

Seasonal Food Preference of Cheetal (*Axis axis*) And Sambar Deer (*Cervus unicolor*) In Corbett National Park, Uttarakhand

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ABSTRACT

This study is based on two years field study by direct observation and questionnaire method in Bijrani and Jhirna zones of Corbett National Park. Cheetal (*Axis axis*) and Sambar deer (*Cervus unicolor*) are found with their sympatric species Barking deer in Corbett Park. The population of Cheetal and Sambar in different vegetative areas of Corbett varies according to the availability of their favourite food (seasonal). This study reveals that Cheetal preferred new sprouting of *Cynadon dactylon*, green *Desmostachya bipinnata*, *Eulaliopsis binata*, *Setaria* species, *Heteropogon* species, *Imperata cylindrica*, *Saccharum bengalensis*, and *Saccharum narenga* in grassland. In dense shrub area, Cheetal preferred green tender leaves of *Murraya koenigi*, *Glycosmis arbores*, and fruits of *Ziziphus mauritiana*, *Embllica officinalis*, and *Solanum nigrum*. In Sal-mixed forest Cheetal preferred green fallen leaves of *Shorea robusta*, *Adena cordifolia*, *Mallotus philippensis* and leaves & fruits of *Syzigium cumini*, *Agle marmels*, *Ficus racemosa*, *Diospyras tomentosa*, flowers of *Bombax ceiba (calyx)*, *Cassia fistula* etc. In the water-side area Cheetal preferred *Dalbergia sissoo*, *S. munja*, *Phragmites roxburghii* and *Acacia catechu* etc. Sambar is mostly found in dense shrub area and preferred leaves of *M. koenigi*, *G. arbores*, *E. officinalis*, *Justicia adhatoda*, *Z. mauritiana*. In Sal-mixed forest, Sambar preferred leaves of *S. robusta*, *A. cordifolia*, *A. marmeles*, *Dendrocalamus strictus*, and flowers of *B. ceiba* etc. In grassland, Sambar preferred *S. munja*, *I. cylindrica*, *D. bipinnata*, *E. binata*. In water-side Sambar preferred *A. arabica*, *P. roxburghii*, and *D. sissoo* on a priority basis. Sambar generally preferred course food like rough leaves, bark, seeds, flowers, soft twigs, and large grasses.

KEYWORDS: Jhirna, Bijrani, Questionnaire, Gypsy, Dhara grassland.

INTRODUCTION

Jim Corbett National Park is a center of attraction for Indian and foreign tourists. The first thing we start to see is herds of Cheetal deers (*Axis axis*) as soon as we enter Corbett Park. Cheetal deer are mainly found in the grasslands area and they live in groups of 10-50 individuals or more. Its herd (group) consists of females with their young and 1-2 stags (males). The body coat of Cheetal deer is reddish brown (rufous colour) with white spots scattered on it. The underparts of the body like the abdomen, inner legs, and inner tail are white [8]. Cheetal prefers open grassland during winter and more

forested patches during summer when the grass is low in abundance [7]. In Corbett National Park the approximate weight of an adult Cheetal deer is 85 kg, its height is 50 cm from the shoulder, and its antler length is 80 cm [6]. The hairs of the coat are soft and shiny. The sebaceous and apocrine glands located at the base of the hair shaft exclude oily liquid and this gives the coat a glossy appearance [3]. About a dozen grass species and 29-36 browse species are reportedly consumed by Cheetal in different areas [7] [10].

The largest-sized deer species known as Sambar (*Cervus unicolor*) is also found in dense shrub area and Sal-mixed forest of the Corbett. Its size is larger than the rest of the deer species found in India [9]. Its weight is about 225-320 kg, height is 135-150 cm and antler length is 90-95 cm [6]. The populations of Sambar deer are vulnerable (VU) because of overexploitation for subsistence and markets in meat and antlers [2]. Corbett National Park has boundaries that are circumscribed by legislation. The natural habitat of the animals is preserved inside the Corbett and the animals are also protected from extraneous predators and diseases. Corbett is a dry deciduous type forest with mixed vegetation due to all these reasons, Sambar species have survived in Corbett till now.

