



Studies on the food and feeding habits of Gaur *Bos gaurus* H. Smith (Mammalia: Artiodactyla: Bovidae) in two protected areas of Goa

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The Gaur or Indian Bison (*Bos gaurus*) is a major herbivore and considered a parental stock for domestic cattle. Globally, Gaur is distributed in Bangladesh, Bhutan, Cambodia, China, India, Peninsular Malaysia, Burma, Nepal, Thailand and Vietnam. In India, Gaur is found in central, southern, southwestern and northeastern regions (Choudhury 2002). Studies on the food habits of wild ungulates have been carried out in different habitats by a number of researchers. Rogers (1987) elaborated on the wild grazing ungulates of India, including Gaur. The activity patterns and feeding habits of gaur in Palni hills, Tamil Nadu were studied by Sathyanarayana & Murthy (1995). Srivatava et al. (1996) carried out microhistological studies on the food habits of Sambar, Gaur and cattle in Periyar Tiger Reserve. The food habits of wild ungulates and their competition with livestock were studied in Pench Wildlife Reserve (Shukla & Khare 1998). Krishnan (1972) studied the habitat, activity patterns and food habits of Gaur. Habitat analysis of Gaur in Bhagvan Mahaveer Wildlife Sanctuary using remote sensing and GIS was carried out by Kittur (2002). Pasha et al. (2002) reported debarking of Teak (*Tectona grandis*) by Gaur during summer in Pench Tiger Reserve. Bhagvan Mahaveer Wildlife Sanctuary and Mollem National Park provide good habitat for Gaur. The present study was undertaken with an aim to identify the plant species consumed by Gaur and their feeding habits in different seasons.

Study Area

Bhagvan Mahaveer Wildlife Sanctuary (133 km²) and Mollem National park (107 km²) (Fig. 1) situated at Mollem in Sanguem taluk of southern Goa were selected as the study area. The area lies between 15°15'30"-15°29'30"N & 74°10'15"-74°20'15"E. The forest cover of this area has been classified as tropical evergreen, semi-evergreen,

moist deciduous and southern Indian subtropical hill savannah woodland (Champion & Seth 1968). Wet and moist bamboo brakes are found throughout the semi-evergreen and moist deciduous forests. The main rivers that flow through this region are the Dudhsagar, Caranzol, Boma, Calem and Ragada, which branches into the Jambauli river. The National highway NH4A makes its way through this sanctuary. The South central railway also has its broad gauge route through this sanctuary. Climatically, the area has three seasons: summer (February-May), monsoon (June-September) and winter (October-January). The area receives monsoon from the south-west monsoon winds with average annual rainfall of 2400 mm. The terrain is plain at lower altitudes and undulating at higher altitudes. The dominant vegetation types include *Callophylum inophyllum*, *Garcinia* sp., *Myristica fragrans*, *Lea indica*, *Calycotris floribunda*, *Terminalia paniculata*, *Strobilanthes* sp., *Xylin*, *Dalbergia*, *Dillenia pentagyna*, *Careya arborea*, *Grewia tiliifolia* mixed with *Calamus* and *Bambusa arundinacea*.

Methods

Sampling sites in different habitats covering moist deciduous, semi-evergreen, evergreen, and grassland habitats totaling an area of 46 km² were selected for the present study. Observation was done on foot and from jeeps on motorable roads. The study was carried out for two years from July 2004 to June 2006. Two methods were employed for studying food habits: i) Direct observation, and ii) Faecal analysis.

1. Direct observation: After observing the feeding of animals through binoculars (10 x 50), on-site inspections of food plants were made to identify plant species. A herbarium of unidentified plant species was prepared for later identification by taxonomists. Time of feeding and atmospheric temperature were also recorded.

2. Faecal analysis: This was carried out by adopting procedures outlined by Satakopan (1972). Reference slides of fresh plant species animals were observed feeding upon were prepared by taking sections of the upper and lower epidermis of leaves, providing a key for all possible food plants of the study area. Gaur dung samples were collected throughout the year, except during the monsoon. The samples were oven-dried, ground coarsely and washed in chloral hydrate solution. Permanent slides of the plant fragments obtained were prepared. The leaf fragments in these samples were compared with the key prepared for identification from fresh plant species. Identification of plant fragments was based on keys given by Satakopan (1972) and Johnson et al. (1983). The results were compared with field observations.

