Journal of Research and Development
Vol.6, Issue-1, May 2023, pp.39-50
DOI: https://doi.org/10.3126/jrdn.v6i01.55238
ISSN: 2616-0366 (Print)
Research and Development Nepal (RDN)

Ethogram and Time Budgeting of Rhesus Monkey Macaca mulatta (Zimmermann, 1789) in Ramdhuni Forest, Nepal

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Abstract

Ethogram provides a list of behaviours a species exhibits together with explanations of each activity in the form of descriptive words and phrases. With the objective to explore the time budgeting of the major behaviours of rhesus monkey the study was conducted from September 2022 to February 2023 by following scan sampling method in Ramdhuni forest, Sunsari,Koshi province Nepal. A total of 750 events were recorded in field working time 300 hours. The time allocated was documented as for foraging (26.67%), locomotion (18.93%), inactive (30.26%), grooming (20.67%) and fighting (3.46%).There was not significant association in gender regarding with the activities (Chi square=0.97, degree of freedom= 4, at significance level 0.05 and tabulated value= 9.49). There was a close relation between the activities in morning and day time (r= 0.80906). Likewise, there was a significant relation between time budgeting for activities with the place for activities (Chi square=78.74, degree of freedom= 20, significance level =0.05 Chi square tabulated= 31.41). Most of the activities were recorded on floor and roof of buildings and temples. There was not association between the allocated time for different activities with the change of season (Chi square= 0.9, degree of freedom=4, significance level= 0.05 and chi square tabulated=9.49). It can be recommended that to manage the monkey and reduce probable conflict between human and monkey, pilgrims should be restricted only in forest sides, not in temple premises to provide foods to monkeys.

Keywords: foraging, grooming, roof, season, tree

Introduction

An ethogram is a record of behaviors exhibited by an animal used in ethology, the scientific and objective study of animal behavior and it provides a list of the behaviors a species exhibits together with explanations of each activity in the form of descriptive words and phrases (Martin and Bateson, 2007).One of the most well-known, least concerned, Simian species is the rhesus monkey (Macaca mulatta), which belongs to the Cercopithecidae family and it is distributed from northern Afghanistan in the east to the Godavari River in India, Thailand, Laos, Cambodia, Vietnam, Nepal, Bangladesh, Tibet, and China in the west. It is found across South East Asia (Roonwal and Mohnot, 1977). In Nepal and also in whole Asia, rhesus monkeys are found in tropical rain forests. But may live at high altitudes in the Himalayas and other temperate regions with long snowy winters (Chalise, 2013).

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Only three species of non-human primates-Hanuman Langurs, Rhesus monkeys and Assamese monkeys have been identified in Nepal (Chalise et al., 2005). The rhesus monkeys (Macaca mulatta Zimmermann, 1780) can be observed roaming freely in both urban and rural religious settings places. Langurs (Semnopithecus entellus Dufresne, 1797) can be found roaming freely in Nepal's natural forests and their fringe areas (Southwick et al., 1982). There have been reports of Assamese monkeys (Macaca assamensis Mc Clelland, 1840) in Nepal's mid-hills and high mountain forests (Chalise, 1999).

The rhesus monkey has a pale face, brown, olive, and yellowish brown fur, and no obvious menstrual swelling is visible, but a sizable region of the buttock's exposed flesh turns red during fertile season (Pocock, 1975). Male rhesus bodies range in length from 48 to 68 cm, while female rhesus bodies are between 45 and 55 cm long. Male weighs between 6.5 and 12 kg and female between 5.49 and 7.37 kg (Chalise, 1997). Rhesus is group dwelling monkey and four types of groupims can be observed. It is mostly ground feeder and partly arboreal (Chalise, 1998).

In South and Southeast Asia, where monkeys are important to both Hindu and Buddhist culture, one might find in temples and holy places (Fuentes et al., 2005 a). The primates most frequently connected with temples are monkey species because they can survive in situations that have been altered by humans. At these locations, there is extensive, uncontrolled, and frequently close contact between humans and monkeys (Fuentes et al., 2005 b).

