

Short Communication:**Breeding seasonality of Chital (*Axis axis*) in the Hetauda Valley of Nepal****Arjun Bhusal^{1*}, Bijay Neupane², Sanjeeb Bhattarai³, Aashish Kapali⁴, Suraj Bhatta⁴, Santosh Bajagain⁵**

Abstract: Breeding seasonality of *Axis axis* differs from place to place mainly due to the difference in vegetation and climate. In Nepal, although Chital is found all over the lower Terai region, studies on breeding seasonality are limited. In this study, we observed the annual cycle of antler renewal and casting, monthly changes in frequency of bellowing call and ratio of new born fawn to adult and sub-adult females from October 2016 to March 2019. Seasonal peak of proportion of hard-antlered males was found in June and seasonal peak of bellowing call frequency was found in May. Seasonal peak of fawning occurred in December, January and February, at the beginning of dry season before monsoon, probably to coincide with the energy demanding late lactation season with excessive food available in rainy season. From antler cycle, bellowing call frequency and fawning frequency data, peak breeding season was identified as May-June. This information can be crucial in nutritional management, herd composition, and translocation period determination for in-situ and ex-situ species management programs.

Key words: *Hard antler, velvet antler, shed antler, bellowing, fawning*

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Introduction

Chital *Axis axis* (Erxleben 1777), also called 'Indian Spotted deer' or 'Axis deer' is an indigenous deer species of South Asia, found naturally in India, Nepal, Bhutan, Bangladesh and Sri Lanka (Raman 2013). Moist and dry deciduous forest areas, especially adjoining dry thorn scrub or grasslands, costal dry evergreen forests, and mixed forests or plantations are optimal habitats for the species (Raman 1998; Jnawali et al. 2011; Dockworth et al. 2015). In Nepal, it is distributed throughout the forests of Terai region (Jnawali et al. 2011) with major concentrations in parks and reserves (Mishra 1982). It is listed as 'Least Concern' species in IUCN Red List due to its large range of distribution (Dockworth et al. 2015).

"Annual temporal variation in quality and availability of food influences the timing of parturition of mammalian herbivores" (Wittemyer et al. 2007 in Ahrestani et al. 2012). Mammalian herbivores synchronize their parturition with durations of optimum food availability to support the increased energetic and nutritional necessities of lactating mothers (Gaillard et al. 2000). Mammals of temperate zone have markedly seasonal breeding as adequate quantity of food is available in summer only but in tropical regions, food is abundant and of high quality in season of rainfall and less abundant in dry season and breeding seasonality is relatively diffused (Ahrestani et al. 2012). In South and South East Asia, monsoon rains define variation in forage availability and quality. Chital exhibits stronger seasonality in parturition than the other larger mammals from the same range (Ahrestani et al. 2012; Raman 2013). The breeding season of deer can be differentiated by their exposed hard antlers, sexual behavior and fawning (Schaller 1967 in Ramesh et al. 2013; Lincoln 1992). Antlers are associated with seasonal fluctuations of reproductive hormones (testosterone and estrogen) concentration for breeding activities (Price et al. 2005) and can be taken as convenient external sign for internal reproductive status of deer (Bubenik et al. 2002). On the onset of antler formation, antler appears in shiny velvet. After shedding of velvet, antlers appear as bony structures stated as 'hard antlers' (Ramesh et al. 2013). The seasonal rise in secretion of testosterone brings the hard antler phase with sexual and aggressive behavior characteristics and after rut, testosterone suddenly declines, which results in casting of antler (Bubenik 1990), called as shed antler phase. Presence of hard antlers shows the sexually active stage of males and velvet or shed antler phase shows the non-rut reproductive stage of the male deer. Rutting male emits a characteristic and distinctive bellow or a peculiar moan which is called bellowing call (Mishra 1982). In this paper, we used the monthly variation in antler state, bellowing call frequency and fawning frequency to study the breeding seasonality and predict peak breeding season of Chital population from Hetauda valley of Nepal.

