Population Structure Of Cheetal (*Axis axis*) And Sambar Deer (*Cervus unicolor*) In Jhirna Zone Of Corbett National Park Uttarakhand

Shalini[1]

&

Dr. Bhawna Pant[2]

ABSTRACT: Corbett National Park, oldest National Park with great Biodiversity. Jim Corbett National Park (520.82 sq.km.) is divided into five tourist zone as Bijrani zone, Dhikala zone, Jhirna zone, Dhela zone and Durgadevi zone. In these zones the Jhirna zone is a dense and thick type forest and its area is 57.0 sq. km. The field study is carried from November 2017 to June 2019 (two year study). Population density and age-composition is estimated by direct observation method in field survey. In Corbett maximum population of Cheetal deer found in Chaur area of Laldhang and Dhara grassland of Jhirna zone. Sambar deer is mostly found in the dense forest areas of Jhirna zone. The highest density of Cheetal deer is 79.6 per sq. km. found in the month of March. The lowest population density of Cheetal is 7.8 per sq. km. found in June month. The highest population density of Sambar deer is 3.2 per sq. km. found in March month. The lowest population density of Sambar is 0.6 per sq. km. found in June month. This two years study concludes that density of the Cheetal is higher in the second year (2018-2019) than in the first year of study (2017-2018). Sambar deer has been found less in the second year (2018-2019) than in the first year of study (2017-2018).

KEYWORDS: Self-defence weapons, Chaur, Herd, Core zone, Van-gram

INTRODUCTION: Jim Corbett National Park famous for its dense forest, large grasslands, diverse flora and rich fauna, especially for the conservation of royal Bengal Tiger (*Panthera tigris*) and different types of birds (about 600 species). Cheetal and Sambar deer are the main source of food for Tiger in Corbett. The area of Jim Corbett National Park is about 520.82 sq. km. which divided into five tourist zone as Bijrani zone, Dhikala zone, Jhirna zone, Dhela zone and Durgadevi zone (Corbett National Park). Both Himalayan and peninsular flora and fauna elements are found in the reserve on account of its location in the foothills (Khanna *et al*., 2008). The maximum population of Cheetal found in grassland and also Sambar is seen in the dense shrub area and Sal-mixed forest with their sympatric species, which attracts tourists. Size of the

available habitat is proportional to the richness of wild animals (ArthurMac, 1965). In this paper the study was conducted in Jhirna zone, a very dense forest zone of Corbett. This zone divided into core zone, tourist zone (park area) and buffer zone. The observations were done in tourist and buffer zone of Jhirna.

CHEETAL (*Axis axis*): The Cheetal is a most attractive deer with a rufous coat colour and white spots on its coat. The under parts like abdomen, inner side of legs, tail, and neck are white in Corbett. The Cheetal is found in large numbers in dense deciduous or semi-evergreen forests and open grassland. Cheetal prefer open grassland during winter and more forested patch during summer when grass is low in abundance (Schaller, 1967). Antler shedding occurs mostly in monsoon and winter (Prater, 1971; Ramesh *et al*., 2013). Older Cheetal stags are more susceptible to predation than younger stags (Johnsingh, 1983; Patel, 1992; Karanth & Sunquist, 1995).

SAMBAR (*Cervus unicolor*) Sambar deer is the largest deer species and considered as vulnerable category of in red list (IUCN). Sambar meat and antlers are sold illegally and its populations declining due to overexploitation (David & Leslie, 2011). Karanth and Sunquist (1992) found habitat specific differences in Sambar densities with teak dominated and moist deciduous forests having significantly higher densities 4.9-10.4 per sq. km and 3.0-11.1 per sq. km compared to dry deciduous forests (0.1-1.8 per sq. km). In Corbett Tiger reserve, it is reported that Sal forest highly suits to the habitat demand of Sambar (Pant *et al*., 1999). Sambar live at much higher densities in moist than in dry deciduous forests of Nagarahole National Park (Karanth & Sunquist, 1992). The ability of the Sambar deer to consume different variety of plants indicates that they are not very specialised in their food preference (Bentley, 2011; Downes, 1983). In Jhirna zone only 5-7 individual are seen together at the time of feeding in a same area.