When they adjusted in the human altered habitat with a different food rather than the wild type, their behaviour might have altered. In Ramdhuni forest there are few groups of rhesus monkey and one group resides around the premise of Ramdhuni temple. Till the date the study of monkey of Ramdhuni forest and temple premise have not been included in the mind of researchers. With the objective to explore the time budgeting of the major behaviours (foraging, moving, resting, grooming and fighting) this study was launched. Ethogram investigation and creation is crucial to the planning of any ethological investigation since it enables proper documentation and quantification of observed behaviors(Stanton et al., 2015).Behaviour study is important because it finds any changes in their pattern, aware the people and reduces the conflict with wild animals and also supports for their proper management.

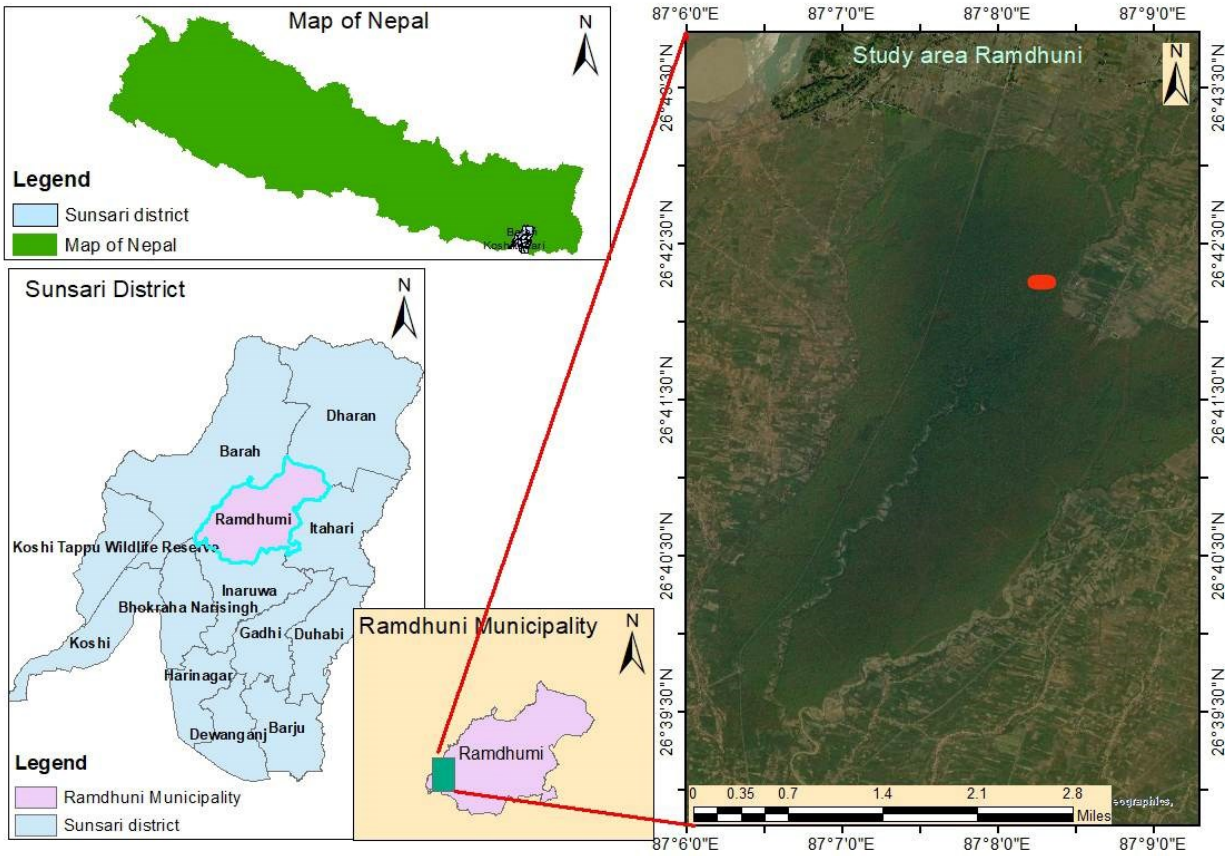
Methods and Materials

Study Area

The study area is Ramdhuni forest. It is a forest dominated by sal tree (Shakhuwa) vegetation, situated in Sunsari district, Koshi province, Nepal. It is located at the latitude 26° 41' 23" N and longitude 87° 7' 44" E. It offers Monsoon-influenced humid subtropical climate (Minidat, 2023).The holy Hindu temple is located in the middle of this spiritual forest, it is also known as Ramdhuni (Dhuni). Around 20.4 sq. km of Ramdhuni forest is located about 10 km east of the Koshi river (the largest river of Nepal). The predominant tree in the area is *Shorea robusta*. The primary forest is still present in the central area, but secondary growth may be seen there in periphery of forest. Around the edge of the woodland there are human settlements and farmings. The recreation center in the forest is typically used by people. Seraha river and Sunsari river both pass through the woodland (Dahal *et al*. 2016).

Figure 1

Location map of Ramdhuni forest and temple, Sunsari



Troop Selection

Regular watching of group of monkey was done for few days around Ramdhuni temple of Ramdhuni forest. We detected particular individuals by observing marked coloured, body sized, tail size, behaviour, leadership etc. in group of monkey. Then we clearly identified the troop by observing their body color, body proportion, height and body size **(**Roonwal and Mohnot, 1977, Chalise, 1995).

Composition of Troop

The composition of the troop was differentiated into adult males, adult females, sub adult males, young adult females, juveniles and infants according to their body size, coloration and behaviour as described by **(**Chalise, 1995). According to this,

1. Adult male: Adult males are distinguished by large and hanging scrotal sacs.
2. Adult female: They are distinguished with small head and protruded nipple.
3. Young and sub adults: They are independent, mostly attained the height however not matured in body fitness and sexual activities.
