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Botanical Composition determination of Goral *Naemorhedus goral* (Artiodactyla: Bovidae) : Goral Rescue Centre, Pahalgam, Jammu & Kashmir, India

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ABSTRACT

Feeding habits of mammals are in the centre of interest of population biology and ecology [1]. Procedures used for estimating the botanical composition of the range herbivore`s diet include the diet observation, utilization techniques, fistula sampling and faecal analysis. The most widely used indirect technique for determining diet composition of herbivores is the micro-histological identification of epidermis fragments in the stomach content or faecal pellet [2]. Micro-histological faeces analysis method includes multiple successive sampling from the individuals, pellets and epidermis fragments. Naemorhedus goral is a medium sized mountain dwelling, Himalayan ungulate of subfamily Caprinaein the Bovidae. Gorals mostly foraged early in the morning or late in the evening before sunset. Vegetation analysis of Goral habitat revealed that about 60% of the vegetation consisted of plant species eaten by Goral [3].

Key Words:*Naemorhedus goral, Ungulates, Micro-histology, Food preferences, Faecal pellets, Pijpijur, Bovidae*

INTRODUCTION

Gorals are goat like antelopes found only in Asia. Swat is the western extremity of their range and they spread eastward in the Himalayas through India, Nepal, Assam, Burma and Thailand. They are enlisted in the Schedule III of J&K Wildlife (Protection) Act, 1972. The Kashmiri name of *Naemorhedus goral* is PijPijur. Their range extends in the north into China and USSR. A few studies conducted elsewhere on feeding habits of goral showed that their diet consisted of both graze and browsespecies and changed seasonally [4, 5, 6]. Nasimovitch[7] concluded that goral principally subsisted on tree and shrub browse during the winter. Zhang [8] found that goral generally fed on lichens and grasses and they mostly foraged in the morning and late in the evening. Roberts [9] reported that goral subsisted mainly on two grass species*Apludacristata* and *Themedaanathera*during monsoon.

Existing information on goral is very scarce. More field and captive studies are needed to be collected on various aspects of this endangered species for its proper management.

MATERIAL AND METHODS

Study area: Present study was conducted in the month of October 2011 at Goral Rescue Centre Pahalgam which is located inside the Mini Deer Park, Phalgam at a latitude/longitude of 34.03, 75.33 and altitude of 2110 metre in the South Kashmir division of Kashmir valley about 92Kms south-east of Srinagar city. The enclosure for Goral is made on the steep slope with low tree cover.

Methods: A total of 12 faecal pellets were collected from the enclosure, packed individually in polythene bags and labelled in the field and brought to the laboratory, where these were analysed, following the micro-histological technique first used by Baumgartner and Martin [2] and described by Ward [10] and Holechek et al [11].

Each of pellets was grinded into coarse powder form and sieved through two successive services (5 and 3mm). The portion of the sample left on top of the second sieve was retained for analysis. About one quarter of this sample was selected as final sample, while the remaining three quarters were maintained as reserve. The final sample was transferred to a test tube, having 33%nitric acid, and heated in a water bath, set at the boiling point, for few minutes. After settling down, fresh nitric acid (33%) was added and allowed to the precipitate. The sample was again boiled in the water bath in order to obtain a fairly clear powder. The material was then washed repeatedly, till the nitric acid was washed off completely. The temporary mount of the appropriate part of the cleared powder was prepared on glass slide, using glycerol, covered with cover slip.

The pieces of the reference plants were collected in the goral enclosure field and packed in polythene bags, labelled and brought back to the laboratory. The plant species were identified at the Department of Botany, SSL Jain PG College, Vidisha (MP). The temporary mounts of the reference plants were prepared following techniques used for the faecal pellets. The reference photos (micro-histological photos) of the pieces recovered from each slide were prepared, specially emphasising the cell shape, structure and size.

A total of 22 slides, from the pooled samples of the faecal pellets, were prepared and scanned thoroughly under a binocular microscope, using a 150x magnification. Seven fields were randomly selected in each slide (a total of 154 fields) for a detailed analysis. Plant particles were identified by comparing the cellular morphology of the recovered pieces with the reference photos. Number of pieces contributed by different species was recorded for each field. The data, thus, collected was appropriately pooled for deriving the overall relative frequency of each item of food and their standard errors calculated.

RESULTS AND DISCUSSION

The studies on food and feeding preferences have been variously based upon the direct field observations, stomach/ gizzard/ rumen content analysis, and faecal pellet analysis. The stomach/ gizzard/ rumen content analysis provides a direct and more reliable data on food and feeding preferences of an animal species. However, this demands direct killing of the animals, which is not advisable for large ungulates, like gorals, especially were the trophy hunting is very limited. The technique of faecal pellet analysis has been extensively used to assess the feed consumption of ungulates [12].

