

# Ecology and Management of Chital (*Axis Axis*) in Pench Tiger Reserve in Central India

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**Abstract:** *Chital (Axis axis) plays an important role in the sustenance of higher trophic levels in an ecosystem. In the present study, the daily activity cycle of chital in the Pench Tiger Reserve of Madhya Pradesh, Central India, was analyzed with particular emphasis on the variations in the time-budget at different stages of the animal's life history. The detailed activities were divided into broader activities for seasonal comparisons. Movement for running and walking, standing for standing resting and standing ruminating, laying for laying resting and laying ruminating, and foraging for grazing and browsing. All the deer were analyzed for different activities and seasons using statistical software SPSS 8.0.*

**Keywords:** Chital (*Axis axis*), Activity, Pench Tiger Reserve

## 1. Introduction

Chital, being an ungulate and primary consumer plays an important role in maintaining the food chain and the ecological balance. Also, in different protected areas of the country, it forms the major bulk of prey base for large carnivores (Rubenstein. 2014, Rathore et al., 2012) in Kanha National Park, in Keoladeo National Park (Choudhary et al., 2020), Nagarhole National Park (Ramchurjee. 2013), in Kalakad-Mundanthurai Tiger Reserve (Selvan K.M. and Sridharan N. 2012) and in Pench Tiger Reserve (Akram et al., 2017). In Indian forests, the majority of wild ungulate density is contributed by chital. It is therefore, chital is a keystone species in indicating large carnivore density and community structure (Evans G. 1992, Raman T.R.S. 1997, Srinivasulu C. 2001, Watter et al., 2019, Chakraborty B.K. 2020). The Axis deer is around 0.6 to 1 m tall at the shoulder and has a body length of about 1.5 m (Osborn D.A. 1999, English A.W. 2007). Being highly sociable animals, their herds can contain 6-30 individuals, few of them being stags. Due to a sudden appearance of a predator, they are always on the alert with maximum active in morning and late afternoon. They usually rest under the shadow and tend to remain near water, drinking in mornings and evenings when the weather is very hot (Mulley R.C. 1993, Evans G. 1999).

The link between ecology and behavior was studied by Gittleman(1997). Despite of the links between ecology and behavior, differences in natural selection appears showing social behavior to be the more conservative element. Behaviour is directly or indirectly affected by the factors of ecological variables. The different ways of using time, habitat and food by different ungulates directly depends on their social, security, comfort and bioenergetic needs (Wolsan M. 1992, Rubenstein D.I. 2010). For activities such as foraging, resting, ruminating, roaming, vigilance, social interactions and breeding, these animals plan a definite period of time in a day. It is mainly the energy demand and the number of constrain that the animal encounters, on which the time division for different activities and the activity pattern depends. The movement

pattern of a particular species has to be observed in order to better understand its specific behaviour or response to the habitat. The movement strategy that animals use while foraging on spatially dispersed resources is crucial to their success in exploiting food resources (Pashov D. 1983, Shirley R.L. 1986). Studies on the movement pattern, effects of weather and seasonal movements of herbivores are very less. However, there are studies related to the general account of routine activities like daily movements, resting, etc (Kareiva P. 1983, Contreras A.M. 1966).

Many previous studies have shown the importance of studying activity patterns of various wildlife species in Pench Tiger Reserve, M.P (Gajbe P. 2004, Quresh Q. 2009, Koshta M.A. 2002, Rajvanshi A. 2013, Fellows A. 2015, Ilyas A. 2018, Chatterjee A.B. 2018, 2020). Apart from this, very little has been known about the activity pattern and time budget of chital. In this study, an attempt has been made to quantify the diurnal activity patterns and compute the activity and time budgets of chital in the Pench Tiger Reserve of Madhya Pradesh, Central India. The activity pattern of this species would reveal the behavioural manifestation of competition within these wild ungulates.