MATERIALS AND METHODS

STUDY AREA: Jhirna zone, a small and dense forest zone from the five range of Jim Corbett National Park. Its area is about 57.0 sq. km and its latitude and longitude are 29.26°N and 78.56°E respectively. Jhirna zone is located 25 km. from Ramnagar city and its entry gate is Dhela entrance gate at Kalagarh road in Uttarakhand (India). Jhirna forest composed from large grassland, hilly terrain, streams and river. Different study points in Jhirna zone are Laldhang Chaur, Khara gate, Kothiro-river side, Jhirna, Bhagwan guru Chauki, watch tower point, Jhirna forest rest house, Dhara Chauki, Dhara grassland, Dhara spring and at last road attach to Kalagarh.

The nearest village is Dhela which is a small van gram. In Dhela village peoples live and farming cereal crops like wheat, paddy crops, green vegetables, ginger, Mangos, black berry, guava like fruits. The vegetation in Jhirna range is thick type forest. In Jhirna there is large undergrowth of shrubs of *Helicteres isora* (Jukai-Maror phali) with *Ziziphus jujube* (Ber), *Glycosmis arbores* (Peelu), *Murraya koenegi* (Kari Patta), *Lantana camera* (Kuri), *Shorea robusta* (Sal), *Dalbergia sissoo* (Shisham), *Adina cordifolia* (Haldu), *Diospyros tomentosa* (Tendu), *Madhuca indica* (Mahua), *Aegle marmelas* (Bael) and *Cassia tora* (Banar). In grasses mainly the *Cynadon dactylon, Desmostachya bipinnata, Pennisetum purpureum, Eulaliopsis binata,*

Chrysopogon montanus, Heteropogon, Imperata cylindrica, Themenda arundinaceae, Saccharum bengalensis, S. spontaneum, and *S.munja* etc are dominantly present in this zone.

METHODOLOGY

The field surveys were carried out for two years from November 2017 to June 2019 in Jhirna zone of Jim Corbett National Park, Ramnagar. The direct observation (random transect sampling) was used for this study (Srinivasalu, 2001). In direct observation monthly two visits from winter season to summer season were done for the seasonal study. In monsoon season the visibility was off due to thick type vegetation and blockage in roads by rain and seasonal rivers. So there is only two season (8 months per year) data were collected and analyse. Firstly the Jeep safaris were hired for field visits in Jhirna zone of Corbett Park (Iqbal *et al*., 2013). During every field visit five random transect sites of 1 sq. km were sited. In this field observation method, all habitats covering the grasslands (Chaur) Sal-mixed forest, dense forest and river side area, water sot, seasonal rivers in study area was observed during field visits. The counting were done by the help of binocular also pictures clicked by DSR Nikon camera and phone. Thus monthly population densities of Cheetal and Sambar deer were found.

RESULT AND DISCUSSION

In the first year of study, the highest population density within the Jhirna zone was 68.8 per sq. km obtained in the month of March. In which the male's density was 9.6±1.69 per sq. km, adult female's population density was 20.2±1.85 per sq. km, yearling male's density was 6.4±0.93 per sq. km, yearling female's density was 15.0±3.0 per sq. km and the fawn's density was 17.6±1.28 per sq. km (Table 1).

In the second year also, the highest population density within the Jhirna zone was 79.6 per sq. km obtained in the month of March. In which the male's density was 10.2±1.42 per sq. km, adult female's population density was 30.6±3.74 per sq. km, yearling male's density was 8.2±2.26 per sq. km, yearling female's density was 17.0±2.44 per sq. km, and the fawn's density was 13.6±3.35 per sq. km (Table 2).

The lowest population density in the first year was 7.8 per sq. km obtained in the month of June inside Jhirna zone of Corbett. In second year the lowest population density obtained was 9.2±3.32 per sq. km in the month of June. In the months of May and June the temperature rises and almost all the grass and shrubs dry up. Therefore, there is a shortage of food for Cheetal deer and they start moving to the core zone for their food and cold habitat. This breaks up large groups and obtained minimum population density in the study area.