In Mudumalai, the Sambar utilized the dry deciduous forest with tall grasses and moist deciduous forests more than any other habitat [11]. Karanth and Sunquist [5] 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). The highest density of Sambar deer (15-26 per sq. km) in its range has been recorded in Rajaji National Park in North-Western India [4].

MATERIALS AND METHODOLOGY

Site Description: This study is done in Bijrani and Jhirna zone of Corbett National Park. The latitude and longitude of Bijrani zone are 29.4613°N and 79.1478°E respectively and its area is about 117.77 sq. km [1]. There are some different sites inside the Bijrani zone, Semalchour chowki, Bijrani-sot, Bijrani forest rest house, Pakki-Puliya, Ringoda-chaur, Jad-Pahad, Cheetal-road, Kichaar-road, Machan-chaur, and Malani. The latitude and longitude of Jhirna zone are 29.26°N and 78.56°E respectively and its area is about 56.99 sq. km. Different sites inside Jhirna zone are Khara-gate, Bhagwan-guru chowki, Laldhang-chaur, Kothiro-river side, Watch tower, Jhirna forest rest house, Dhara grassland, and Dhara-chowki.

Vegetation in different habitats

1. Grassland area: This includes large grassland (Chaur area) and grassland with trees boundary. In the Bijrani zone, there are three grasslands Semalchour, Ringoda-chaur, and Machan-chaur. In Jhirna zone, there are two grasslands Laldhang-chaur and Dhara grassland. The entire part of the chaur area is composed from grasses like *Eulaliopsis binata*, *Desmostachya bipinnata*, *Pennisetum purpureum*, *Cynadon dactylon*, *Saccharum munja*, *Saccharum narenga*, *Imperata cylindrica*, *Thysanolaena maxima*, *Phragmites roxburghii*, *Digitaria* species in the Bijrani zone.

2. Vegetation in Water stream area: This includes areas near river banks, areas with seasonal water sources, and vegetation growing near small ponds formed by water logging after rain. It contains mainly

Dalbergia sissoo, *Syzigium cumini* tree with grasses such as *Saccharum munja*, *Phragmites roxburghii* in Bijrani zone and *Zizyphus mauritiana* and *Acacia catechu* and grasses such as *Saccharum munja* and *Dendrocalamus strictus* etc. in Jhirna zone.

3. Sal-mixed forest: This is the core area of the forest; it mainly consists of *Shorea robusta* with other tree species like *Adena cordifolia*, *Dalbergia sissoo*, *Mallotus philippensis*, *Holoptelea integrifolia*, *Diospyras tomentosa*, *Terminaria belerica*, *Terminaria chabula*, *Terminaria arjuna*, *Aegle marmeles*, *Bombax ceiba*, *Bauhinia variegata*, *Ficus bengalensis*, *Ficus racemosa*, *Butea monosperma*, *Albija lebac*, *Anogeissus latifolia*, *Acacia catechu*, *Cassia tora* and *Embllica officinalis*.

4. Shrub area: The shrub area is very important because shrubs, grasses, and some tree species are also found. In the Bijrani zone, there are mainly *Lantana camera* bushes. Whereas Jhirna zone has the maximum number of *Zizyphus mauritiana* bushes. Along with these other species of shrubs like *Murraya koenegi*, *Glycosmis arbores*, *Helictocers isora*, *Clerodenderon infortunatum*, *Justicia adhatoda* and *Solanum nigrum*. In grasses *Cynadon dactylon*, *Desmostachya bipinnata*, *Imperata cylindrica*, *Chrysopogon montanus*, *Apluda mutica*, and *Dendrocalamus strictus* are present with shrubs.