4. Juveniles: They are the individuals that are left nipple contact (weaned) and depend on natural foods and mostly following their kin.

5. Infants: They are those who still suck the nipple as their main food on attaching or following mother.
   In the selected troop there were totally 18 individuals. Among them 2 males, 6 females, 4 young sub adult and 6 were juvenile.

Behaviour Recording

The scan sampling method (Altmann, 1974) was followed to record the activities of rhesus monkey for the focal troop. Data collection was done for two seasons- autumn (September, October and November) and winter (December, January and February of)in 2022 and 2023.Activities of individuals were documented to calculate the time budget. The activities were recorded in every 10 minutes with two minutes scanning. The observation time was started from 7:00 A.M. before sun rising and terminated to 5:00 P.M.Total time spent in Jungle is 300 hours at the rate of 10 hours a day for 5 days in each month and totally six months duration was the observation period.

Activities were recorded with the help of binoculars. The study was done only in day time so nocturnal activities were not documented. The zoologist like McHugh (1958), Jerman and Jerman (1973), Jingfors (1980)classified animal activities broadly into two to five categories viz. foraging, resting(Inactive), moving(Locomotion), grooming and fighting.

Table 1

Ethogram for the Categorization of Behaviour

Activities	Description
Foraging	The time use for searching of food and consuming food or drinking water.
Locomotion	Movement from one location to other by pedal or jumping movement
Inactive	Resting, inhabiting and sleeping on tree, roof or on any support and sitting, stretched legs situation
Grooming	Searching for their own fur or other macaque's body fur for lice, ticks, fleas and bugs/activity of rubbing or scratching.
Fighting	Expression of aggressive nature to each other by bare teeth, slapping or making noise which occurs mostly in groups

Data Analysis

The numerical value 1 was given to each activity of each individual in a scan. All the events were summed up for each period of time. Total time budgeting for each day, month and season was calculated and presented using percentage of time allocated for particular activity

The overall activities of rhesus monkey of focal troop was calculated by using following formula (Khatiwada *et al*., 2020)

$$\text{Activity} = \frac{\text{Number of behavior records for each activity} \times 100\ \%}{\text{Number of behavior records for all activities}}$$

Statistical Analysis

Time allocation for different activities by gender, fragments of day, place etc. were calculated in Microsoft Excel. Chi square and correlation and other the data were analyzed in Statistical Package for Social Sciences (SPSS).

