

FOOD HABITS OF BARKING DEER (*MUNTIACUS MUNTJAC*) IN THE MIDDLE HILLS OF NEPAL

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ABSTRACT - The food habits of the barking deer (*Muntiacus muntjac*) were studied in 2005, analysing fresh pellets collected in spring (N=247) and the rainy season (N=151). Fresh pellet groups were sampled along line transects and analysed using microhistological techniques. Results were expressed in terms of percentage of occurrence (O%) and per cent volume (V%). Muntjac diet included 22 plant species, most of them belonging to browse. In spring, grasses (O%=55.36%; V%=37.5) dominated muntjac diet, whilst in the rainy season browse plants prevailed (O%=48.44%; V%=51.69). Lichens were consumed only in the rainy season. Significant seasonal differences were recorded in the frequency of consumption of the different food items, but not in terms of volume. *Imperata cylindrica*, *Smilax aspera*, *Moghania strobilifera* and *Arundinaria falcata* were major food items in both seasons. Fruits of *Prunus cerasoides*, *Berberis asiatica* and *Rubus ellipticus* and bark of *Pinus roxburghii* and *Castanopsis indica* were also taken in significant amounts. No animal remains were recorded in the diet. Our results suggest that muntjacs are mixed feeders.

Key words: Barking deer, *Muntiacus muntjac*, food habits, seasonal variation, Nagarjun forest, Nepal

RIASSUNTO – *Abitudini alimentari del Muntjac (Muntiacus muntjac) sulle colline nepalesi.* Nel 2005, la dieta del Muntjac è stata indagata tramite l'analisi micro-istologica di feci fresche rinvenute in primavera (N=247) e nella stagione delle piogge (N=151). I risultati sono stati espressi come frequenza relativa percentuale (O%) e volume percentuale (V%). Lo spettro trofico del Muntjac comprende 22 specie vegetali, per la maggior parte incluse nella categoria "da brucatore". In primavera prevalgono le "erbe" (O%=55.36%; V%=37.5), mentre le essenze da brucatore predominano nella stagione umida (O%=48.44%; V%=51.69), quando il Muntjac utilizza anche i licheni. Differenze stagionali significative sono emerse in termini di frequenza di utilizzo, ma non di volume. *Imperata cylindrica*, *Smilax aspera*, *Moghania strobilifera* e *Arundinaria falcata* sono le specie maggiormente consumate in entrambe le stagioni considerate, seguite dai frutti di *Prunus cerasoides*, *Berberis asiatica* e *Rubus ellipticus* e dalla corteccia di *Pinus roxburghii* e *Castanopsis indica*. Non sono stati rinvenuti resti di origine animale. In base ai risultati ottenuti, il Muntjac può essere considerato un ruminante brucatore-pascolatore di tipo intermedio.

Parole chiave: *Muntiacus muntjac*, dieta, variazione stagionale, valle di Kathmandu, Nepal

INTRODUCTION

The barking deer or muntjac (*Muntiacus muntjac*) is a relatively common, small, solitary ruminant living in dense tropical and sub-tropical forests of Asia (Oli and Jacobson, 1995; Shrestha, 1997). In Nepal, the species is commonly distributed in Terai and mountains (Shrestha, 1997). Several studies on its food habits in a wide range of habitats have shown that the barking deer is a selective feeder, subsisting on easily digestible food offering few fibres, but rich in energy and proteins (Barrette, 1977; Maloiy *et al.*, 1988; Kranz, 1991; Estes, 1993; Brotherton and Manser, 1997). Due to its small size, the barking deer has a high energy requirement per unit body weight compared with larger herbivores (Barrette, 1977). It is a selective browser, taking food items such as flowers, twigs, fruits, and seed pods (Hofmann and Stewart, 1972; Jarman, 1974; Hofmann, 1989). Muntjacs are virtually omnivorous, feeding on bamboo shoots, foliage, bark, fruits, herbs, sprouts, seeds, grasses, birds eggs, carrion (Kurt, 1981) and small mammals which they kill and eat using their canines and forelegs (Humas, 2004). Very little information is available on the diet of the barking deer in Nepal (Yonzon, 1978; Shrestha, 1984). This study aimed to document the food habits of the muntjac in the middle hills of Nepal, analysing its diet in spring and the rainy season.

