Research Note
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SEASONAL ACTIVITY PATTERN OF MONKEY (*Macaca mulatta*) IN DIFFERENT CROP ECOSYSTEMS OF TELANGANA

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The Rhesus macaque (*Macaca mulatta)*, is one of the important non-human primates distributed in several parts of India, including Telangana. In Telangana, rhesus macaques are commonly observed in forest fringe villages, temple premises, peri-urban regions and agricultural ecosystems adjoining reserve forests. Rapid urbanization, expansion of agricultural lands and degradation of natural habitats have intensified interactions between wildlife and humans in recent decades (Sinha and Vijayakrishnan, 2017). Human–wildlife conflict has emerged as a serious ecological and agricultural problem in many parts of India (Madhusudan, 2003). Among various wildlife species, monkeys have become one of the major vertebrate pests causing substantial economic losses in agricultural and horticultural ecosystems (Chauhan and Pirta, 2010). Increasing monkey populations, habitat fragmentation, deforestation and reduction in natural food resources have forced monkeys to move towards agricultural fields and human habitations in search of food, water and shelter (Imran and Ahmed, 2018).

Primates are highly adaptive animals capable of modifying their behavioural patterns according to environmental conditions and food availability (Southwick and Siddiqi, 2001). Agricultural ecosystems provide abundant and easily accessible food resources, which attract monkey populations throughout different crop growth stages.

In Telangana, crop raiding by monkeys has increased considerably particularly in areas located near forest fringes, reserve forests and peri-urban settlements. Monkeys inflict damage to crops through feeding, trampling, breaking of branches and plucking of fruits and grains (Kumar and Singh, 2019). Jayson and Christopher (2008), who stated that wild animals exhibit increased foraging activity during crop reproductive stages because of easy food accessibility and high nutritional value. Crops such as rice, cotton, maize, fruits and many vegetables are highly vulnerable during reproductive and maturity stages such asmilking, boll formation and fruiting stages due to higher nutrient content and palatability of crop produce (Madhusudan, 2003). However, the severity of crop damage varies depending upon with crop stage, seasonal food availability and behavioural activities of monkeys (Ram *et al*., 2021). The severity of crop damage varies with crop stage, seasonal food availability and behavioural activities of monkeys (Ram *et al*., 2021).

The behavioural ecology of monkeys plays a crucial role in determining the intensity and extent of crop depredation. Activities such as feeding, movement, grooming, vocalization and aggression influence the duration of stay and frequency of monkey visitation in agricultural ecosystems (Southwick and Siddiqi, 2001). Seasonal fluctuations in food resources also influence monkey behaviour and movement patterns between forest habitats and cultivated lands.

Farming communities are incurring economic losses due to damage caused by monkeys and increased labour cost to ward off monkeys. Understanding the behavioural pattern and activity distribution of monkeys in different crop ecosystems is therefore essential for developing suitable management strategies. Information regarding feeding and other behavioural activities during critical crop stages helps in identifying the peak period of crop vulnerability and planning timely interventions. Hence, the present study was undertaken to document the month-wise activities of monkeys in rice, cotton and guava ecosystems in selected districts of Telangana.

The study was conducted during 2023-24 in three major crop ecosystems of Telangana, India,

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selected based on the prevalence of monkey-induced crop damage and their proximity to forest fringe habitats. The study covered Vikarabad, Nagarkurnool and Nalgonda districts.The rice ecosystem comprised four locations in Vikarabad district, *viz.,* Pargi, Kotepally, Mominpet and Chowdapur. The cotton ecosystem included Amrabad, Tadur, Thimmajipet and Telkapally in Nagarkurnool district, while the guava ecosystem consisted of Chandampeta, Gattuppal, Shaligouraram and Thipparthy in Nalgonda district.The study was conducted during the *Kharif* season (2023) for rice and cotton, whereas both *Kharif* and *Rabi*, 2023-24 for guava. Rice was observed from the nursery stage to harvesting, cotton from the vegetative stage to boll maturation, and guava during fruit development and harvesting. The crop growth stages were recorded according to the respective sowing dates followed by farmers in each study location.Behavioural observations were carried out during the crop stages that were most vulnerable to monkey damage. Observations were made during the peak activity periods of monkeys, between 06:00-10:00 hr and 16:00-18:30 hr. Each study location was visited repeatedly throughout the cropping season, and behavioural observations were recorded on 15 observation days covering 3 crop fields per location (total sample size = 36 fields).

Behavioural observations were conducted using direct visual scan sampling from a safe distance without disturbing the animals. During each observation session, all visible individuals in a troop were monitored, and their behavioural activities were recorded. The activities were classified into seven categories: resting, feeding, moving, grooming, playing, vocalization and aggression.The frequency of each behavioural activity was recorded at regular observation intervals and expressed as the percentage occurrence using the following equation:

Behavioural activity (%) = (Number of observations of a particular behaviour / Total behavioural observations recorded) × 100.