Results and Discussion

From our study focusing the activities of rhesus monkey we made the following results and our results were compared and discussed with those of previously published documents.

Time Allocated by Monkey for Different Activities

In this research work we documented a total of 750 events among them maximum events and time were for inactive (30.26%, n= 227) and least in fighting (3.46%, n=26)(table 2).

Table 2
Time Allocated by Monkey for Different Activities

Activities	Foraging	Locomotion	Inactive	Grooming	Fighting	Total
Number of events	200	142	227	155	26	750
Percentage	26.67	18.93	30.26	20.67	3.46	100

Pandey and Chalise studied on focusing Assamese monkey. They recorded totally 769 events of Assamese monkeys and maximum time consumed in foraging/ eating (39.3%) and secondly in locomotion (21.46%) in Shivapuri National Park (Pandey and Chalise, 2015)

The study of Assamese monkey, concentrated in Shivapuri National park recorded that they spent more time in locomotion in spring claiming 27 % time and 13% in winter (Pandey and Chalise 2005). In the next study Assamese monkey used 40% time in foraging and feeding (Sarkar et al., 2012). This result was quite different from Thai Assamese monkey (31.2%) for feeding (Schülke et al., 2011). Another finding described similar with Sebrubeshi monkeys of Langtang National Park (43.4%) in foraging (Chalise, 2010). In the next finding(Chalise et al. 2013) had estimated in winter season 46% of total diurnal time spending on feeding and foraging.

In the comparative study regarding with the time budget of rhesus monkey in Bangladesh recorded that the rural group of rhesus had significantly longer feeding time than that in the urban group. Oppositely, grooming and playing were significantly longer in the urban than the rural group (Jaman and Huffiman, 2013).The macaques were passive (resting, sleeping, and sitting) for 29% of the time. This research showed 19% difference from (Ghimire, 2017) findings in the Nagarjun forest of Nepal.

Gender wise time allocation

From mentioned table (table 3) it could be expressed that female spent more time (25%) for foraging in comparison to male (23%). The male remained more inactive (time spent 33%) in comparison to female (32%). Similarly male used more time (7%) in fighting but female consumed only 5% for this purpose. In case of locomotion male allocated more time (17%) and in locomotion male was spending more time (17%) than female (16%). There was no association

in gender regarding with the activities (Chi square=0.97, tabulated value= 9.49, degree of freedom= 4, at significance level 0.05).

Table 3

Gender-wise Time Allocation

Activities	Percentage of time spent	
	Male	Female
Foraging	23	25
Locomotion	17	16
Inactive	33	32
Grooming	20	22
Fighting	7	5

An experiment was done in squirrel monkey (Saimiri sp.) to find out the activity difference between male and female. It found that squirrel monkey's female were more strongly attracted to strangers comparatively to males and hence their movement was more actively and for more time than other activities at that time. They also made it plain that they preferred female strangers to either other males or their male cagemates (Mason, 1975).

In the next study males spent more time on the ground scavenging for invertebrates. Females consumed embedded, colonial invertebrates more frequently, consumed substantially more sloppy stationary invertebrates. These female allocated more of their daily energy budget to foraging for invertebrates (Melin et al. 2010). Time shared out in different activities was studied on the gender base by Johnson and coworkers. The high-status females spent more time feeding that did low-status females. It was at the constant age of female. It was applicable on contemporary females (Johnson et al., 1991).