STUDY AREA

Nagarjun forest, (from 27° 43' 37.13" to 27° 46' 22.84" N and from 85° 13' 52.97" to 85° 18' 14.38" E) located at the northernmost boarder of Kathmandu valley, covers a surface of 16.45 Km² (Fig. 1). The study area largely consists of quartzite rock and, secondarily, of limestone, siliceous limestone and calcisilicate rocks (Hagen, 1959). Soil composition varies according to different forest cover, including dry hard and light brown to black soils with different amounts of humus (Kanai *et al.*, 1970). Mean monthly temperature ranges from 3.05°C to 30.53°C, relative humidity from 54.7% to 94.2%, rainfall from 5.15 mm to 548.73 mm; July, August and September are the most humid months, July and August being the most rainy months. Four types of forest can be distinguished in the Nagarjun hills, namely *Schima wallichii* forest, pine forest, mixed broadleaved forest and dry oak forest. There are a few small patches of grassy meadows (Kanai and Shakya, 1970).

METHODS

The study area was divided into four blocks, each covering 4.11 Km² (Fig. 1). Line transects of 0.5-1.5 km in length were laid down with the interval of 100 m, corresponding to contour lines of topographic maps, to collect pellets. Plot A, Plot B, Plot C and Plot D contained 10, 7, 5 and 3 transects respectively, depending on topography. Fresh pellet samples were collected in spring (N=247; 24 April-24 May 2005) and during the rainy season (N=151; 18 July-5 August 2005), tagged and stored in plastic bags separately. Microhistological analysis of faecal samples was carried out following Gyawali (1986), Gurung (1991) and Shakya (1999). Sun dried samples were broken and animal components were separated for subsequent

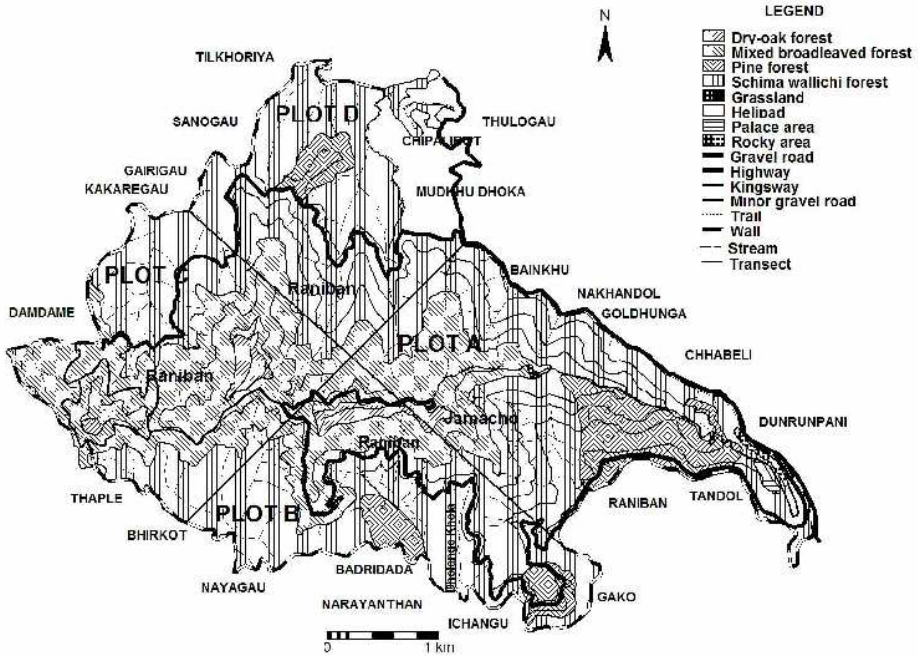


Figure 1 - Study area with sampling plots and transects.

identification. The remaining portion of pellets containing plant fragments was ground thinly in a mortar, homogenized and sieved through meshes of size 1 mm and 0.5 mm. Then 0.25 g of sediment from both 1 mm and 0.5 mm sieves were separately taken for slide preparation, rejecting all tailings. To facilitate the identification of plant fragments from faecal samples, reference slides were prepared using plants collected in the study area. Microphotographs of each slide - concerning shape, size and distribution pattern of epidermal cells and stomata, shape and size of the inter-stomatal cells and trichomes, fibre structures, arrangement of veins and structure of seeds - were used as diagnostic keys.

Faecal samples slides were read using a microscope, at 100x and 400x magnifications and also photographed. The number

of fragments and estimated volume of each food item were filed, grouping food items into five categories: browse, soft mast, grasses, lichens and others. Data were expressed as percentage of occurrence ($O\% = \text{number of occurrences of each item} / \text{total number of occurrences} \times 100$; Cavallini and Lovari, 1991) and per cent volume ($V\% = \text{estimated volume of each item} / \text{total estimated volume} \times 100$; Lucherini and Crema, 1995).

One-way ANOVA and the t-test were used to test for seasonal differences in the diet considering, respectively, raw frequency and volume data.