Table 1: Most common vegetation (Grasses, Shrubs and Trees) in Bijrani and Jhirna zone of Corbett National Park (During study period)

Sr. no.	Common/Local name	Botanical name
1	Ulla	<i>Arundinella bengalensis</i>
2	Dub ghas, Durva	<i>Cynadon dactylon</i>
3	Gori	<i>Chrysopogon montanus</i>
4	Pengi	<i>Chloris delichostachya</i>
5	Bhuri	<i>Chrysopogon serrulstus</i>
6	Devil bean	<i>Crotolaria species</i>
7	Bamboo	<i>Dendrocalamus strictus</i>
8	Kush	<i>Desmostachya bipinna</i>
9	Crab grass	<i>Digitaria species</i>
10	Sabai, baib grass	<i>Eulaliopsis binata</i>
11	Kumeria	<i>Heteropogon contartus</i>
12	Sirav, Pula	<i>Imperata cylindrical</i>
13	Narkul, Nal	<i>Phragmites roxburghii</i>
14	Elephant grass	<i>Pennisetum purpureum</i>
15	Sarkanda	<i>Saccharum bengalensis</i>
16	Munj	<i>Saccharum munja</i>
17	Ganeria	<i>Saccharum narenga</i>
18	Kansa	<i>Saccharum spontaneum</i>
19	Ballu	<i>Setaria species</i>
20	Tiger Grass, Broom Grass	<i>Thysanolaena maxima</i>
21	Adhapushpi	<i>Trichodesma indicum</i>
22	Khas	<i>Vetiveria zizanioides</i>

23	Sonkadi grass	<i>Vicoa indica</i>
24	Libhera	<i>Cardia dichotoma</i>
25	Lasora	<i>Cardia myxa</i>
26	Bhanua	<i>Clerodenderon species</i>
27	Peelu	<i>Glycosmis arbores</i>
28	Maror-fal	<i>Helictoceras isora</i>
29	Vasaka	<i>Justicia adhatoda</i>
30	Kuri	<i>Lantana camera</i>
31	Kari Plant	<i>Murraya koenegi</i>
32	Makoi	<i>Solanum nigrum</i>
33	Jujube (Ber)	<i>Zizyphus mauritiana</i>
34	Goat Weed	<i>Ageratum conyzoides</i>
35	Khair	<i>Acacia catechu</i>
36	Babool	<i>Acacia arabica</i>
37	Haldu	<i>Adina cordifolia</i>
38	Bael	<i>Aegle marmelos</i>
39	Serus	<i>Albija lebbeck</i>
40	Bakli	<i>Anogeissus latifolia</i>
41	Kachnar	<i>Bauhinia variegata</i>
42	Dhak	<i>Butea monosperma</i>
43	Semal	<i>Bombax ceiba</i>
44	Amaltas	<i>Cassia fistula</i>
45	Banar	<i>Cassia tora</i>
46	Shisham	<i>Dalbergia sisso</i>
47	Tendu	<i>Diospyras tomentosa</i>
48	Amla	<i>Emblica officinalis</i>
49	Badh, Bargad	<i>Ficus bengalensis</i>
50	Gular	<i>Ficus racemosa</i>
51	Pipal	<i>Ficus religiosa</i>
52	Lakhar	<i>Ficus retusa</i>
53	Pilkhan	<i>Ficus rumphi</i>
54	Kanju	<i>Holoptelea integrifolia</i>
55	Mahua	<i>Madhuca indica</i>
56	Rohini	<i>Mallotus philippensis</i>
57	Sal	<i>Shorea robusta</i>
58	Jamun	<i>Syzigium cumini</i>
59	Arjun	<i>Terminaria arjuna</i>
60	Bahad	<i>Terminaria belerica</i>
61	Harad	<i>Terminaria chabula</i>

Field study and Data collection method: There are two methods for collecting primary data in research methodology, the direct observation method and the Questionnaire method. The secondary data

regarding the study area, vegetation, population, behaviour and activities of Cheetal and Sambar were collected from the official websites of Corbett Park and offline newspapers and literature study.