Time Allocated in Morning and Day Time for Different Activities

The mentioned table (table 4) shows the time allocated by rhesus monkey of Ramdhuni in two parts of a day (12 hours). For foraging morning time was mostly used (33%) but in day they used only 24% for this activity. Similarly, they reduced locomotion in morning but increased in day time. Longer resting or inactive situation (27%), grooming (20%) and fighting (9%) were recorded in daytime. This reading showed the monkeys in the morning depend on pilgrims since they provide food them in temple premises. There was a close relation between the activities in morning and day time (r= 0.80906).For example if they spent more time in foraging in morning, they reduced time for this activity in day.

Table 4

Time Allocated in Morning and Day Time for Different Activities

Activities	Percentage of time spent	
	Morning (Before 12:00 noon)	Day(After 12:00 noon)
Foraging	33	24
Locomotion	18	20
Inactive	22	27
Grooming	19	20
Fighting	8	9

The study on Nagarjun of Sivapuri National Park showed a variation in activities in morning and day time. According to this the troop spent 29% of their time in inactive, it was highest value and 1% in fighting (lowest) in the morning time. In day time, 27% time of the troop activity was inactive (highest) and for fighting only 1% as lowest during day (Ghimire and Chalise, 2021). In some places the monkeys expressed a much time spending in locomotion during day rather than morning. Their home range and diurnal range of moving was larger and hence much time was found to be spent (Neville, 1968). In the experimental research also the monkeys were fed in the morning (Mattison et al. 2017) keeping it in mind that they use most of time in foraging specially in morning and with the hypothesis morning feeding was good for health.

Allocation of Time and Place Used in Different Activities by Monkeys

The focal troop spent time for different activities in different places. The mentioned table (table 5) expressed that 24% of time of foraging used on grassland, 23% on roof, 15% on shrub, 27% on floor of temple, 6% on roadside and 5% of time of foraging was used on tall trees. Likewise, the locomotion was maximally (32%) in the roof of temple and least on roadside. The time spent for being inactive maximally on tall tree (22%) and floor of temple and least on roadside. Maximum time for grooming was in shrub (27%) and least on roadside (2%). Finally time used for fighting was maximum on grassland (27%) and least percentage (7%) on tall trees.

The chi square test showed that there was significant relation between time budgeting for activities with the place for activities (Chi square=78.74, degree of freedom= 20, significance level =0.05 Chi square tabulated= 31.41).

Table 5

Allocation of Time and Place Used in Different Activities by Monkeys

Activities	Percentage of time spent in different place					
	Grassland	Roof of construction	Shrub	Temple's floor	Roadside	Tall tree
Foraging	24 (n=48)	23 (n=46)	15(n=30)	27 (n=54)	6 (n=12)	5 (n= 10)
Locomotion	28	16	12	32	5	7
Inactive	15	20	21	21	1	22
Grooming	16	19	27	17	2	19
Fighting	27	24	12	19	11	7

The research work in Nagarjun highlited that rhesus monkeys were mostly terrestrial, with 58.5% of their activities on the ground (Khatiwada et al., 2020). This finding resembles with that previously done. The research in Nagarjun forest found that Assamese Monkeys spent highest time (24.21%) inSchimawallichiifor foraging, 35.82% for locomotion and 36.26% for inactive. Similarly the rhesus monkeys on the same habitat spent maximum time on same species of trees and least time in time in Myrica esculenta for foraging, locomotion and resting/sleeping/sitting (inactive) (Ghimire and Chalise, 2021).

Season-wise Time Division for Different Activities

The season wise variation was recorded concerning with the activities of monkey. In spring season the focal troop spent maximum time in foraging (35%) and least in fighting (13%). Similarly, in winter maximum time for foraging(37%) and least for fighting and grooming(13% each). Comparatively it can be concluded that in winter the time for foraging, locomotion and inactive was more than for those in autumn (table 6).