Similarly, in the first year study in Jhirna zone, highest population density of Sambar deer has been obtained was 3.2±1.28 per sq. km in the month of March 2018. In which the male density was 1.0±0.31 per sq. km, the female density was 1.4±0.50 per sq. km and young density was 0.8±0.37 per sq. km which are the highest in these categories of other months. In the second year, the highest population density obtained was 2.6±0.92 per sq. km in the month of March 2019. In which the male density was 1.2±0.37 per sq. km, female density was 0.8±0.37 per sq. km and young density was 0.6±0.24 per sq. km which is the highest in these categories of other months except fawn density.

Table 1: Data significance table for different age-composition of Cheetal in Jhirna zone (from November 2017 to June 2018)

Mean population of Cheetal (per sq. km)					
Month	Male	Female	Fawn	Yearling male	Yearling female
November 2017	$4.6\pm.0.812^{bc}$	13.6 ± 2.94^{b}	1.6 ± 0.50^{a}	3.2 ± 0.58^{ab}	4.4 ± 0.67^{ab}
December 2017	$0.4\pm.0.24^{a}$	2.2 ± 0.86^{a}	1.8 ± 0.37^{a}	1.6 ± 0.51^{a}	3.0 ± 0.44^{a}
January 2018	$3.4\pm.0.74^{ab}$	12.2 ± 1.35^{b}	4.4 ± 0.4^{a}	2.8 ± 0.37^{ab}	6.4 ± 0.92^{ab}
February 2018	$4.2\pm.1.06^{bc}$	14.4 ± 1.86^{b}	10.2 ± 1.31^{b}	4.4 ± 1.36^{bc}	8.4 ± 1.86^{b}
March 2018	$9.6\pm.1.69^{d}$	20.2 ± 1.85^{c}	17.6 ± 1.28^{c}	6.4 ± 0.93^{c}	15.0 ± 3.0^{c}
April 2018	$7.2\pm.1.71^{cd}$	21 ± 3.40^{c}	12.8 ± 2.92^{b}	5.6 ± 0.51^{c}	14.4 ± 2.04^{c}
May 2018	$0.6\pm.0.24^{a}$	5.4 ± 1.36^{a}	4.8 ± 0.86^{a}	2.6 ± 0.51^{ab}	7.0 ± 1.70^{ab}
June 2018	0.8 ± 0.48^{a}	2.2 ± 0.58^{a}	1.2 ± 0.37^{a}	1.0 ± 0.45^{a}	2.6 ± 0.4^{a}

Table 2: Data significance table for different age-composition of Cheetal in Jhirna zone (from November 2018 to June 2019)