1. Direct observation by field visits: Field visits were conducted from November 2017 to June 2019. In this two years study the field is visited for 8 months each year, including the winter and summer seasons. Corbett National Park remains closed for visitors in monsoon season, from mid-June to mid-October (four months).

The study sites were visited two times in every month of the study period. The direct observation method was used (by random transect sampling) to calculate the population density of Cheetal and Sambar deer. During the field visit the following items were used to observe Cheetal and Sambar, camera, binocular (Nikon-action 16x50), mobile, lance, polythene, airtight bags, inch tape, diary, and pen. The fields were visited by gypsies and in the buffer area by foot walking. The study period is divided into four seasons based on the vegetation and temperature present here. It has pre-winter from 15th October to 15th December, winter from 16th December to 15 February and spring from 16 February to 15 April, and summer from 16 April to 15 June. In every field visit a transect area of 1 sq. km. (measured by meter-reading of the vehicle) were randomly taken out from different vegetative habitats such as large grassland area (chaur), grassland with mixed tree species, water-side area, Sal-mixed forest and dense shrub area.

For food habits, the vegetation available in the study area was note down. The study animals were observed during grazing and browsing. On-site inspections and identification of that particular vegetation were made with the help of forest guide. In some places where study animals were not found, their footprints and fecal pallets were found under the trees.

2. Questionnaire from the local community

A total of 30 houses were visited in Aamdanda khatta and Ringoda villages adjoining to Bijrani zone (1st study site). Similarly in the Jhirna zone (2nd study site), a total of 30 houses were visited in Dhela and Patrani villages. Firstly a list of dominant food species of trees, shrubs, and grasses was prepared with the help of nature guides and drivers of Corbett for the questionnaire. The questionnaires were done to the local women and villagers as they go inside the forest every day to cut the grass and collect dry wood also. In the questionnaire, questions related to Cheetal and Sambar population, herd size, and feeding preferences were asked. The questionnaires were also done to the gypsy drivers and nature guides of Corbett National Park. A total of 40 questionnaires were done with gypsy drivers and nature guides. Thus a total of 100 questionnaires were found by visiting 60 houses in the villages near the Bijrani and Jhirna zone and 40 questionnaires from gypsy drivers and nature guides.

In this way, a total of 100 questionnaires were found. In the above public, 15 people went 1 to 2 times inside Corbett Park in one month, 62 people went 3 to 5 times, and 23 people went more than 5 times inside the park in one month.

RESULTS AND DISCUSSION

In a particular vegetative habitat, the presence of large herds of Cheetal deer indicates the availability of their favourite food species in that place. Similarly, the presence of more pairs of Sambar deer in dense shrub area and Sal-mixed forest indicates the availability of the most preferred food species in those habitats. In Corbett National Park, the availability of green grasses, leaves, flowers,

fruits, and seeds depends on its particular season. So the seasonal variation in the population of Cheetal and Sambar is found during the study period.

Table 2: Seasonal mean population (per km. sq.) of Cheetal deer in Bijrani zone of Corbett National Park (from November 2017 to June 2019)

Mean Population (per sq. km.)						
Year	Season	Grassland with mixed tree species	Large grassland (Chaur)	Shrub area	Sal-mixed forest	Water stream area
2017-2018	Pre-winter	27	60	2.0	0	0.5
	Winter	37.5	62	27	1.5	1.0
	Spring	73	107	26.5	5.5	4.0
	Summer	7.0	8.5	1.5	6.0	7.0
2018-2019	Pre-winter	33	68.5	5.0	0	0
	Winter	45	73	18.5	2.0	3.5
	Spring	74.5	126.5	15.0	12.0	10.5
	Summer	5.5	8.0	5.0	14.5	14.0

Table 3: Seasonal mean population (per km. sq.) of Cheetal deer in Jhirna zone of Corbett National Park (from November 2017 to June 2019)