The chi square calculation showed that there was not association between the allocated time for different activities with the change of season (Chi square= 0.9, degree of freedom=4, significance level= 0.05 and chi square tabulated=9.49)

Table 6

Season-wise Time Division for Different Activities

Activities	Percentage of time spent	
	Autumn	Winter
Foraging	35	37
Locomotion	15	17
Inactive	19	20
Grooming	18	13
Fighting	13	13

During the period of inactivity, monkeys spent the majority of the time (53%) at rest. Infants remain playing(27 %) when adult goes for rest. The annual average for sunbathing is 29%, with the winter months accounting for 49% of the total (Pandey and Chalise, 2015). The monkeys spent a lot less time socializing during the winter season (14%), preferring to sunbathe and relax instead. Just opposite, social behavior was essentially the same during the spring and autumn seasons (19% and 17%, respectively). The social pre-monsoon behavior was 9+1%, monsoon behavior was 6+1%, post-monsoon behavior was 12+1%, and winter behavior was 14+1% (grooming + playing) (Sarkar et al. 2012).

It was found a difference in the activities throughout the year in some research. According to that study done by (Sarkar et al., 2012) the monkeys spent considerable time in winter (20%) but in while spring and autumn it had spent a small difference i.e. 11% and 14% for particular activities respectively.The next research work stated that not only the behavioural but the social structure of group was found to be changed in different season. The researchers fully believe to the occurrence of behavioural and time budgetary changes according to seasonal change(Brent et al., 2013). Next study in India recorded no seasonal variation in the activitity pattern. The researcher published the report stating there was variation on reproductive behaviour, home range etc but no seasonal variation in daily activity pattern and diurnal movement ranges throughout the year in the sanctuary (Ganguly and Chauhan, 2018).

In Spring, more contact aggression was aimed at males, and fighting between males for estrous females couldnot explain the pattern of agonistic activity seen. Although the oldest guys played more in the Spring, there was noticeably greater play among the subjects in the Autumn (Brenstein, 1993). In the work focusing to female rhesus monkey in china showed significant different in the activity pattern in different season. In autumn, they spent 35.9% in feeding,

30.0% in resting and15. 9% in travelling but in winter, adult females spent 35.4%, in feeding, 39.7% in resting and 8.0% of time in traveling (Zhenwei et al., 2015).

Figure 2

Individuals of Focal Troop, in Ramdhuni Temple Premise. (Photo Credit: Nabin Regmi)

Conclusion

Ethogram provides a list of the behaviours a species exhibits together with explanations of each activity in the form of descriptive words and phrases. Behaviour and time budgeting are important to study because they reflect the situation of adaptation of monkey and any changing in their different habit and the study supports for the sustainable management of the particular animal.

With the objective to explore the time budgeting of the major behaviours of rhesus monkey the study was conducted from September 2022 to February 2023 by following scan sampling method in Ramdhuni, Sunsari. A total of 750 events were recorded in field working time 300 hours. The time allocated was documented as for foraging (26.67%), locomotion (18.93%), inactive (30.26%), grooming (20.67%) and fighting (3.46%). The much time spent for inactive (Resting, inhabiting and sleeping on tree, roof or on any support and sitting, stretched legs situation) indicates that they fill up the stomach in short period of time and go on rest. Since there was least time recorded for fighting it can be concluded that there was no competition for food and other resources. With the hypothesis there would be a variation in time budgeting sex wise, the study was forwarding to this direction. The theme of finding states that there was not

significant association in gender regarding with the activities (Chi square=0.97, degree of freedom= 4, at significance level 0.05 and tabulated value= 9.49). There was a close positive relation between the activities in morning and day time (r= 0.80906).The monkey used more time for foraging in morning and for the rest of the activities they used much more time on day (after noon). The selected troop used the manmade construction (temple, buildings) for the activities. While feeling danger they moved to tall tress too. Hence, there was a significant relation between time budgeting for activities with the place for activities (Chi square=78.74, degree of freedom= 20, significance level =0.05 Chi square tabulated= 31.41).The troop showed longer time taken for foraging, locomotion and inactive in Winter season with the comparison of Autumn. There was no association between the allocated time for different activities with the change of season (Chi square= 0.9, degree of freedom=4, significance level= 0.05 and chi square tabulated=9.49).From the finding of this study it can be recommended that to manage the monkey and reduce probable conflict, the area should be defined for the feeding to monkey by pilgrims in forest sides, not in temple premises.