Materials and Methods

Study Area

This study was conducted inside the premises of Tribhuvan University, Institute of Forestry, Hetauda Campus. It is located in Hetauda Sub-Metropolitan City (27°21' - 27°40' N and 84°41' - 84°35' E) Makawanpur district. Hetauda valley is located in the lower tropical climatic zone with mean monthly maximum and minimum temperatures of 29°C and 17°C and annual rainfall of 2125 mm (Marashini et al. 2008). Area of the campus premises is extended to 97 hectares, divided into residential area, grassland, and forest. It supports a wide range of flora and fauna which includes more than 150 species of flora (Singh 2016), 98 species of butterflies (Chhetri 2017), 91 species of birds (Pokharel 2017) and 11 species of snakes (Pradhan et al. 2020). The forest is sub-tropical type; dominated by tree species *Shorea robusta* associated with *Pinus roxburghii*, *Bombax ceiba*, *Schima wallichii*, *Aesculus indica*, *Gmelina arborea*, *Albizia lebbek*, *Trewia nudiflora*, and *Syzizium cumini*. The study area is bordered by Karra river in the south and Rapti river in the west. Grassland of *Imperata cylindrica* and *Saccharum spontaneum* is present in the bank of Rapti River.

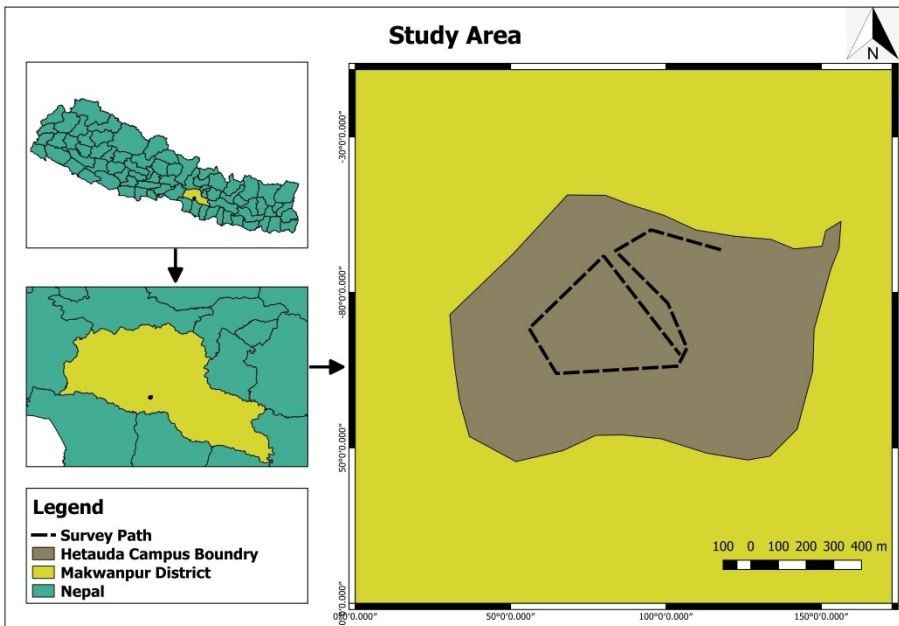


Figure 1: Location Map of Study Area

Data Collection

We assumed the proportion of hard-antlered male, fawn frequency (number of fawn per 100 mature female deer) and bellowing call frequency would vary seasonally indicating a restricted period of enhanced breeding as mentioned by previous studies including Mishra (1982), Raman (1998), Eisenberg and Lockhart (1972) and

Ramesh et al. (2013). Data were collected from October 2016 to March 2019 and arranged and analyzed month-wise. As male Chital grow antler at the age of one year and females come into estrus almost at the same age, sub-adults were included in the study of breeding seasonality. We have followed the aging and sexing criteria developed by Eisenberg and Lockhart 1972. Fawns were defined as the smallest size class characterized by their longish hair. Sub-adult and adult males were classified as:

- (i) Cast Antler Males – Only the tall pedicel is present.
- (ii) Velvet Antler Males- Antler is covered with skin.
- (iii) Hard Antler Males- Hard bony antler with no trace of velvet left.

As rate of bellowing call is higher in morning and evening and lower in afternoon, only the calls recorded during 06:00-09:00 and 16:00-19:00 time blocks were used to estimate bellowing frequency following (Raman 1998). Observations were made using forest trails and vintage points.

Data Analysis

For determination of antler cycle, antler condition of adult and sub-adult (yearling) males encountered in each month was recorded and expressed as the percentage of total number of males following (Mishra 1982).