Mean Population (per sq. km)						
Year	Season	Grassland with mixed tree species	Large grassland (Chaur)	Shrub area	Sal-mixed forest	Water stream area
2017-2018	Pre-winter	29	51.5	6.0	0	4.5
	Winter	41.5	109.5	15.5	4.0	6.5
	Spring	92	183	23	18	8.5
	Summer	11	25.5	8.0	16	10
2018-2019	Pre-winter	30	90.5	5.0	0	4.5
	Winter	70	147.5	22	1.5	9.0
	Spring	97	212.5	23	17.5	2.0
	Summer	19.5	25	14	20	16.0

Table 4: Seasonal mean population (per km. sq.) of Sambar deer in Bijrani zone of Corbett National Park (from November 2017 to June 2019)

Mean Population (per sq. km.)						
Year	Season	Grassland with mixed tree species	Large grassland (Chaur)	Shrub area	Sal-mixed forest	Water stream area
2017-2018	Pre-winter	2.5	0	2.5	2.0	0
	Winter	2.0	1	4.0	3.5	1.0

	Spring	0	0	4.0	6.0	2.5
	Summer	0	0	1.0	2.5	3.5
2018-2019	Pre-winter	1.0	1	2.0	1.0	0.5
	Winter	0.5	0	4.5	3.5	1.0
	Spring	1.5	0	2.5	5.0	2.0
	Summer	0	0	1.5	1.0	2.5

Table 5: Seasonal mean population (per km. sq.) of Sambar deer in Jhirna zone of Corbett National Park (from November 2017 to June 2019)

Mean Population (per sq. km.)						
	Season	Grassland with mixed tree species	Large grassland (Chaur)	Shrub area	Sal-mixed forest	Water stream area
2017-2018	Pre-winter	1.5	1.0	4.5	2.5	0
	Winter	1.5	1.0	6.5	3.5	1.0
	Spring	2.5	0	3.5	6.5	1.5
	Summer	0	0	1.0	3.0	1.5
2018-2019	Pre-winter	1.0	0	4.5	1.5	0.5
	Winter	3.5	0.5	4.0	1.0	1.0
	Spring	2.5	0	2.0	3.5	3.0
	Summer	1.0	0	1.0	1.5	1.5