References

Bernstein, I. S. (1993). Seasonal influences on rhesus monkey (*Macaca mulatta*) behavior. *International journal of primatology, **14***. 383-403.

Brent, L. J., MacLarnon, A., Platt, M. L., & Semple, S. (2013). Seasonal changes in the structure of rhesus macaque social networks. *Behavioral Ecology and Sociobiology*, ***67*.**349-359. *Bulletin*, **7**(3-4):4-9.

Chalise, M. K. (1995). *Comparative study of feeding ecology and behavior of male and female langurs* (*Presbytis entellus*). Ph.D. Thesis. IOST Tribhuvan University, Kathmandu, Nepal.

Chalise, M. K. (2010). A study of Assamese monkey in Sebrubeshi of Langtang National Park, Nepal. *Journal of Natural History Museum, **25*,** 54-61.

Chalise, M. K. (2013*). Fragmented primate population of Nepal*. L. K. Marsh and Chapman, C.A. (Eds.), *Primates in Fragments: Complexity and Resilience; Developments in Primatology; Progress and Prospects*. 329-356.

Chalise, M. K. and Ghimire, M. (1998). Non-human primate census in different parts of Nepal.

Chalise, M.K. (1997). Monkeys from Makalu-Barun Conservation Area (MBCA) *NAHSON*

Chalise, M.K. (1999). Some behavioral and ecological Aspects of Assamese Monkeys (Macaca assamensis) in Makalu-Barun Area, Nepal. *Nepal Journal of Science & Technology***1**:85-90.

Dahal, S., Appel, A., Shrestha, S., Dahal, D. R., Gurung, S., and Oasis, W. (2016). *Re-Accessing and Identifying the Conservation needs of Fishing Cat in Bankalwa, Sunsari, Nepal.* A report submitted to WWF Nepal.

Fuentes A., and Gamerl S.(2005a). Disproportionate participation by age/sex classes in aggressive interactions between long-tailed macaques (*Macaca fascicularis*) and human tourists at Padangtegal Monkey Forest in Bali, Indonesia. *Am J Primatol*.**66**:197–204. 0.1002/ajp.20138

Fuentes A., Southern M., and Suaryana K.G.(2005b).*Monkey forests and human landscapes: is extensive sympatry sustainable for* Homo sapiens *and* Macaca fascicularis *on Bali*? In: Patterson J, Wallis J, editors. *Commensalism and conflict: the human-primate interface*. Norman (OK): ASP Press;165–95.

Ganguly, I., and Chauhan, N. S. (2018). Daily behavioural activity patterns and reproductive ecology of urban rhesus macaques (Macaca mulatta) in human dominated landscape and its implication in management. *Journal of Applied and Natural Science*, ***10*(4):**1101-1108.

Ghimire, A. (2017). *Feeding behaviour of sympatric Rhesus monkeys (Macaca mulatta Zimmerman, 1780) and Assamese monkeys (Macaca assamensis McClell 1840) in Nagarjun forest, Shivapuri Nagarjun National park, Nepal*. MSc Thesis, Tribhuvan University, Kirtipur, Kathmandu, Nepal.

Ghimire, K. and Chalise, M. K. 2021. Activity pattern and habitat association of Assamese macaques *Macaca assamensis* McClelland, 1840 in Shivapuri Nagarjun National Park, Nepal. *Nepalese Journal of Zoology* **5(2):**51–61. https://doi.org/10.3126/njz.v5i2.42032

Jaman, M. F., and Huffman, M. A. (2013). The effect of urban and rural habitats and resource type on activity budgets of commensal rhesus macaques (*Macaca mulatta*) in Bangladesh. *Primates*, ***54*:**49-59.