RESULTS AND DISCUSSION

The barking deer consumed 22 plant species, most of these belonging to

browse (Tab. 1). In spring, grasses (O%=55.36%; V%=37.5) dominated deer diet followed by browse (O%=38.5%; V%=28.48) and soft mast (O%=2.49%; V%=30.04). In the rainy season browse plants prevailed (O%=48.44%; V%=51.69), followed by grasses (O%=42.62%; V%=39.33), lichens and soft mast. Considering

individual plant species, the grass *Imperata cylindrica* (O% = 54.2, V% =37.89) and browse species such as *Smilax aspera* (O% = 17.48, V% = 12.97), *Moghania strobilifera* (O% = 10.61, V% =7.70) and *Arundinaria falcata* (O% = 4.37, V% =3.06) contributed appreciably to deer diet in spring, whilst, *Imperata cylindrica*

Table 1- Overall muntjac diet in spring and in rainy season; for abbreviations see Methods.

FOOD ITEMS	O%		V%	
	SPRING	RAINY	SPRING	RAINY
Browse				
<i>Arundinaria falcata</i>	4.37	3.74	3.06	3.72
<i>Castonopsis indica</i> (bark)	0.62	1.56	0.49	3.85
<i>Coleobrookia oppositifolia</i>	0.83	0.94	0.71	0.86
<i>Indigofera phullchela</i> (leaf)	0.83	0.42	0.52	0.48
<i>Lindera</i> sp (leaf)	0.10	0.42	0.04	0.43
<i>Melisoma simplicifolia</i> (leaf and flower)	0.31	-	0.22	-
<i>Moghania strobilifera</i>	10.61	20.17	7.70	19.53
<i>Oxyspora paniculata</i> (leaf)	0.52	-	0.37	-
<i>Pinus roxburghii</i> (bark)	0.52	1.46	0.56	2.77
<i>Prunus cerasoides</i> (leaf)	-	4.26	-	3.59
<i>Rhododendron arboreum</i> (leaf)	0.21	1.77	0.19	4.28
<i>Schima wallichii</i> (leaf)	-	1.04	-	0.30
<i>Smilax aspera</i> (leaf)	17.48	12.68	12.97	11.88
<i>Smilax lanceofolia</i> (leaf)	2.08	-	1.64	-
Soft mast				
<i>Berberis asiatica</i> (fruit pericarp)	0.62	1.46	0.41	1.25
<i>Prunus cerasoides</i> (fruit seed)	0.83	0.62	28.33	1.30
<i>Rubus ellipticus</i> (fruit seed)	1.04	-	1.31	-
Grass				
<i>Imperata cylindrica</i>	54.21	42.10	37.89	38.76
<i>Pogonatherium paniceum</i>	0.94	0.52	0.71	0.56
<i>Saccharum spontaneum</i>	0.21	-	0.15	-
Lichen				
Lichen (foliose)	-	3.53	-	3.46
Lichen (fruticose)	-	1.46	-	1.38
Unidentified (A)	3.64	1.87	2.73	1.60

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(O% = 42.10, V% = 38.76), *Moghania strobilifera* (O% = 20.17, V% = 19.53), *Smilax aspera* (O% = 12.68, V% = 11.88) and *Prunus cerasoides* (O% = 4.88, V% = 4.89), were the main food items in the rainy season. No animal remains were recorded.

One-way ANOVA test showed a significant seasonal difference in the frequency of consumption of the different food items ($F = 5.33$, $P < 0.05$). On the other hand, volumes did not vary significantly ($t = 0.0002$, $P = N.S.$).

Diet composition in this study suggests that muntjacs are mixed feeders. Barrette (1977) reported that barking deer are not grazers even if they occasionally do graze. Nonetheless, in Nagarjun forest, they abundantly rely on grasses, particularly in spring. Accordingly, Yonzon (1978) reported that in Chitwan National park deer graze in the forest fringes or in open areas and only divert to other food items after grass burning takes place in January. He further elaborated that in grassland areas barking deer feed on the more palatable upper shoots of *Imperata cylindrica* even after burning. The newly growing plant leaves and shoots in the rainy season could cause deer to switch from grazing to browsing.

The muntjacs were primarily 'nibblers' (Barrette, 1977), feeding on tender leaves, twigs, seed pods and shrub fruits. These food items are richer in proteins, offer accessible plant cell content (Gonzalez-Hernandez and Silva-Pando, 1999) and tend to be small, distinct, and spatially scattered (Jarman, 1974). The grass *Imperata*

cylindrica, the creeper *Smilax aspera* and the shrubs *Moghania strobilifera* and *Arundinaria falcata*, which were important food items for deer, are widespread in the study area and are likely to be among the most abundant species.

Lichens were eaten only in the rainy season according to their availability. Considering the absence of animal remains in their pellets, the barking deer of Nagarjun can not be considered omnivorous as stated by Kurt (1981) in India and Humas (2004) in Indonesia.

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