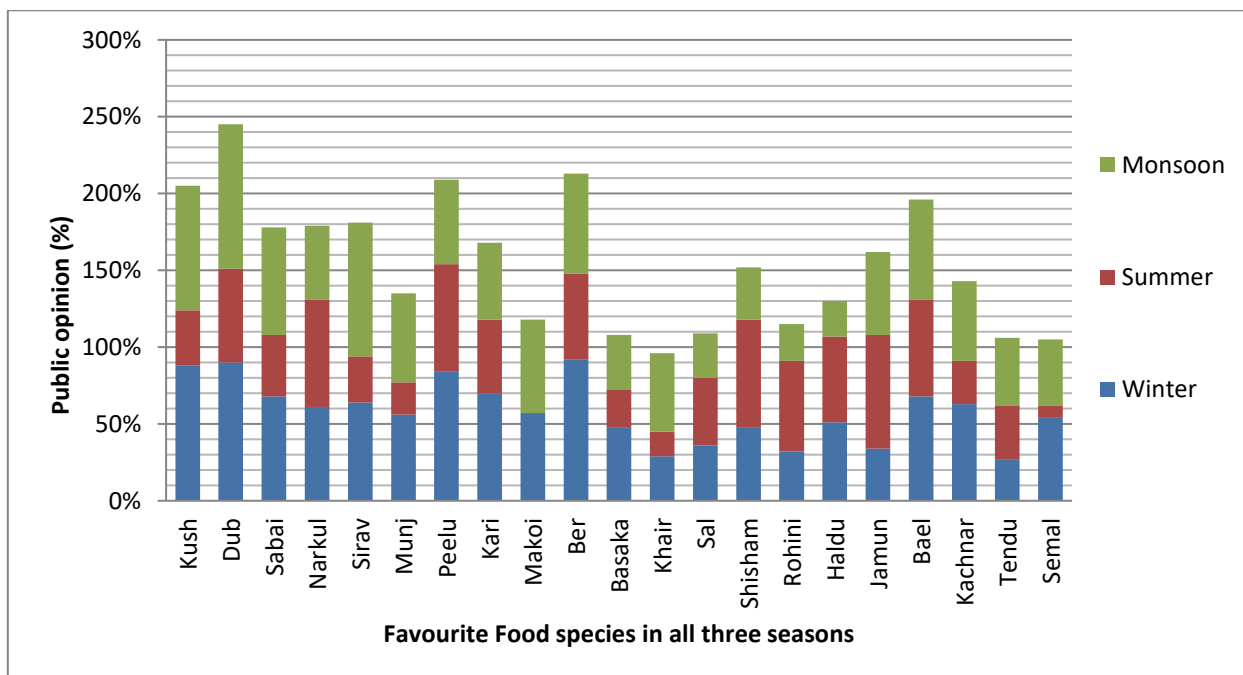


Figure 1: Results of Questionnaire for favourite food species of Cheetal deer in Winter, Summer and Monsoon season in Corbett National Park

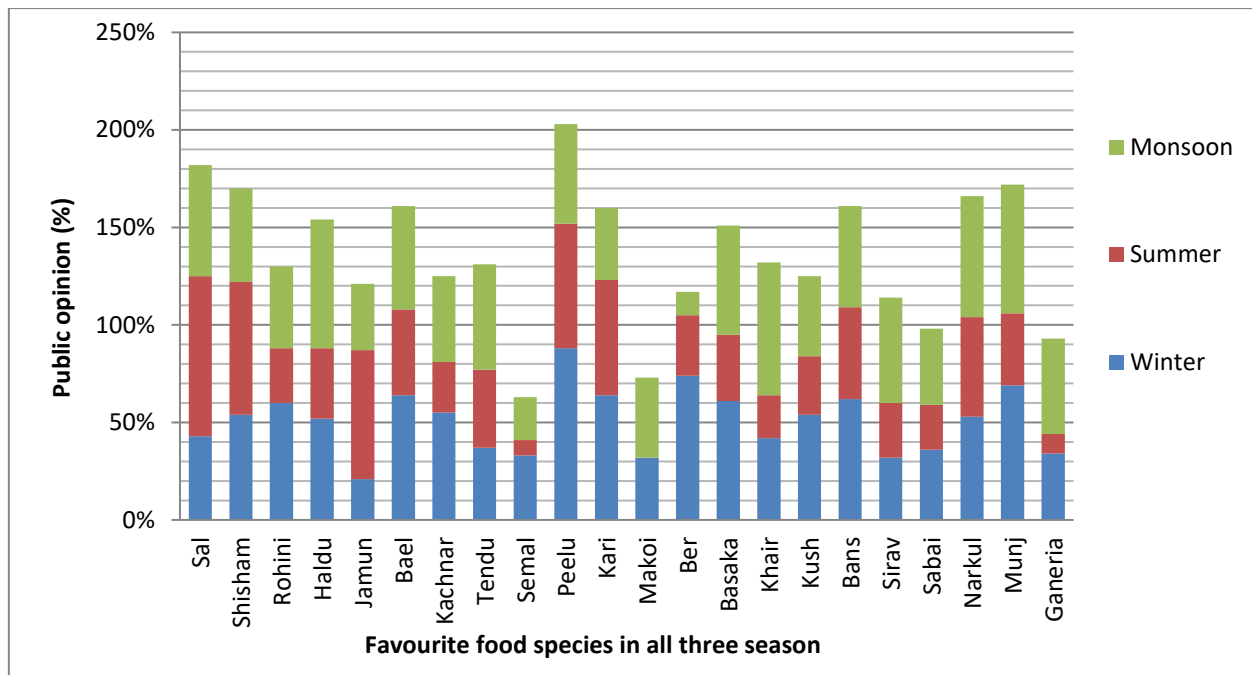


Figure 2: Results of Questionnaire for favourite food species of Sambar deer in Winter, Summer, and Monsoon season in Corbett National Park