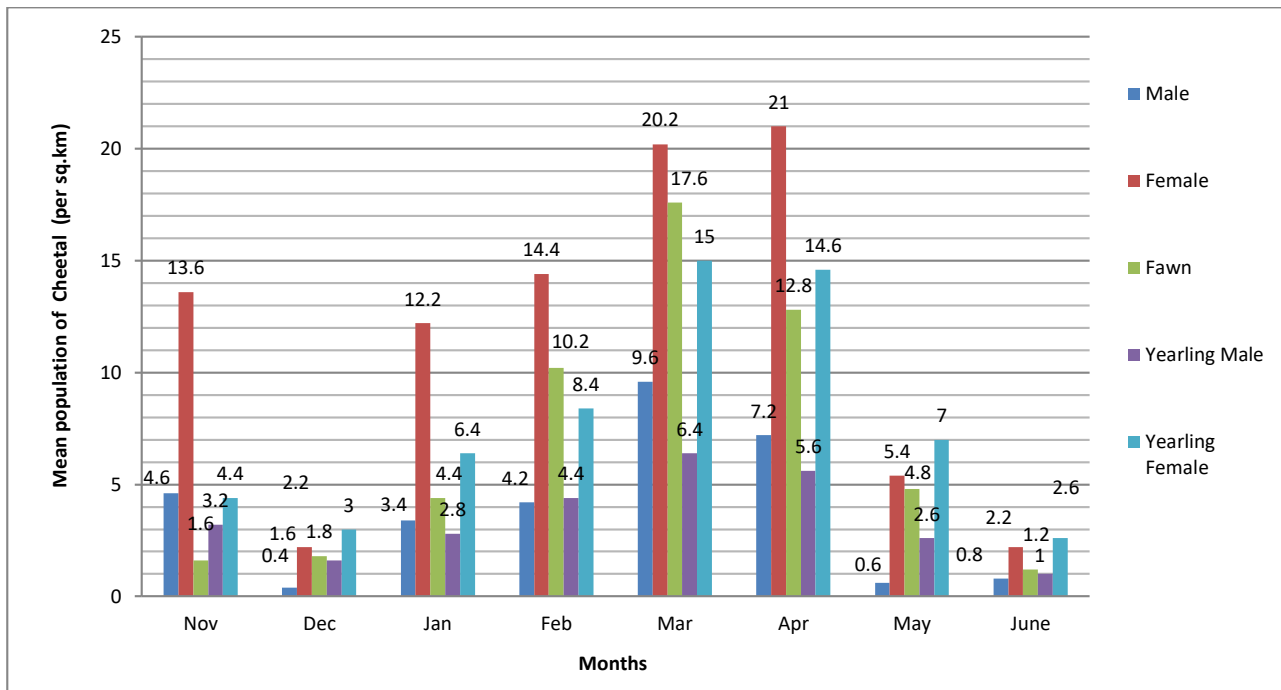| Mean population of Cheetal (per sq. km)					
Month	Male	Female	Fawn	Yearling male	Yearling female
November 2018	3.8 ± 0.58^{ab}	17.4 ± 1.56^{c}	2.6 ± 0.67^{a}	4.2 ± 2.08^{a}	8.4 ± 2.08^{ab}
December 2018	0.8 ± 0.37^{a}	6.2 ± 2.43^{ab}	1.8 ± 0.20^{a}	2.6 ± 0.40^{a}	4.2 ± 1.06^{ab}
January 2019	3.0 ± 0.74^{ab}	17.6 ± 2.94^{c}	5.0 ± 0.54^{ab}	4.4 ± 0.92^{ab}	9.6 ± 1.86^{b}
February 2019	8.6 ± 1.46^{c}	19.6 ± 1.99^{c}	10.4 ± 2.65^{cd}	5.0 ± 1.51^{ab}	16.8 ± 2.47^{c}
March 2019	10.2 ± 1.42^{c}	30.6 ± 3.74^{d}	13.6 ± 3.35^{d}	8.2 ± 2.26^{bc}	17 ± 2.44^{c}
April 2019	4.4 ± 1.28^{b}	18.2 ± 4.74^{c}	9.4 ± 1.8^{bcd}	9.6 ± 2.13^{c}	19.6 ± 1.72^{c}
May 2019	2.2 ± 0.86^{ab}	11.4 ± 1.53^{bc}	5.4 ± 1.07^{abc}	2.4 ± 0.50^{a}	7.2 ± 1.59^{ab}
June 2019	1.0 ± 0.44^{a}	2.4 ± 0.50^{a}	1.6 ± 0.24^{a}	1.0 ± 0.31^{a}	3.2 ± 0.58^{a}