Male % with specific antler condition

$$= \frac{\text{Number of males of specific antler condition in specific month}}{\text{Total number of males recorded in that month}} \times 100\%$$

To determine the fawn frequency, the number of fawns was expressed per 100 adult and sub-adult females in each month.

$$\text{Fawn frequency} = \frac{\text{Number of fawn recorded in field}}{\text{Number of adult and sub-adult recorded in field}} \times 100\%$$

The number of bellows heard during 06:00-09:00 hours and 16:00-19:00 hours was divided by the number of total hours spent in field in those time blocks to identify bellowing frequency following (Raman 1998).

$$\text{Bellowing frequency} = \frac{\text{Number of bellowing call recorded}}{\text{Number of hours spent in the field}}$$

Results and Discussion

Altogether 2829 observations of adult, sub-adult, and fawn were made during the study period. Out of these observations, 1039 were males, 1658 were females and 129 were fawns. Out of 1039 males, 691 were hard antlered, 294 were velvet antlered and 54 were shed antlered during the time of record (Table 1).

Table 1: Number of observations of Chital of different age-sex category in each month

Months	Adult and sub-adult males			Adult and sub-females	Fawns
	Hard antlered	Velvet antlered	Shed antlered		
January	9	39	4	103	20
February	7	26	4	79	14
March	30	39	1	124	14
April	56	12	0	132	7
May	126	2	0	160	8
June	164	0	0	187	3
July	90	6	1	142	0
August	116	11	5	155	9
September	25	14	6	102	5
October	28	20	11	151	10
November	18	51	8	140	12
December	22	77	14	183	27
Total	691	294	54	1658	129

Antler Cycle

Males were found in hard antler phase in all months of the year (Figure 2). Hard-antlered males were found in lowest proportion in January, which gradually increased from February to June, reached its seasonal peak in June and gradually declined from July to January (Figure 2). All recorded males (100%) were hard antlered in the month of June. Seasonal peak of hard-antlered males was recorded in June-July in Chitwan National Park (Mishra 1982). Proportions of hard antlered males were at peak during May to mid-October in Western Ghat (Ramesh et al. 2013), May - June in Bandipur and Gunde National Park (Sharatchandra and Gadgil 1975; Johnsingh 1983), April - June in Sariska Tiger Reserve (Sankar 1994 in Ramesh et al. 2013) and June - July in Corbett National Park (Tak and Lamba 1984) of India.

The highest proportion of velvet-antlered males was recorded in February, began to decrease from March, and reached minimum in June. Their percentage again started to increase gradually from July to February. Males with shed antlers were observed for 8 months of the year and were absent only during April, May, June and July. Their percentage was relatively low with slight seasonal peak in October.

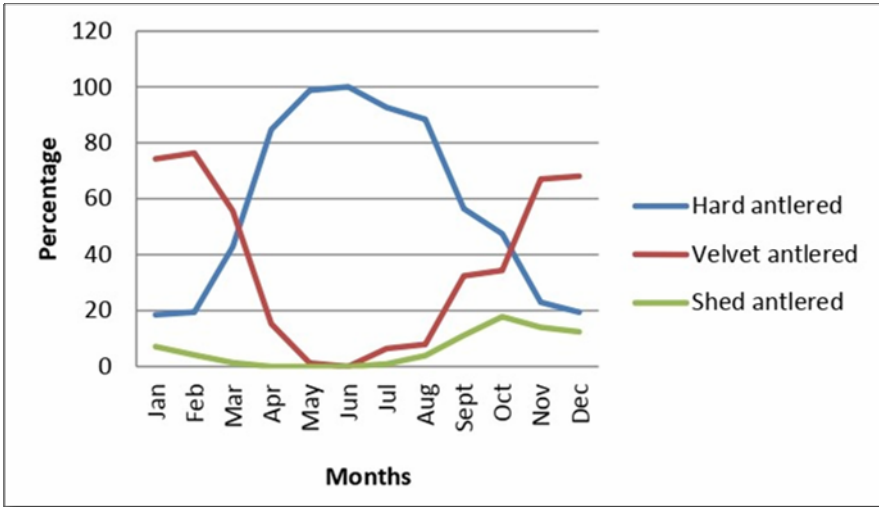


Figure 2: Percentage of antler condition in different months of year

Seasonality of Bellowing Call Frequency

Bellowing calls were heard during eight months of the year, from February to September. The frequency of bellows reached its peak in May (3.55) after which it declined rapidly to its lowest in September (Figure 3). Seasonal peak of Similar results were found in Chitwan National Park as the seasonal peak of bellowing call frequency was found in May (Mishra 1982).