## 2. Material and Methods

### 2.1 Study Area

The study has been undertaken at three sites (Pench National Park, Rukhad Reserve Forest and Pench Sanctuary) of Pench National Park in central India's Madhya Pradesh state, established in 1975 with an area of 257.26 km<sup>2</sup>.



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## 2.2 Activity Pattern

The activity pattern was studied by the method suggested by Altman (1974) for quantifying the daily activity of ungulates. This Scan Animal Sampling technique (English A.W. 1992) was used to investigate the time activity budget, foraging behavior and habitat use of chital. Individual activity was recorded for daylight hours from dawn to dusk. During each observation, the main activity of each individual was observed and noted at an interval of 15 minutes. The time spent by individuals in any activity was recorded. The data collection was carried out during the daytime. Chital herds in the intensive study area were habituated during reconnaissance study to the continuous presence of the observer in the vicinity. Preliminary observations suggested a scan interval of 10-15 minutes to be appropriate for the study area. The field observations were carried out with the aid of 10±40 binocular or 10± to 35± spotting scope, depending upon the prevailing field conditions.

Observations were recorded from 30-50-meter 84 distance so that focal herd doesn't get disturbed. The behavior states in the present study were grazing, browsing, cud chewing (rumination), standing, lying, moving and the other activities like social interaction, standing alert etc. A minimum of seven scan sampling sessions from dawn to dusk (minimum of 12 hrs.) were carried out on chital herds in each season (two winter, two monsoon and three summer seasons). The focal chital herd was continuously followed on foot from dawn to dusk.

Activities were classified as feeding, resting, standing and others (running, display, defecation etc.), most of the continuous observations lasted for 10-12 hours, although, on a few occasions continuous activity records were obtained only for 4-5 hours. While, observing the behaviour, an activity was considered only when the time spent for that activity exceeded 35 seconds before change over to the next activity. The feeding activity was observed at its peak during morning and evening hours i.e. 7:00am to 9:00am and 4:00pm to 5pm in winter season in all the three study sites. During summers it was observed in between 7:00am to 8:00am in the morning and at 6:00pm in the evening at site-I, site-II and site-III.

The average time spent by the animals in each hour of daylight was calculated separately for summer, winter and rainy and expressed in terms of percentage. As already mentioned earlier the night time activities were recorded with the help of night duty staff of tiger reserve. All these observations were made only during the day time from sunup to sunset, because permission to observe the study period was granted only for day period. But on personal request to Chief Wildlife Warden the required information about night time observations regarding the different parameters were provided by him, which were collected by their night duty staff members.

The detailed activities were divided into broader activities for seasonal comparisons. Movement for running and

walking, standing for standing resting and standing ruminating, laying for laying resting and laying ruminating, and foraging for grazing and browsing. All the deer were analyzed for different activities and seasons using statistical software SPSS 8.0.

## 3. Result

### 3.1 Activity Patterns

Seasonal activity budgets of chital was computed for their major activity patterns for three seasons i.e., winter, summer and monsoon. Activity of standing includes standing resting and standing ruminating, activity of laying includes laying resting and laying ruminating, and activity of foraging includes grazing and browsing.