The present study has been based upon a total of 12 faecal pellet samples collected from the goral enclosure range and examination of 154 microscopic fields (2-3 slides per faecal sample and 7 fields in each slide). The number of the faecal samples is less than a desired level and hence a geographic variation in the feeding preferences could not be achieved which are required for the studies in wild and open. This may demand further studies which would be required to confirm the present findings and for a better understanding of the feeding preferences of this ungulate species to a level where these can be used for the effective management of the species.

Table I.Food species recorded from the faecal samples of*Naemorhedus goral* and their percentage composition.

S.No.	Food Species	Type	Percent Composition
1.	*Themedaanathera*	H	21.25
2.	*Alchemilla vulgaris*	S	19.55
3.	*Apludacristata*	H	16.27
4.	*Digitariadecumbens*	H	8.75
5.	*Pinusroxburghii*	T	7.72
6.	*Utricadioica*	H	5.93
7.	*Daphne oleoides*	S	5.04
8.	*Acacia modesta*	T	4.26
9.	*Berberis lyceum*	S	2.66
10.	*Poapratensis*	H	0.26
11.	*Minor Herbs*	H	3.90
12.	*Minor Shrubs*	S	2.25
13.	*Minor Trees*	T	1.50

H= Herb; S= Shrub; T=Tree

The feeding usually occurred at sunrise and before sunset (75%). Table 1 presents a summary of the results collected on food and feeding preferences of the goral in the enclosure, keeping in view the manual food provided by the Goral Rescue Centre Caretaker as well. The table suggests that a minimum of 10 species were consumed by the goral in the area (under captivity). The fragments recovered from the faecal pellets, as also confirmed by the direct field observations, suggest that the species mainly subsists on the leaves and the softer parts of the plants [13, 14]. On the basis of fragments recovered from the faecal pellets, a ratio of **12: 27: 53** is suggested for the relative consumption of tree, shrubs and forbs (herbs) respectively (Table 2). The calculated values of food preference for trees (11.98), shrubs (27.25), and forbs (52.46) suggest that trees are not preferred as food of the species, while shrubs are preferred and forbs are highly preferred items of food.

The present study suggests that goral, in its enclosed home range, subsists on a minimum of 9-11 plant species. The Russian goral has been reported to subsist on 268 species [15]. Awasthi[12] has proposed that goral subsists on 19 species. Two other more careful studies [12, 16] have suggested that this ungulate depends upon 24 (by direct field observation) and 21(by faecal pellet analysis)species of plants.

A look on the Table 2 suggests the presence of a minimum of 5 species of herbs in the faecal pellets, which collectively constitute 52.46% of the food of this animal species. Among herbs*Themadaanathera*contributes 21.25% in the food of the animal, followed by *Apludacristata* (16.27%) and*Digitariadecumbens*(8.75%). Among shrubs, *Alchemilla vulgaris* has a very high (19.55%) preference followed by *Daphne oleoides*(5.04%). Among trees *Pinusroxburghii* (7.72%) makes the major food preference of the animal followed by *Acacia modesta*(4.26%).

Description of the Animal:

Classification		Body size	
Kingdom	Animalia	Body Length	95-130 cm / 37-53 in.
Phylum	Chordata	Shoulder height	75-80 cm/ 30-32 in.
Class	Mammalia	Tail length	Up to 18 cm / 7.2 in.
Order	Artiodactyla	Weight	35-42 Kg / 77-92 lb.
Family	Bovidae		
Sub-family	Caprinae		
Genus	*Naemorhedus*		
Species	*goral* (Kashmiri goral)		

Table II. Total percentage composition of each plant type from faecal pellet analysis of *Naemorhedus goral*

Plant Species Type	Plant Species	% Composition	Total Composition
Herbs	*Themedaanathera*	21.25	52.46
	Apludacristata	16.27	
	Digitariadecumbens	8.75	
	Utricadioica	5.93	
	Poapratensis	0.26	
Shrubs	*Alchemilla vulgaris*	19.55	27.25
	Daphne oleoides	5.04	
	Berberis lyceum	2.66	
Trees	*Pinusroxburghii*	7.72	11.98
	Acacia modesta	4.26	
Unidentified	-----	8.31	8.31

CONCLUSION

The micro-histological technique based on the percentage of occurrence of the plant fragments on a microscope field (presence or absence) has become one of the most popular methods of determining food habits, although it faces several limitations as reported by the researchers evaluating its accuracy [17]. One of the limitations refers to the fact that the relation between the identifiable epidermal tissue and unidentifiable tissue is not similar for all species, which could result in over-estimation or under-estimation of some items/ species [18].

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Fig. I.A view of the goral rescue centre at Pahalgam

Fig. II. Desciption board of the goral on the fencing wall of the goral rescue centre, Pahalgam

Fig. III. A grazing goral inside the rescue

Fig. IV.Faecal Pellets of *Naemorhedus goral*

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