Results

Altogether 32 species of plants belonging to 17 families were identified as food plants of Gaur. The Gaur consumed fruits, leaves, young shoots, bark and flowers with high preference for leaves (87%). In summer the Gaur also consumed bark of cashew (*Anacardium occidentale*) and teak (*Tectona grandis*) trees. The diet of Gaur is represented by seven species of grasses, five species of herbs, eight species of shrubs and 12 species of trees. Gaur were also observed feeding on fruits of *Dillenia pentagyna* (Image 1).

Species fed upon in different seasons by Gaur are represented in Table 1. Gaur spent most of their daily time feeding (63%). Peak feeding activity was observed in the morning (0630 to 0830 hr) and in the evening (1730 to 1845 hr). During hot hours of the day (1330 to 1530 hr) they were found resting in the shade of big trees.

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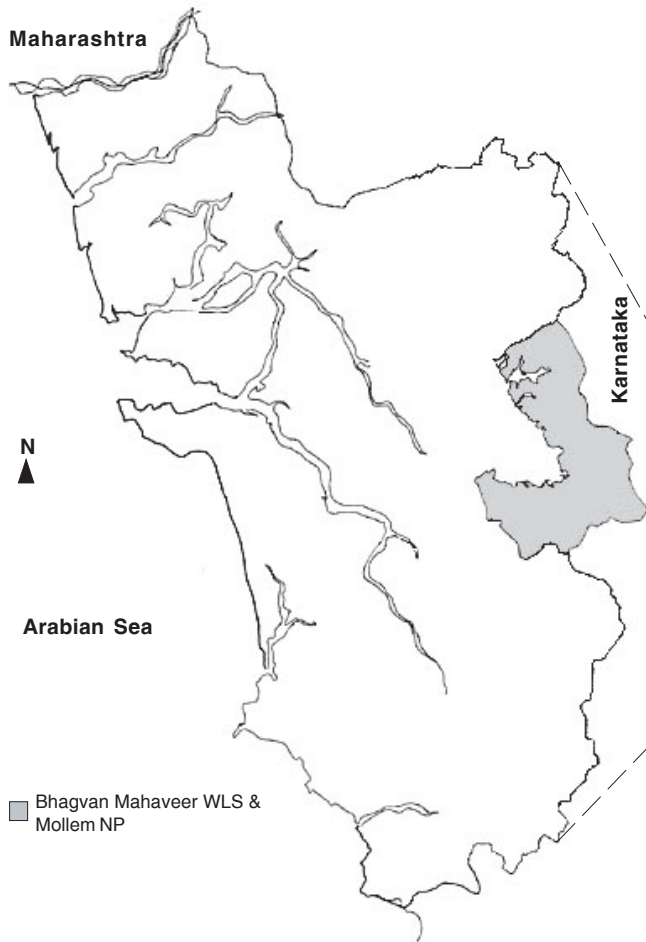


Figure 1. Map of Goa showing Bhagvan Mahaveer Wildlife Sanctuary and Mollem National Park, Mollem



Discussion

We have observed that the gaur diet consists of grasses, herbs, shrubs and trees, with high preference for leaves. These observations are in agreement with the reports of Shukla & Khare (1998) who reported that Gaur grazed and browsed on a much wider variety of plants than any other ungulate species of India, with a preference for the upper portions of plants, such as leaf blades, stems, seeds and flowers of grass species. In contrast, some earlier studies (Krishnan 1972; Peden et al. 1974; Reynolds & Hawley 1987; Sathyanarayana & Murthy 1995) showed that Gaur fed selectively in grass-dominated areas and are primarily grass eaters.

Although Sathyanarayana & Murthy (1995) reported that Gaur prefer both finer and coarser grasses, we observed that finer and fresh grass was preferred more as compared to coarse grasses, and that during dry seasons Gaur browsed on tree species. *Strobilanthes iziiocephalus* (Image 2) and *Strobilanthes callosus* were the most preferred food plants. Preference for a particular food type showed seasonal variation with more grass and herb species (5 spp. each) consumed in monsoon than tree species (1 sp.). In winter all the food classes are represented proportionately in the diet (6 grasses, 5 herbs, 7 shrubs and 6 trees). In summer maximum tree species (8 spp.) are represented as compared to grasses and shrubs (2 spp. & 1 sp. respectively). Strong association was observed between food preference and season (chi-square=12.94; $p=0.001$).