The percentage occurrence of each behavioural activity was calculated separately for each crop ecosystem and month.

Behavioural activity data were expressed as percentages for each crop ecosystem and observation month. The data were subjected to analysis of variance (ANOVA), and treatment means were separated using Duncan's Multiple Range Test (DMRT) at the 5% significance level. Mean values, standard error of the mean (SEm), critical difference (CD at P = 0.05) and coefficient of variation (CV%) were calculated to compare behavioural activities among crop stages and months.

Monkey Behavioural Activity in Rice Ecosystem

The month-wise activity pattern of monkeys in rice ecosystem is presented in Table 1. Significant variation was observed in behavioural activities during different crop growth stages. Feeding activity was found to be highest during October (43.9%) corresponding to milking to harvesting stage, followed by June–July (35.6%) during nursery to tillering stage. The increased feeding activity during October was primarily due to monkeys feeding directly on the filled grains by plucking and breaking the rice panicles to consume the grains.Comparatively lower feeding activity (7.8%) was observed during August–September.when the crop was in the maximum tillering to panicle initiation/booting stage and mature grains were not yet available.

The higher feeding activity during reproductive and grain development stages indicates increased preference of monkeys towards succulent grains and tender plant parts. Movement activity was comparatively higher during August–September (28.4%), suggesting increased movement between fields during vegetative growth stages.

Playing and grooming activities were also frequently observed, indicating adaptation of monkeys to agricultural habitats. Aggression and vocalization activities remained comparatively lower throughout the observation period.

Monkey Behavioural Activity in Cotton Ecosystem

Monkey behavioural activity varied across the boll formation stage (August–October) of cotton (Table 2). The dominant activity differed among months, reflecting changes in crop phenology and resource availability.

August: During August, monkeys spent most of their time in playing (23.2%), followed by grooming (18.4%), moving (16.7%), feeding (14.0%), resting (12.8%), vocalization (8.5%), and aggression (6.4%). Playing, grooming and moving were the predominant activities,

indicating increased locomotion and social interactions during the early boll formation stage, whereas feeding activity remained comparatively lower.

September: Feeding activity increased markedly during September, accounting for 51.8% of the total observations, and was significantly higher than most other behavioural activities. Resting (7.0%), moving (8.6%), grooming (8.7%), playing (11.4%), vocalization (5.9%) and aggression (6.5%) were comparatively lower and many of these activities were statistically at par, suggesting that monkeys devoted most of their active time to feeding when cotton bolls became more accessible.

October: During October, feeding continued to be the dominant activity (32.9%), although lower than in September. This was followed by playing (17.3%), grooming (13.6%), moving (12.7%) and resting (9.9%), while vocalization (7.2%) and aggression (6.5%) remained the least frequent behaviours. Several non-feeding activities were statistically at par, indicating relatively stable allocation of time among these behaviours during the later reproductive stage.

Table 1. Behavioral activity (%) of monkeys during different growth stages of rice crop

Behavioral activity	Jun–Jul	Aug–Sep	Oct	Mean ± SEm
Resting	11.2[b]	23.9[a]	8.6[b]	14.6 ± 4.6
Feeding	35.6[a]	7.8[c]	43.9[a]	29.1 ± 10.9
Moving	13.2[b]	28.4[a]	11.1[b]	17.6 ± 5.4
Grooming	13.5[b]	15.3[a]	10.0[b]	12.9 ± 1.6
Playing	12.3[b]	16.7[b]	10.9[b]	13.3 ± 1.8
Vocalization	7.5[b]	5.6[c]	7.8[b]	6.9 ± 0.7
Aggression	6.8[b]	2.3[c]	7.8[b]	5.6 ± 1.7
SEm (±)				2.41
CD (P=0.05)				7.12
CV (%)				18.64

*Nursery stage to tillering stage during Jun-July months

Tillering to Panicle Initiation stage during Aug-Sept months

Milking stage to harvesting stage during Oct month

- Means with the same superscript letter are not significantly different from each other at P d" 0.05.
- Means with different superscript letters are significantly different at P d" 0.05

Overall, feeding behaviour peaked during September and remained high in October, coinciding with the boll formation stage when cotton plants provided readily available food resources. In contrast, August was characterized by greater investment in locomotion and social behaviours such as playing and grooming. Resting, vocalization and aggression remained comparatively low throughout the reproductive stage, with only minor month-to-month variation.

Monkey Behavioural Activity in Guava Ecosystem

The activity pattern of monkeys in guava ecosystem is presented in Table 3. Feeding activity was highest during September (37.7%), followed by October (25.8%) and November (13.2%). Increased feeding behaviour during fruiting stage clearly indicated preference of monkeys towards ripened and succulent guava fruits.

Movement and playing activities were also high during November, indicating active searching behaviour and social interaction among monkey groups. Resting activity varied from 10.1 to 15.7 per cent during the study period.

Aggression and vocalization activities were comparatively minimal in guava ecosystem.

