang & Nadine Ruppert, Pp. 19246–19253

**Photographic evidence of Red Panda *Ailurus fulgens* Cuvier, 1825 from West Kameng and Shi-Yomi districts of Arunachal Pradesh, India**  
– Moktan Megha, Sylvia Christi, Rajesh Gopal, Mohnish Kapoor & Ridhima Solanki, Pp. 19254–19262

**On the reproductive biology of the invasive Armoured Sailfin Catfish *Pterygoplichthys pardalis* (Castelnau, 1855) (Siluriformes: Loricariidae) from the natural drainages in Thiruvananthapuram, India**  
– Smrithy Raj, Suvarna S. Devi, Amrutha Joy & A. Biju Kumar, Pp. 19263–19273

**On the high bird diversity in the non-protected regions of Trashiyangtse District in Bhutan**  
– Lam Norbu, Phuntsho Thinley, Tandin Wangchuck, Ugyen Dechen, Lekey Dorji, Tshering Choephel & Pasang Dorji, Pp. 19274–19292

**Population status and distribution of the Critically Endangered Bengal Florican *Houbaropsis bengalensis* in the grassland of Koshi Tappu Wildlife Reserve, Nepal**  
– Ritika Prasai, Hemanta Kafley, Suraj Upadhaya, Swosthi Thapa, Pratistha Shrestha, Alex Dudley & Yajna Prasad Timilsina, Pp. 19293–19301

**Is habitat heterogeneity effective for conservation of butterflies in urban landscapes of Delhi, India?**  
– Monalisa Paul & Aisha Sultana, Pp. 19302–19309

**A preliminary checklist of moths (Lepidoptera: Heterocera) from Gangajalghati, Bankura, West Bengal, India**  
– Ananya Nayak, Pp. 19310–19323

**First report of three species of the genus *Diaphanosoma* (Crustacea: Cladocera: Sididae) from Jammu waters (J&K), India**  
– Nidhi Sharma & Sarbjeet Kour, Pp. 19324–19337

## Review

**Wild ungulates in Jordan: past, present, and forthcoming opportunities**  
– Ehab Eid & David Mallon, Pp. 19338–19351

## Viewpoint

**The captive population of the Lion-tailed Macaque *Macaca silenus* (Linnaeus, 1758). The future of an endangered primate under human care**  
– Nilofer Begum, Werner Kaumanns, Alexander Sliwa & Mewa Singh, Pp. 19352–19357

## Short Communication

**Jaguar *Panthera onca* (Linnaeus, 1758) (Mammalia: Carnivora: Felidae) presumably feeding on Flathead Catfish *Pylodictis olivaris* (Rafinesque, 1818) (Actinopterygii: Siluriformes: Ictaluridae) at Aros and Yaqui rivers, Sonora, Mexico**  
– Juan Pablo Gallo-Reynoso, Pp. 19358–19362

## Notes

**Life near a city: activity pattern of Golden Jackal *Canis aureus* Linnaeus, 1758 (Mammalia: Carnivora: Canidae) in a habitat adjoining Bhubaneswar, India**  
– Subrat Debata, Pp. 19363–19366

**Chemical immobilisation of a Eurasian Lynx *Lynx lynx* (Linnaeus, 1758) (Mammalia: Carnivora: Felidae) with ketamine-dexmedetomidine mixture in Ladakh, India**  
– Animesh Talukdar & Pankaj Raina, Pp. 19367–19369

**White-bellied Heron *Ardea insignis* in Hkakabo Razi Landscape, northern Myanmar**  
– Myint Kyaw, Paul J.J. Bates, Marcela Suarez-Rubio, Bran Shaung, Han Nyi Zaw, Thein Aung, Sai Sein Lin Oo & Swen C. Renner, Pp. 19370–19372

**Range extension of the Common Slug Snake *Pareas monticola* (Cantor, 1839) (Reptilia: Squamata: Pareidae): a new family record for Nepal**  
– Dipa Rai, Manoj Pokharel & Tapil P. Rai, Pp. 19373–19375

**First record of *Mantispilla indica* (Westwood, 1852) (Neuroptera: Mantispidae) from the Western Ghats, India**  
– T.B. Suryanarayanan & C. Bijoy, Pp. 19376–19379

**A new distribution record of the Western Ghats endemic damselfly *Melanoneura bilineata* Fraser, 1922 (Insecta: Odonata) from Maharashtra, India**  
– Yogesh Koli & Akshay Dalvi, Pp. 19380–19382

**A new record of the Emerald Striped Spreadwing *Lestes viridulus* Rambur, 1842 (Zygoptera: Lestidae) from Nepal**  
– Manoj Sharma, Pp. 19383–19385

**Rediscovery of the Bhutan Primrose *Primula jigmediana* W.W. Smith (Angiosperms: Primulaceae) after 87 years in Bumdeling Wildlife Sanctuary, Bhutan**  
– Tez B. Ghalley, Tshering Dendup, Karma Sangay & Namgay Shacha, Pp. 19386–19388

**First report of *Golovinomyces* sp. causing powdery mildew infection on *Dyschoriste nagchana* in Western Ghats of India**  
– Sachin Vasantrao Thite, Pp. 19389–19390

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