According to questionnaire findings, the Cheetal deer is mostly found in grassland, and sprouting grass is its main food. According to public opinion (90%), Cheetal prefers almost all the grasses found in the grassland in Corbett. In the winter season, Cheetal eats most of the Dub grass and Kush grass in the grassland. Along with this, Cheetal also preferred to eat Sabai, Sirav, Narkul and Ganeria grasses in the grassland (55-68% public opinion). In the shrub area, Cheetal preferred to eat Jujube fruits (92% public opinion) with Peelu and Kari leaves (84-70% public opinion). Along with these shrubs, Cheetal preferred to eat green leaves of Vasaka and Khair from dense shrub area. In Sal-mixed forest, Cheetal preferred to eat green leaves of Kachnar, fruits of Bael, and flowers of Semal tree. Along with this, Cheetal preferred to eat fallen leaves of Haldu, Sal, Shisham, Rohini, and Jamun in Sal-mixed forest.

In the winter season, Sambar deer preferred to eat Peelu, Kari, fruits of Ber and Vasaka leaves in dense shrub area. In Sal-mixed forest, Sambar preferred to eat green leaves from Rohini, Shisham, Haldu, Kachnar and fruits of Bael. Sambar deer eats most of the Bamboo and Ganeria grass in grassland area.

In the summer season, Cheetal preferred to eat most of the Narkul grass and new sprouting Dub grass, and remaining green grasses of all species in the grassland. Cheetal preferred to eat Peelu, Ber and Kari leaves in the shrub area. In Sal-mixed forest, Cheetal preferred to eat fruits of Jamun and Bael and green leaves of Shisham, Haldu, and Rohini. In the summer season, Sambar preferred to eat leaves of Peelu and Kari in shrub area. In Sal-mixed forest, Sambar eats most of green leaves of Sal, Shisham, and fruits of Jamun. In grassland area, Sambar preferred to eat Narkul and Bamboo grasses.

CONCLUSION

In the Pre-winter season, Cheetal is found eating *Cynadon dactylon* grass on priority, also eat *Desmostachya bipinnata*, *Eulaliopsis binata*, *Imperata cylindrica*, *Heteropogon* species, *Setaria*, *Saccharum munja*, *S. bengalensis*, *S.narenga*, and *Phragmites roxburghii*. Due to the easy availability of green grass in this season, the highest population of Cheetal is found in the grasslands. In the Jhirna,

Cheetal eats fruits of *Ziziphus mauritiana*, *Ficus racemosa* fruits, *Terminaria bellerica*, and green leaves of *Glycosmis arbores*, *Murraya koenegi*, *Ageratum conyzoides* and *Cassia fistula* in the shrub area.

In this season, Sambar mostly eats leaves of *Dalbergia sissoo*, *Mallotus philippensis*, *Acacia catechu*, *Shorea robusta*, *Glycosmis arbores*, *Murraya koenegi* and *Agle marmels* etc. In Bijrani zone, Sambar deer eat fruits of *Agle marmels*, *Terminaria bellerica*, *Embllica officinalis*, *Solanum nigrum*, *Ziziphus mauritiana* and *Ficus racemosa*.

In the winter season, the *Cynadon dactylon* and other grasses get dried up even then Cheetal eats the remaining green grasses at grassland. Cheetal also eat green leaves and fruits from *Agle marmels*, *Syzigium cumini*, *Embllica officinalis*, *Agle marmels*, *Solanum nigrum*, *Phragmites roxburghii* grass, and *Saccharum munja* near the waterside area. Cheetal were found eating *Glycosmis arbores* and *Murraya koenegi* leaves from the shrub area and also flowers of *Ageratum conyzoides*. Sambar eats leaves of *Mallotus philippensis*, *Acacia catechu*, *Glycosmis arbores*, *Murraya koenegi*, *Syzigium cumini*, *Terminaria arjuna*, *Bauhinia variegata*, fruits of *Ziziphus mauritiana*, *Embllica officinalis* and *Ficus racemosa* and certain grasses.

