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Food and Feeding habits of Indian Bison, Bos Gaurus (Smith, 1827) in Kuldiha Wildlife Sanctuary, Balasore, Odisha, India and its Conservation

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Abstract

The Indian Bison (IB), Bos gaurus is one of the large wild ungulates of Asian jungles. It is a dominant herbivore and considered as a parental stock for domestic cattle. In India, Indian Bison (IB) is seen in central, southwestern and northeastern regions. We studied it's activity pattern, food plants species and feeding habits of IB during 2008-2012 using Focal Animal Sampling Method and Fecal analysis. Activity pattern of IB shows a bimodal diurnal activity pattern in feeding with peaks in the morning and evening hours The Indian Bison in Kuldhia wildlife sanctuary (KWS) was observed to feed on diverse species of food plants comprising of 47 species of plants belonging to 17 families. The food plants of IB were represented by 18 species of grasses, 6 species of herbs, 8 species of shrubs and 15 species of trees. The food plants from the families of Poaceae and Fabaceae constitute nearly 50% forming the major food plant species of IB in KWS. The Indian Bison in KWS was a generalist feeder resorting to both grazing and browsing. The IB in KWS fed on leaves, young shoots, flowers and fruits showing high preference for leaves. The diet composition varied according to season and food availability. Reduction of anthropogenic pressure, protection of food plants species and restoration of suitable habitats are significant measures suggested for conservation of Indian Bison in KWS.

Keywords: Indian Bison, Kuldiha wildlife sanctuary, time activity budget, feeding.

Introduction

The Indian Bison (IB) or Gaur, *Bos gaurus* is one of the large wild ungulates of Asian jungles[1]. It is a dominant herbivore and considered as the largest bovid confined to the oriental biogeographic region of the world. Globally, Gaur is distributed in Bangladesh, Bhutan, Cambodia, China, India, Peninsular Malaysia, Burma, Nepal, Thailand and Vietnam. In India, IB is found in central, southwestern and northeastern regions[2]. India is having the highest IB population than any other countries in the world accounting for approximately 85% of its current global population. The Indian Bison in India occur in 124 protected areas (PAs) which cover only 26% of actual global distribution area of IB. In recent years, the population trend of IB is declining in many PAs and there are records of local extinction in protected areas like Bandhabagarh National Park, M.P and Kangar Ghati Wildlife sanctuary, C.G[3]. One of the first steps towards conservation of IB is to identify the food and feeding habits. Knowledge and comprehension on diet composition of the species is essential to take management decisions for viable population maintenance in the wild.

Much information based on studies on food and feeding of wild ungulates including Indian Bison are available in different habitats by the number of researchers. Information on its current distribution status in India has been gained through a questionnaire survey and literature reports[4]. Rodger[5] described on the wild grazing ungulates of India. Habitat analysis of Indian Bison in Bhagvan Mahaveer Wildlife Sanctuary using remote sensing and GIS was carried out by Kittur[6]. The food habits of wild ungulates and their competition with livestock were vividly studied in Pench Wildlife Reserve[7]. Krishnan[8] conducted an ecological survey based on the habitat, activity patterns and food habits of the large mammals including Indian Bison in peninsular India. Vairavel[9] studied ecology of Bos gaurus with special reference to habitat utilization in Parambikulam Wildlife Sanctuary, Kerla[10] carried out Micro Histological studies on the food of Sambar, Gaur and cattle in Periyar Tiger Reserve, Kerala[11] reported debarking of Teak (*Tectona grandis*) by IB during summer in Pench Tiger Reserve, Bhagvan Mahaveer Wildlife Sanctuary and Mollem National Park.

No qualitative information on the aspects of food and feeding habits of IB is available in Kuldhia Wildlife Sanctuary (KWS), Odisha which comes under the central distributional range of IB in India. The current study was undertaken with an objective to document activity pattern, food plants and feeding habit of IB in KWS.

Study area: The study area comprises of the three Hill ranges of Kuldiha Wildlife Sanctuary namely Kuldiha, Tenda, and Devgiri in the district of Balasore, Odisha. KWS came into existence in 1984 by Govt. of Odisha and was recognized in 1992 as an Elephant Reserve through "Project Elephant" by Govt. India. The sanctuary lies within 21^0 -45^0 to 21^0 – 30^0 N latitude and 80^0-30^0 to 80^0-45^0 E longitude encompassing an

area of 272.75 sq k.m. The landscape is hilly with moderate to steep slopes having range of altitude between 169 mts to 682 mts. KWS is a tropical moist mixed deciduous forest[12]. Biogeographically, KWS represents four Biotic Provinces i.e. Eastern plateau, Chhotnagpur, lower- Gangetic and coastline[13]. The temperature lies between 42^0C during summer and goes below up to 8^0C in winter. The maximum and minimum Relative Humidity is 88% and 62% respectively. The annual average precipitation in KWS is around 1460 mm. Three small rivers, Tangna, Kamala and Usatalnala are the main water sources of the sanctuary.