### 3.2 Activity of standing

Besides, chital spent relatively more time on vigilance i.e., "standing alert" compared to other seasons i.e., winter and monsoon. The activity was observed to touch the peak at different times of the day in different seasons. During winter only where the temperature was observed little higher, they come out for feeding otherwise they were observed resting. The % of resting time was observed gradually increasing from 9:00am and reached to its peak at around 12:00pm and afterwards gradually declined in all the three entities. During summers it was observed that at 7:00am and only 25.8% chital were seen resting at site-I, 24.3% at site-II and 10.9% at site-III. The resting activity gradually increased were observed from 9:00am to 12:00pm when 74.1% at 11:00am and 75.3% at 12:00pm at site-I, 70.3% at 11:00am and 72.6% at 12:00pm at site-II and at site-III 67.9% at 11:00am and 78.3% at 12pm. it was observed that maximum time spent on resting summer season in three entities. In the same way, the observations made during rainy season at all the three sites go along with the observations of resting activity during winter and summer seasons. So, it can be concluded that the resting activity was observed at its peak in noon hours during all the different seasons at every part of the study area. The only difference noted was in % which was little different in different seasons. It was observed 77.3% in winter, 75.3% in summer and 61.3% in rainy seasons noon time at site-I, 76.8%, 72.6% and 51.3% at site-II respectively in winter, summer and rainy seasons. Almost same types of observations were recorded at site-III also. The data recorded for standing activity at site-I shows that the maximum time spent in this activity in all the three seasons is at 7:00am to 9:00am and 5:00pm to 6:00pm in morning and evenings. In spite during summers, they spend 38% from 10:00am to 11:00am and 42.2% time from 11:00am to 12:00pm during rainy season in standing activity. At site-II and site-III also almost same type of observations were recorded.

### Activity of foraging

Likewise, winter, foraging was the major activity observed for chital during summer. The contribution of browsing in total foraging activity was observed to be increased compared to winter months. the feeding activity was

observed at its peak in early morning and late evening hours during all the different season at every part of study area. The only difference noted was in % which was somewhat different in different seasons. It was observed 40.3% in winter, 50.2% in rainy season and 52.2% in summers in morning time at sit-I and 41.6%, 54.0% and 49.3% at site-II respectively in winter, rainy and summer seasons. Almost same types of observations were recorded at site-III. During evening time, the maximum percentage was noted at

6:00pm. During summer (62.0%, 58.6% and 59.1% from site-I, site-II and site-III respectively). Same way it was observed 62%, 59.9% and 57.8% at 6:00pm respectively from site-I to site-III (Table 1 to table 3). During winter season the maximum feeding activity in percent was recorded at 5:00pm i.e. 36.3%, 35.3% and again 36.3% respectively at site-I, site-II and site-III which was almost same. This was due to the less availability of sun light during winter.

**Table 1: Time Spend In Different Activities (in %) in Different Seasons at Pench National Park (SITE-I)**

Hour	Winter Season				Summer Season				Rainy Season			
	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other
07:00am	40.3	24.0	30.6	5.1	52.2	25.8	15.3	6.7	50.2	11.2	33.1	5.5
08:00am	38.6	29.3	20.7	11.4	28.9	34.2	33.4	3.5	28.3	20.6	46.5	4.6
09:00am	38.2	34.7	14.3	12.8	24.0	52.8	18.5	4.7	32.6	23.2	30.7	13.5
10:00am	30.7	36.6	16.3	16.4	20.0	36.2	38.0	5.8	32.9	26.8	35.2	5.1
11:00am	16.5	66.3	9.5	7.7	7.8	74.1	15.8	2.3	18.3	32.3	42.2	7.2
12:00am	8.0	77.3	12.5	2.2	10.4	75.3	14.3	-	22.1	61.3	15.4	1.2
01:00pm	37.3	24.6	29.2	8.9	9.3	62.6	28.1	-	18.3	69.6	9.8	2.3
02:00pm	17.7	49.6	28.6	4.1	15.4	53.3	22.9	8.4	20.4	44.3	33.2	2.1
03:00pm	12.4	50.3	22.4	14.9	25.4	35.5	30.5	8.6	21.4	44.9	31.6	2.1
04:00pm	32.8	23.7	34.0	9.5	18.9	30.8	42.9	7.4	34.7	31.0	34.3	-
05:00pm	36.3	7.3	38.8	17.6	28.2	18.1	46.4	7.3	42.3	5.3	46.0	6.4
06:00pm	-	-	-	-	62.0	-	38.0	-	62.0	8.5	27.8	3.5