Gaur consumed the bark of Teak (*Tectona grandis*) and Cashew (*Anacardium occidentale*) in the summer season. This may be due to an

insufficiency of green grass in summer. Gaur are also known to feed on the bark of other tree species like *Adina cordifolia* (Brander 1923; Schaller 1967; Shukla & Khare 1998), *Holarrhena antidysentrica* (Ogilvie 1954), *Tectona grandis* (Ranjitsingh 1997; Pasha et al. 2002) and *Wendlandia natoniana* (Ogilvie 1954). Several arguments have been put forth to explain the probable reason for debarking behavior in different species of mammals. The mammals may debark in response to shortage of food resource in an area (MacKinnon 1976), a shortage of minerals and trace elements required to meet their nutritional demands (Vancuylenberg 1977), or for maintaining an optimum fiber: protein ration for proper digestion of food and better assimilation of nutrients (Spinage, 1974). Gaur may turn to available browse species and fibrous teak bark in summer as green grass and herbaceous resources dry up. In the dry season, high fibrous diet increases the retention time of food in the gut (Owen-Smith 1988) and also decreases the turnover rate of the rumen contents (Bell 1971). High concentrations of calcium (22400 ppm) and phosphorus (400 ppm) have been reported in teak bark (Tewari 1992). Thus the consumption of teak bark may help animals to satisfy both mineral and food needs.

Conclusion

The Gaur is a generalist feeder, consuming a wide variety of grasses, herbs, shrubs and trees, and diet composition may vary according to season and food availability. Long-term survival and conservation of herbivores depends on the availability of suitable habitats, hence protection of the plant species utilized by herbivores is a significant factor in conservation biology.

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Table 1. List of food plants consumed by Gaur at Bhagvan Mahaveer Wildlife Sanctuary and Mollem National Park

Plant species	Part eaten	Summer	Winter	Monsoon
Grasses				
<i>Arundinella leptochloa</i>	L	—	+	+
<i>Bambusa arundinacea</i>	YL	+	+	+
<i>Cynodon dactylon</i>	L	—	+	+
<i>Cyperus rotundus</i>	L	—	+	+
<i>Digitaria</i> sp.	L	—	+	+
<i>Dendrocalamus strictus</i>	YL	+	+	+
<i>Vetiveria zizanioides</i>	L	—	—	+
Herbs				
<i>Spermacoce</i> sp.	L	—	+	+
<i>Cordia myxa</i>	L	—	+	+
<i>Desmodium triflorum</i>	L	—	+	+
<i>Stylosanthes</i> sp.	L	—	+	+
<i>Urena lobata</i>	L	—	+	+
Shrubs				
<i>Strobilanthes callosus</i>	L	+	+	+
<i>Strobilanthes ixiocephalus</i>	L	+	+	+
<i>Strobilanthes</i> sp.	L	+	+	+
<i>Gardenia latifolia</i>	L	+	+	+
<i>Grewia abutilifolia</i>	L	+	+	+
<i>Helicteres isora</i>	L	+	+	+
<i>Symplocos racemosa</i>	L	—	+	+
<i>Vitex negundo</i>	L	+	+	+
Trees				
<i>Anacardium occidentale</i>	Fr*/BK	+	—	—
<i>Bauhinia racemosa</i>	L	—	+	+
<i>Butea monosperma</i>	YS	—	+	+
<i>Cassia fistula</i>	Fr	+	—	—
<i>Dillenia pentagyna</i>	Fr	+	+	—
<i>Gmelina arborea</i>	L	+	+	+
<i>Grewia tilifolia</i>	L	+	+	—
<i>Phyllanthus emblica</i>	Fr	—	+	—
<i>Tamilnadia uliginosa</i>	L	—	+	—
<i>Syzygium cumini</i>	L/Fr	+	+	—
<i>Tectona grandis</i>	BK	+	—	—
<i>Terminalia paniculata</i>	L	+	+	—

YL - Young leaves; L - Leaves; YS - Young shoots; Fr - Fruits; BK - Bark; + - Eaten during this season; * - Fruits thrown after extracting juice by the villagers in the sanctuary

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Image 1. Fruits of *Dillenia pentagyna*



Image 2. *Strobilanthes ixiocephalus* - the most preferred food plant of Gaur (*Bos gaurus*)

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