Figure 1: Monthly variation in mean population of different age-composition of Cheetal deer in Jhirna zone (from November 2017 to June 2018)
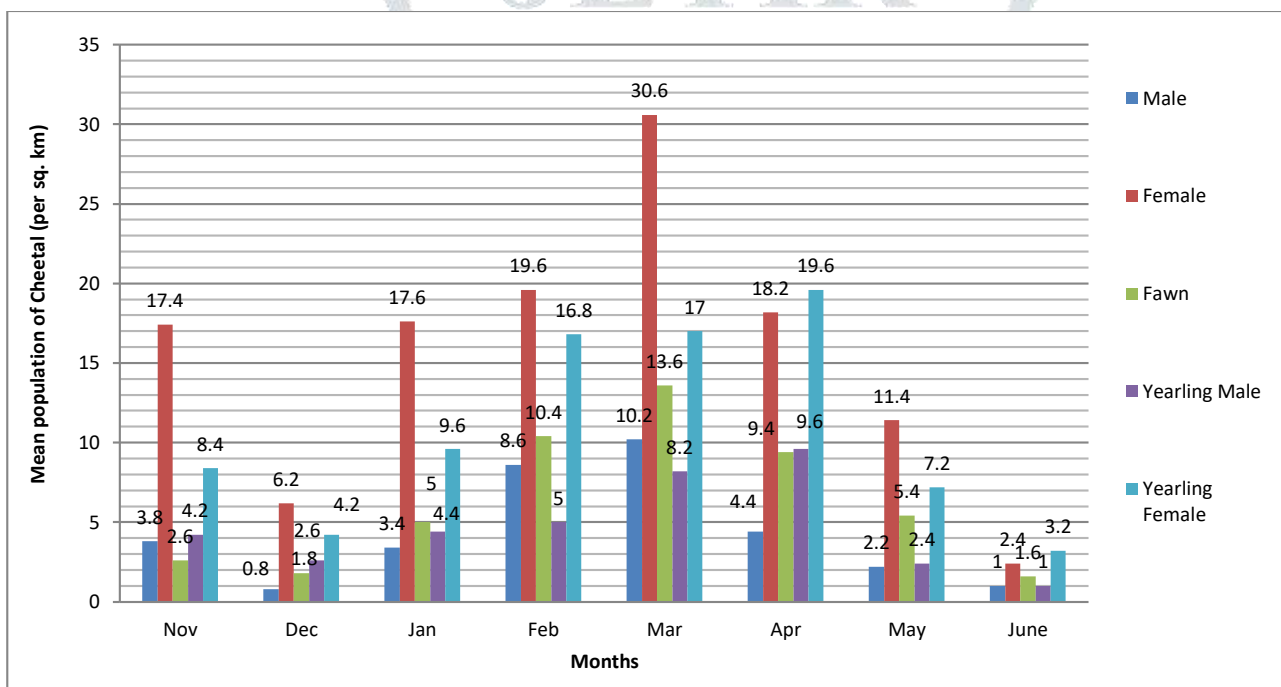

Figure 2: Monthly variation in mean population of different age-composition of Cheetal deer in Jhirna zone (from November 2018 to June 2019)

Table 3: Data significance table for different age-composition of Sambar in Jhirna zone (from November 2017 to June 2018)

Month	Male	Female	Fawn
November 2017	1.0 ± 0.31^a	0.8 ± 0.37^a	0.2 ± 0.20^a
December 2017	0.8 ± 0.37^a	0.6 ± 0.24^a	0.4 ± 0.24^a
January 2018	1.0 ± 0.31^a	1.0 ± 0.31^a	0.6 ± 0.24^a
February 2018	0.6 ± 0.24^a	1.2 ± 0.48^a	1.0 ± 0.44^a
March 2018	1.0 ± 0.31^a	1.4 ± 0.50^a	0.8 ± 0.37^a

April 2018	1.0 ± 0.54^a	1.0 ± 0.31^a	0.4 ± 0.24^a
May 2018	0.2 ± 0.2^a	0.4 ± 0.24^a	0.6 ± 0.24^a
June 2018	0 ± 0^a	0.4 ± 0.24^a	0.4 ± 0.24^a

Table 4: Data significance table for different age-composition of Sambar in Jhirna zone (from November 2018 to June 2019)