**Table 2: Time Spend in Different Activities (in %) in Different Seasons at Rukhad Reserve Forest (SITE-II)**

Hour	Winter Season				Summer Season				Rainy Season			
	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other
07:00am	41.6	22.3	29.3	6.8	49.3	24.3	18.3	8.1	54.0	10.9	29.3	5.8
08:00am	38.1	30.4	22.2	9.3	24.5	31.3	34.8	9.4	36.8	17.0	40.3	5.9
09:00am	30.9	32.4	22.4	14.3	24.3	56.1	15.9	3.7	33.1	22.1	33.2	11.6
10:00am	30.9	34.1	18.4	16.6	18.7	42.3	33.4	5.6	32.8	22.1	37.8	7.3
11:00am	12.8	67.1	10.3	9.8	5.3	70.3	21.3	3.1	25.3	31.4	35.0	8.3
12:00am	9.9	76.8	10.5	2.8	8.4	72.6	19.0	-	15.4	51.3	33.3	-
01:00pm	29.8	25.7	33.4	11.1	9.2	64.9	25.9	-	18.8	70.2	7.9	3.1
02:00pm	21.2	50.2	24.3	4.3	18.2	49.1	32.7	-	21.6	38.4	37.6	2.4
03:00pm	13.9	47.0	26.3	12.8	25.1	29.8	37.5	7.6	26.3	40.6	30.6	2.5
04:00pm	34.2	21.3	36.3	8.2	20.3	29.0	43.4	7.3	28.8	27.4	42.0	1.8
05:00pm	35.6	6.9	45.6	11.9	30.7	16.1	45.0	8.2	43.7	8.3	40.9	7.1
06:00pm	-	-	-	-	58.6	-	41.4	-	59.9	7.3	29.9	2.9

**Table 3: Time Spend In Different Activities in Different Seasons at Pench Sanctuary (SITE-III)**

Hour	Winter Season				Summer Season				Rainy Season			
	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other
07:00am	38.4	19.3	33.8	8.5	49.6	22.6	19.0	8.8	58.7	8.7	28.5	4.1
08:00am	39.6	28.6	23.5	8.3	28.2	23.8	39.3	8.7	30.1	20.1	45.1	4.7
09:00am	32.9	28.3	26.6	12.2	26.6	58.4	11.2	3.8	26.6	26.6	36.3	10.5
10:00am	30.3	35.2	19.2	15.3	21.3	42.5	30.0	6.2	36.8	26.8	30.2	6.2
11:00am	11.3	62.2	17.9	8.6	10.8	67.9	18.6	2.7	18.4	28.4	46.3	6.9
12:00am	10.1	73.8	14.9	1.2	8.3	78.3	13.4	-	15.6	55.6	26.9	1.9
01:00pm	28.6	29.3	34.3	7.8	11.9	61.8	26.3	-	22.2	72.2	4.2	1.4
02:00pm	24.3	52.3	17.8	5.6	21.3	48.7	26.9	3.1	28.3	38.3	29.8	3.6
03:00pm	16.4	50.6	22.4	10.6	21.1	33.6	38.5	6.8	18.3	38.3	40.6	2.8
04:00pm	33.0	21.0	39.3	6.7	26.4	23.7	43.5	6.4	36.9	32.9	28.0	2.2
05:00pm	36.3	5.4	46.0	12.3	26.4	17.2	48.0	8.4	47.9	7.9	38.5	5.7
06:00pm	-	-	-	-	59.1	-	40.9	-	57.8	7.8	31.4	3.0