Table 2. Behavioral activity (%) of monkey during reproductive stage of in cotton

Behavioral activity	August	September	October	Mean ± SEm
Resting	12.8[b]	7.0[b]	9.9[c]	9.9 ± 1.7
Feeding	14.0[b]	51.8[a]	32.9[a]	32.9 ± 10.9
Moving	16.7[a]	8.6[b]	12.7[b]	12.7 ± 2.3
Grooming	18.4[a]	8.7[b]	13.6[b]	13.6 ± 2.8
Playing	23.2[a]	11.4[b]	17.3[b]	17.3 ± 3.4
Vocalization	8.5[b]	5.9[b]	7.2[c]	7.2 ± 0.8
Aggression	6.4[b]	6.5[b]	6.5[c]	6.5 ± 0.03
SEm (±)				2.76
CD (P=0.05)				8.14
CV (%)				19.82

*Boll formation stage in cotton during August,September & October months

- Means with the same superscript letter are not significantly different from each other at P d" 0.05.
- Means with different superscript letters are significantly different at P d" 0.05

Table 3. Month wise monkey behavioural activity (%) during critical stage of fruiting in Guava

Behavioural activity	Aug	Sept	Oct	Nov	Mean ± SEm
Resting	15.7[b]	10.2[c]	10.1[c]	12.0[b]	12.0 ± 1.4
Feeding	13.1[b]	37.7[a]	25.8[a]	13.2[b]	22.5 ± 6.3
Moving	21.6[a]	11.4[b]	16.3[b]	28.0[a]	19.3 ± 3.5
Grooming	16.0[b]	12.2[b]	13.0[b]	13.0[b]	13.6 ± 0.9
Playing	26.4[a]	17.1[b]	23.2[a]	27.9[a]	23.7 ± 2.5
Vocalization	4.6[c]	5.7[c]	5.4[c]	4.9[c]	5.2 ± 0.3
Aggression	2.7[c]	5.8[c]	6.2[c]	1.7[c]	4.1 ± 1.1
SEm (±)	1.98				
CD (P=0.05)	5.84				
CV (%)	16.27				

*Fruiting stage during Sept & Oct months

- Means with the same superscript letter are not significantly different from each other at P d" 0.05.
- Means with different superscript letters are significantly different at P d" 0.05

Comparative Analysis of Monkey Activity Across Crop Ecosystems

Comparative analysis revealed that feeding activity was the dominant behaviour across all crop ecosystems studied. Cotton ecosystem recorded highest mean feeding activity (32.9%), followed by rice (29.1%) and guava (22.5%). This clearly indicates that reproductive structures and nutrient-rich crop parts strongly influence monkey visitation and feeding behaviour (Ram *et al*., 2021). The higher feeding activity in cotton and rice during reproductive stages indicates that monkeys preferentially target crops with high nutritional and moisture content. Guava ecosystem recorded comparatively higher playing and movement

activities, suggesting longer residence time of monkey groups in orchard ecosystems. The study clearly demonstrates that monkey behaviour is strongly associated with crop phenology and seasonal food availability. Similar findings were reported by Sinha and Vijayakrishnan (2017), who observed behavioural adaptation of monkeys in human-modified agricultural landscapes. The present findings indicate that feeding activity constitutes the primary cause of crop damage in all ecosystems. The increased feeding behaviour during grain filling, boll formation and fruiting stages may be due to availability of nutrient-rich food resources (Madhusudan, 2003). Higher movement activity during vegetative stages may indicate exploratory behaviour before establishment of regular feeding sites. Social activities such as grooming and playing suggest behavioural adaptation of monkeys to human-dominated agricultural landscapes (Southwick and Siddiqi, 2001). The increasing incidence of monkey damage in Telangana may be associated with habitat fragmentation, reduction in natural forest food resources, expansion of agriculture near forest fringes, anthropogenic food dependency and urbanization and landscape modification. The prolonged presence of monkeys in agricultural ecosystems may further intensify economic losses to farmers. Hence, integrated management strategies such as solar fencing, crop guarding, community participation and habitat-based management should be implemented during critical crop stages (Chauhan and Pirta, 2010).

The present investigation revealed that among different activities monkeys perform in troops the most important destructive activity of feeding coincided with the reproductive phase of both field and fruit crops. This clearly signifies that though the monkey troops make frequent crop raids but they actually cause minimum damage like trampling, cutting the branches etc. during the vegetative stage. It is also interpreted that these troops actually wait for the maturity stage of the crop and indulge in maximum feeding activity during the reproductive and maturity stages of crops, indicating higher vulnerability of the field and orchard crops during economically important stages.

Among the ecosystems studied, cotton recorded highest feeding activity followed by rice and guava. Understanding seasonal behavioural dynamics can help in planning effective monkey management strategies and minimizing crop losses in affected regions. Adoption of suitable crop protection measures during peak activity periods may help in minimizing crop damage in vulnerable agricultural ecosystems.

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