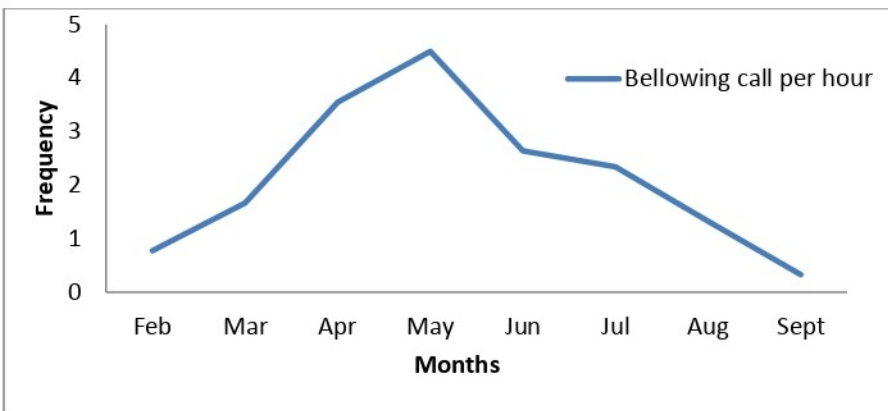


Figure 3: Bellowing call frequencies in different months

Seasonality of Fawning

Fawning frequency of Chital is given in Figure 4. Fawns were observed during all months except July. Out of the months when fawns were recorded, ratio of fawn per

100 adult and sub-adult females was lowest in June (1.709) and reached highest in January (19.658). Seasonal peak of fawning was observed in December-February.

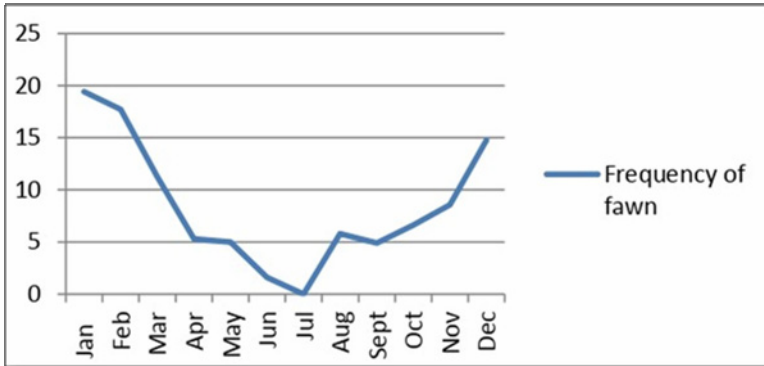


Figure 4: Ratio of fawn per 100 adult and sub-adult does

As most parturition occurred in December-February, most of the conceptions most likely occurred in April-June, considering the gestation period of Chital as about 8 months (Raman 1998). Female deer undergo parturition during periods that are most favorable for fawn survival, usually in terms of high food availability (Robbins et al. 1987). However, in our study area, most births occur during December to February, which is onset of the dry season, a period of relative resource scarcity. Similar results were observed in Guindy National Park (Raman 1998) and Bandipur (Sharadchandra and Gadgil 1975) of India, and Chitwan National Park (Mishra 1992). Sharadchandra and Gadgil (1975) suggested that female Chitals pursue this strategy to coincide with the energy demanding late-lactation period with flush of the plant growth following the pre-monsoon season shower. Seasonal peaks of proportion of hard-antlered males, bellowing call frequency and fawn frequency suggest May-June as peak breeding season of Chital in the study area. Past studies suggest that breeding seasons are not consistent throughout the range of individual species. Peak of the breeding season varies in different locations for the same species throughout their ranges, which could be related to regional differences in climate and vegetation (Krishnan 1972).

Conclusion

In the study area, breeding activities were found to be spread all over the year with distinct seasonal peaks. Highest proportion of hard-antlered males was found in June. Seasonal peak of bellowing call frequency was found in May. Peak fawning occurred in December, January, and February months. From the data of antler cycle, bellowing call frequency and fawning frequency, peak breeding period of Chital was identified as May-June. We recommend managing grasslands for in-situ population and high nutrient food for ex-situ populations focusing on peak fawning season of December- February. Also the translocations should be avoided during peak

fawning and peak breeding season (December to July). Herd composition should change in peak rutting season of male to avoid the injury or death of buck due to fighting.

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