**Table 4: The Seasonal Average Time Spent in Different Activities**

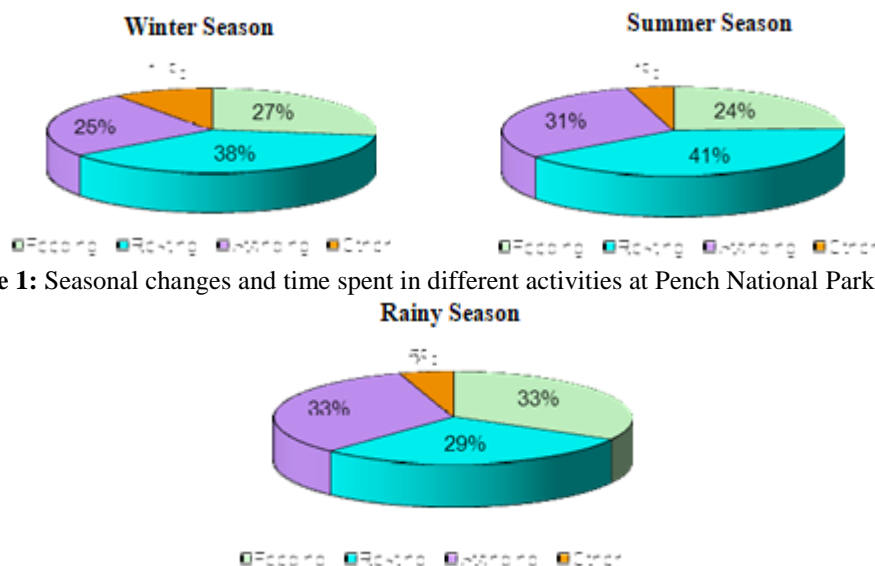
Season	Pench National Park (Site I)				Rukhad Reserve Forest (Site II)				Pench Sanctuary (Site III)			
	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other	Feeding	Resting	Standing	Other
Winter Season	24.90	35.31	21.82	9.63	24.91	34.52	23.25	8.99	25.10	33.83	24.64	8.09
Summer Season	25.21	41.56	28.68	4.56	24.38	40.48	30.72	4.42	25.92	39.88	29.63	4.58
Rainy Season	31.81	31.58	32.15	4.46	33.04	28.92	33.15	4.89	33.13	30.30	32.15	4.42

**Table 5:** The Correlation Coefficient of Different Parameter with Temperature at Each Site in Different Season with Maximum Temperature

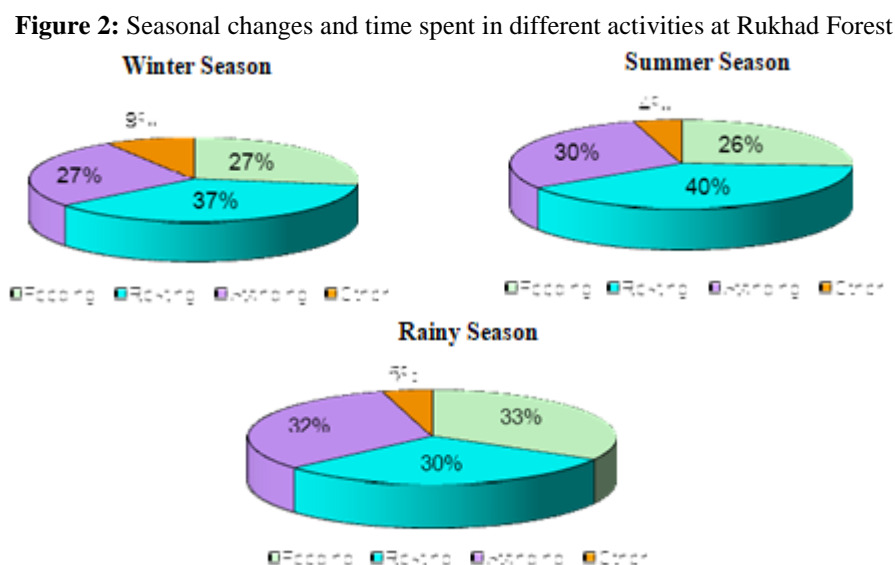
Activity	Year	SITE – I			SITE – II			SITE – III		
		Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy
Feeding	05-06	-0.357	-0.023	-0.205	-0.301	0.021	-0.214	-0.280	-0.034	-0.108
	06-07	-0.189	0.031	-0.087	-0.176	0.066	-0.134	-0.177	-0.033	-0.054
Resting	05-06	-0.022	0.0003	0.453	0.037	-0.086	0.477	0.122	-0.072	0.389
	06-07	-0.151	-0.097	0.434	-0.144	-0.157	0.487	-0.066	-0.129	0.423
Standing	05-06	-0.315	-0.0013	-0.361	0.184	0.258	-0.407	-0.006	0.228	-0.364
	06-07	0.376	0.161	-0.489	0.339	0.284	-0.560	0.214	0.339	-0.487
Other	05-06	-0.337	0.121	-0.659	-0.423	-0.295	-0.711	-0.431	-0.237	-0.735
	06-07	-0.134	-0.039	-0.617	-0.253	-0.131	-0.677	-0.332	-0.177	-0.775