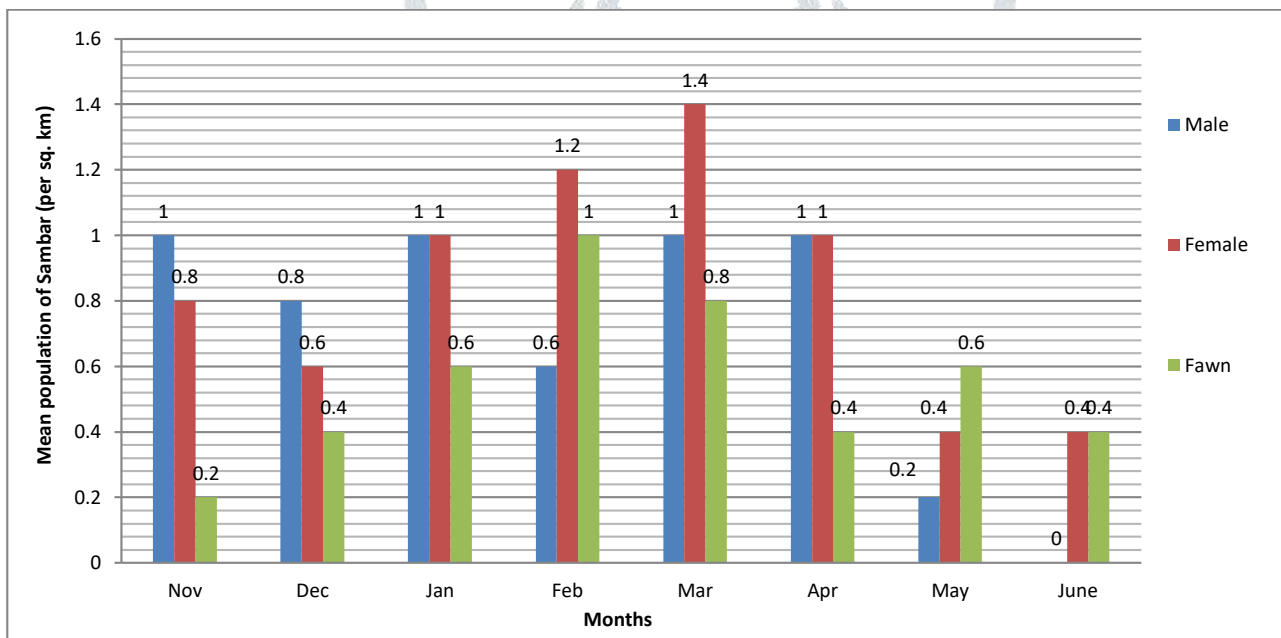| Month	Male	Female	Fawn
November 2018	0.8 ± 0.37^{ab}	0.6 ± 0.24^a	0.2 ± 0.20^a
December 2018	0.4 ± 0.24^{ab}	0.6 ± 0.24^a	0.4 ± 0.24^a
January 2019	0.8 ± 0.37^{ab}	1.0 ± 0.44^a	0 ± 0
February 2019	0.6 ± 0.24^{ab}	0.8 ± 0.37^a	0.8 ± 0.37^a
March 2019	1.2 ± 0.37^b	0.8 ± 0.37^a	0.6 ± 0.24^a
April 2019	0.6 ± 0.24^{ab}	0.6 ± 0.4^a	0.6 ± 0.40^a
May 2019	0.6 ± 0.4^{ab}	0.2 ± 0.2^a	0.2 ± 0.20^a
June 2019	0 ± 0	0.2 ± 0.2^a	0.4 ± 0.24^a