In the Spring season, the sprouts of *Cynadon dactylon*, *Desmostachya bipinnata*, *Eulaliopsis binata*, flowers of *Bombax ceiba*, *Butea monosperma*, *Diospyras tomentosa* trees, and fruits of *Solanum nigrum* mainly eaten by Cheetal deer. Sambar deer also eats flowers of *Bombax ceiba*, *Cassia fistula*, *Butea monosperma* and *Diospyras tomentosa* fruits of *Madhuca indica* and *Glycosmis arbores*.

In the summer season, all the grass dries up in the grassland and Cheetal is found grazing on new sprouted grass also. Cheetal eats fruits of *Syzigium cumini*, leaves of *Dalbergia sissoo*, *Shorea robusta*, *Ficus racemosa*, and *Adena cordifolia* in Sal-mixed forest, to avoid extreme temperatures. Sambar deer eat leaves of *Shorea robusta*, *Dalbergia sissoo*, *Adena cordifolia*, *Bauhinia varigiata*, *Terminaria chabula*, *T.bellerica*, *Bombax ceiba*, fruits of *Syzigium cumini*, *Glycosmis arbores* and flowers of *Cassia fistula* etc.

Along with the changes of season, the population of Cheetal deer is found spreading from grassland to dense shrub area and Sal-mixed forest. According to the change of season, the population of Sambar deer is found in the Sal forest and grassland along with the dense shrub area.

REFERENCES

1. Corbett National Park (2018). *Tourism Zones*. Retrieved from <https://www.corbettnationalpark.in/safari-zones-in-corbett.htm>.
2. David, M. & Leslie, J.R. (2011). *Rusa unicorn* (Artiodactyla: Cervidae) Mammalian Species. *American Society of Mammalogists*. 43 (871): 1-30.
3. Graf, W. & Nicholas, L. (1966). The Axis deer in Hawaii. *Journal of Bombay Natural History Society*. 63: 629-734.
4. Harihar, A., Prasad, D.L., Pandav, B. et al. (2009). Losing ground Tiger Panthera Tigris in the North Western Shivalik Landscape of India. *Oryx*. 43:35-43.
5. Karanth, U.K. & Sunquist, M.E. (1992). Population Structure, Density and Biomass of Large Herbivores in the Tropical Forests of Nagarahole, India. *Journal of Tropical Ecology* 8:21-35.
6. Khatri, S.A. (2008). *Corbett National Park and Tiger Reserve*. Pelican Creations International. pp.1-243.
7. Schaller, G.B. (1967). *The Deer and the Tiger*. a Study of Wildlife in India. University of Chicago Press, Chicago. pp. 370.

8. Shalini, & Pant, B. (2018a). The Cheetal deer (*Axis axis*) Ecology and Population Status in Corbett Tiger Reserve: A Study based on Data Analysis (from 1992 to 2008), Ramnagar, Uttarakhand. *International Journal of Science and Research*. 7(10): 1525- 1527.
9. Shalini, & Pant, B. (2018b). The Population status and habitat of Sambar (*Cervus unicolor*) in Corbett Tiger Reserve: A study based on data analysis (from 1992 to 2008) Ramnagar, Uttarakhand, India. *Journal of Emerging Technologies and Innovative Research*. 5 (11): 668-672.
10. Tak, P. C. & Lamba, B. S. (1984). Ecology and Ethology of the Spotted Deer, *Axis axis* (Erleben), published by Director, Z S I Calcutta, India.
11. Varman, K. & Sukumar, R. (1993). *Ecology of Sambar in Mudumalai Sanctuary, Southern India*, in deer of China, N. Ohtaishi and HI Sheng, eds. Elsevier science publishers BV. pp. 273- 284.