**Table 6:** The Correlation Coefficient of Different Parameter with Temperature at Each Site in Different Season with Minimum Temperature

Activity	Year	SITE – I			SITE – II			SITE – III		
		Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy
Feeding	05-06	-0.019	0.353	0.391	-0.146	0.342	0.340	-0.113	0.279	0.295
	06-07	-0.176	0.331	0.223	-0.060	0.404	0.212	-0.030	0.346	0.308
Resting	05-06	-0.425	-0.413	-0.125	-0.438	-0.426	-0.063	-0.435	-0.412	-0.082
	06-07	-0.386	-0.499	-0.08	-0.384	-0.591	-0.063	-0.327	-0.582	-0.122
Standing	05-06	-0.112	0.368	-0.163	-0.204	-0.307	-0.291	0.285	0.428	-0.158
	06-07	0.479	0.394	0.063	-0.390	0.626	0.016	0.205	0.641	-0.066
Other	05-06	-0.062	-0.197	-0.249	-0.057	0.279	-0.246	-0.144	0.079	-0.406
	06-07	-0.144	0.415	-0.545	-0.400	0.139	-0.560	-0.321	0.186	-0.581



**Figure 1:** Seasonal changes and time spent in different activities at Pench National Park (Site I)



**Figure 3:** Seasonal changes and time spent in different activities at Pench Sanctuary

#### 4. Discussion

From the results it was observed that in all three seasons chital spent considerable amount of time on the foraging. After foraging, resting was the second major activity during summer. During afternoon hours of hot summer season, it spends prolonged time on ruminating. Chital spent relatively more time on laying during monsoon compared to other two seasons. In chital, resting was the next major activity after foraging. This is comparable with earlier studies elsewhere (Pyke G.H. 2019, Gadagkar R. 2018, James C. H. 1991).

In all seasons, the proportion of grazing was higher as compared to browsing under overall foraging activity of chital. The activity budgets during three seasons i.e., monsoon, winter and summer, revealed that chital feeds more on food items available on forest surface such as fruits, pods and leaves along with grasses. In winter, the surface covered with vegetation offers rich nutrients available to chital. This is the reason of increased browsing during monsoon. Hence during monsoon browsing proportion increases comparatively (Janis C. 2008, Brooke C.F. 2019). The increase in feeding during winter season is a relative increase because chital and other ungulates used to conserve their energy by restricting their movement during adverse weather condition. Fawning occurs during winter when interactions between doe and fawn were observed maximum. While, rutting peak of chital was observed during summer, when male-male and male- female interactions are frequent (Owen-Smith N. 2008, Bakker J.P. 2008). The movement was observed to be lowest during winter as forage availability is good compared to summer and monsoon. In winter, the time spent on foraging was reduced as an energy saving strategy.

#### 5. Conclusion

Chital, similar to other ungulates, allocate a definite period of time of a day for different activities such as foraging, resting, ruminating, traveling, vigilance, social interactions and on breeding during rutting season. Chital were found more alert and spending relatively more time on standing during summer. This is because in order to avoid the extreme hot temperature during late afternoon hours they spend much time in dense moist vegetation surfaces. Moreover, the chances of predator presence are also high in dense habitat hence standing position is safer to escape from sudden attack by wild animals present in the park.

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