Figure 3: Monthly variation in mean population of different age-composition of Sambar deer in Jhirna zone (from November 2017 to June 2018)
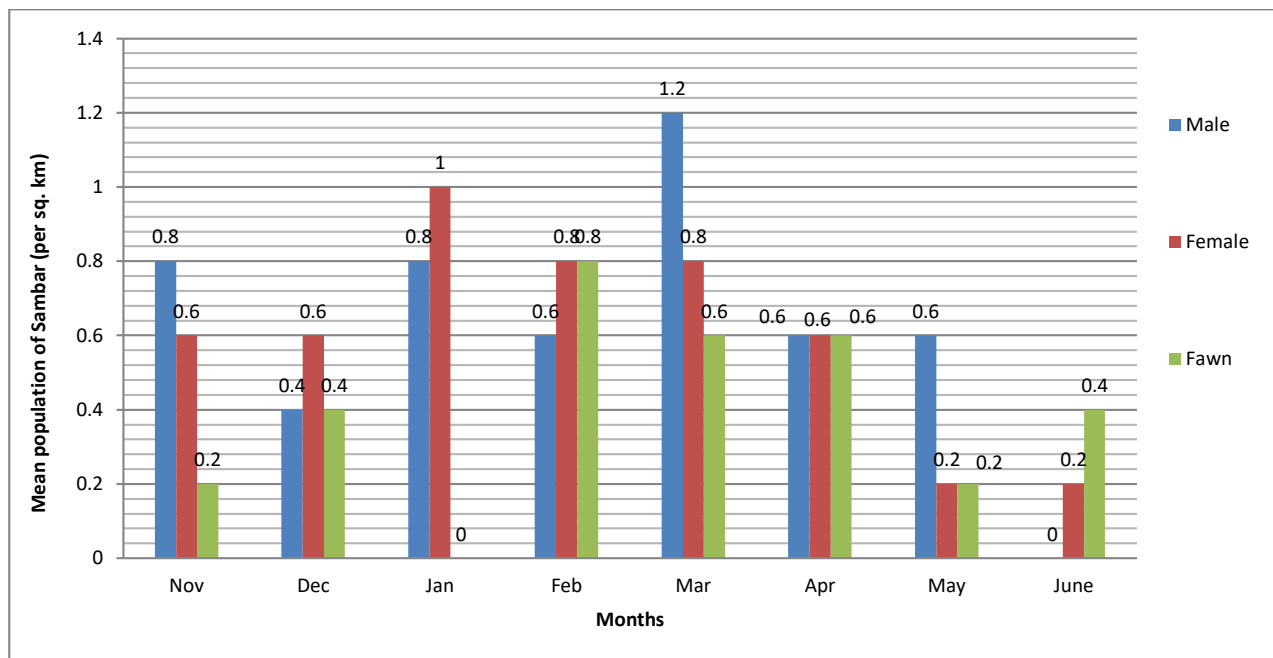
Figure 4: Monthly variation in mean population of different age-composition of Sambar deer in Jhirna zone (from November 2018 to June 2019)

Cheetals associate in herds of various sizes ranging from a few individuals to several hundred (Khajuria, 1982). Age structure of a population is useful for understanding dynamics of population growth and estimating life history parameters (Spillet, 1966; Stearns, 1992). The above data shows that, all the Cheetals are getting sufficient food in one place and maximum number of babies born and with their lactating/ nursing mother in month of March. The yearling males and females also graze with their mother. Adult males and adult females graze in their group during this time all members do not need to move to go out due to adequate food, space and sex. Even at this time, there is neither much greenery inside the park, nor more dense bushes nor is the height of grass due to which the maximum visibility is found in the park.

So the whole group grazes in one place, babies are also highest and yearling males and females are also highest in number. Therefore the large groups of Cheetal are seen at this time. The general predictions of change in group size in Cheetal are directly linked to percent availability of rutting stags and fawns as adult males join female groups during the rutting season (Raman, 1997; Ramesh *et al*., 2013). Food choice, abundance, and dispersion also vary with cover density and these may influence the size of ungulate groups (Lagory, 1986).

The group size of Sambar is found bigger in January, February and March months. In Sambar deer also the mother grazes with the young and at the same time takes care of young. The male is present with his family for safety. The number of groups of Sambar deer is large in November, February and March months. The group size depends on the vegetation of the study area. In winter, green grasses and shrubs like *Glycosmis arbores, Murraya koenegi, Ziziphus mauritiana, Clerodenderon infortunatum* and trees like *Bauhinia varigiata, Mallotus philippensis, Acacia Arabica*, *Acacia catechu, Syzigium cumini, Agle marmels, Emblica officinalis, Bombax ceiba, Terminaria arjuna* and *Ficus* all species are available in forest. With this, groups of Sambar are found grazing in all vegetative sites. While in the month of December and January, there is

less sunlight inside the forest and the temperature remains low, due to which all the animals do not come out. At this time their individual number and groups cannot be accurately estimated.

CONCLUSION: According to the above study, there is a abundance eof Cheetal in Jhirna zone. The Sambar deer is also found in the dense vegetative habitat of Jhirna zone. The best time to see and study Cheetal and Sambar deer is in February and March in Jhirna zone (Corbett National Park). In the two year study, the density of the Cheetal is higher in the second year (2018-2019) than in the first year of study (2017-2018). Sambar deer has been found in lower density in the second year (2018-2019) than in the first year of study (2017-2018).

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