Jarman, P.V. and Jarman, P.J. (1973). Daily activity of Impala. *E. Afr. Wildl. J.,***11** : 75-92

Jingfors, K.T. (1980). *Habit relationships and activity patterns of a reintroduced musk ox population,* M.S. Thesis, Univ. Alaska, Fairbanks, pp.l 16.

Johnson, R. L., Malik, I., and Berman, C. M. (1991). Age-and dominance-related variation in feeding time among free-ranging female rhesus monkeys. *International journal of primatology*, ***12*:**337-356.

Khatiwada, S., Paudel, P. K., Chalise, M. K. and Ogawa, H. (2020). Comparative ecological and behavioral study of Macaca assamensis and M. mulatta in Shivapuri Nagarjun National Park, Nepal. *Primates*, ***61***: 603-621.

Martin, P. and Bateson, P. (2007). *Measuring behaviour: An introductory guide* (3rd ed.). Cambridge: Cambridge University Press.

Mason, W. A. (1975). Comparative studies of social behavior in Callicebus and Saimiri: Strength and specificity of attraction between male-female cagemates. *Folia Primatologica*, ***23***(1-2), 113-123.

Mattison, J. A., Colman, R. J., Beasley, T. M., Allison, D. B., Kemnitz, J. W., Roth, G. S., and Anderson, R. M. (2017). Caloric restriction improves health and survival of rhesus monkeys. *Nature communications*, ***8*(1):**14063.

McHugh, T. (1958). Social behaviour of the American buffalo (*Bison bison bison*). *J. Zoologica* ***43*** **(1**): 1- 40

Melin, A. D., Fedigan, L. M., Young, H. C. and Kawamura, S. (2010). Can color vision variation explain sex differences in invertebrate foraging by capuchin monkeys?. *Current Zoology*, ***56*(3):**300-312.

Minidat. (2023). Accessed on 8th Feb. 2023. https://www.mindat.org/feature-11605831.html *NAHSON, Bulletin* ***8***:11-15. 45

Neville, M. K. (1968). Ecology and activity of Himalayan foothill rhesus monkeys (*Macaca mulatta*). *Ecology*, ***49*****(1):** 110-123.

Pandey, B. P. and Chalise, M. K. (2015). General ecology and time budgeting for Assamese monkey (Macaca assamensis) in Shivapuri Nagarjun National Park, Nepal. *Biodiversity Conservation Efforts in Nepal*, ***1:*** 57-73.

Pocock, R.I. 1975. *The Fauna of British India, including Ceylon and Burma*. Todays and Tommorows printers and publishers, New Delhi. Mammalia Vol.-I.

Roonwal, M. L. and Mohnot, S. M.(1977) .*Primates of South Asia, ecology, sociology and behavior*. Harvard University Press, Cambridge, London, England.

Sarkar, P., Srivastava, A., Dasgupta, S. and Bhattacharjee, P.C. (2012). Activity prole of free ranging forest group of Assamese Macaques. *The Clarion; International Multidisciplinary Journal,* ***1*** **(2):**59-67.

Schulke, O. Pesek, D., Whitman, B.J. and Ostner, J.(2011). Ecology of Assamese macaques (Macaca assamensis) at Phu Khieo Wildlife Sanctuary, Thailand. *Journal of Wildlife in Thailand,* ***18 (1):*** 1-17.

Zhenwei, C. U. I., Zhenlong, W. A. N. G., Guoliang, Z. H. A. O., and Jiqi, L. U. (2015). Seasonal variations in activity budget of adult female rhesus macaques (*Macaca mulatta*) at Mt. Taihangshan area, Jiyuan, China: Effects of diet and temperature. *Acta Theriologica Sinica*, ***35*****(2):** 138.

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