Figure-1.A
Map of India showing Odisha

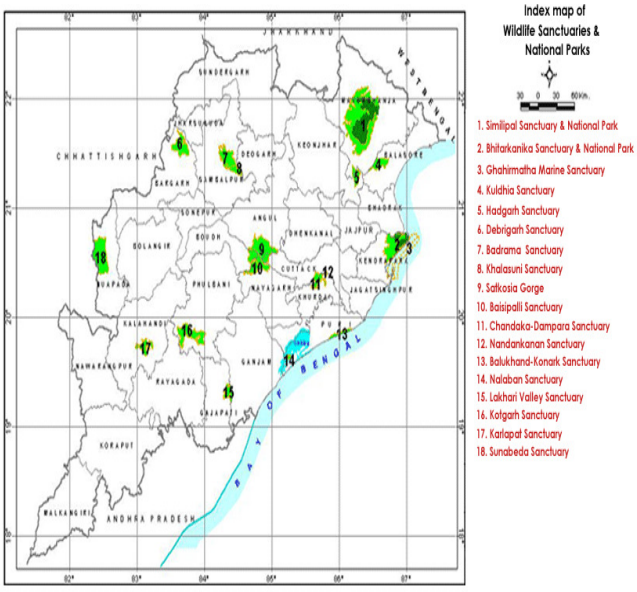

Figure-1.B
Index map of wildlife Sanctuaries and National Parks of Orissa

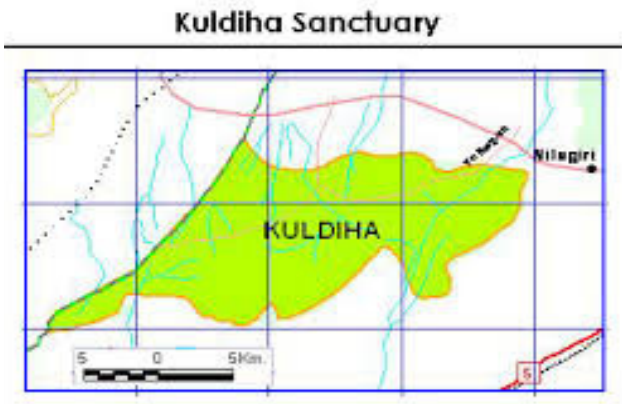

Figure-1.C
GIS map of KWS

Figure-1.D
Map of KWS

Material and Methods

The study on the activities of food and feeding of IB was conducted through opportunistic sightings in course of different field trips during 2008-2012. Two types of methods were used for studying food and feeding habits. Direct method: Direct Observation and Indirect Method: Fecal Analysis.

Direct Observation: Data on activity pattern, food plant species and feeding habits of IB were recorded by direct sightings with the help of a pair of Bushnell 10x50 binocular and Cannon 500D Digital SLR with 75-300 mm Lens using Focal Animal Sampling Method[14]. Focal animals were observed from dawn to dusk i.e from 0600-1800 hrs. After direct observation of feeding of animals, on-site inspections of food plant species were identified as per Saxena and Brahmam (1994-1996)[15] Feeding signs and samples of leaf, shoot, flower and fruits observed and collected were compared with subsequent microscopic analysis of dung.

Fecal Analysis: This study was based on the microscopic recognition of indigestible plant fragments mainly the epidermal features that are characteristic of different plant groups. Fecal Analysis was done by the procedures outlined by Satakopan,

1972[16]. The whole process required collection, preservation, preparation of fecal samples and reference slides. Reference slides of fresh plant species upon which Indian Bison observed feeding 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. Fresh IB dung samples were collected by following fresh tracks of animal in different seasons. The individual samples were collected separately, air dried for a minimum of 72 hours, ground thoroughly by hand and washed in Chloral hydrate solution to make seasonal sample. The samples were later analyzed in Environmental Research Laboratory of Department of Zoology, Utkal-University. The leaf components in these samples were compared with key prepared for identification from fresh plant species based on characters like shape, arrangement of epidermal tissue i.e cell wall structure, shape and size of cells, hairs and trichomes, shape and size of stomata and inter stomatal cells, fibre structure and arrangement of veins. Then the results were compared with field observations.

Results and Discussion

Time Activity Budget: Daily activity pattern of IB shows a bimodal diurnal activity pattern in feeding with peaks in the morning and evening hours. Feeding activity was low during noon hours when there was gradual increase in resting and reached a peak at noon and then gradually decreased (figure-2.A). The animals were observed to recline in the cover during hottest period of the day and rumination mostly occurred during this resting period. Moving was more or less uniform throughout the day and it was more during morning and evening along with feeding than noon hours. But during dry season moving was observed to be more in noon hours as the IB moved from one place to another as shade moved. Social behavior includes suckling, fighting and playing. Vigilance was observed more while feeding during morning and evening hours. A vigilant gaur stands in a typical posture with its head raised, ears erected and directing its head towards source of danger.In KWS, IB was diurnal. But it has been reported that in areas of high human disturbance IB is observed to become nocturnal[17].

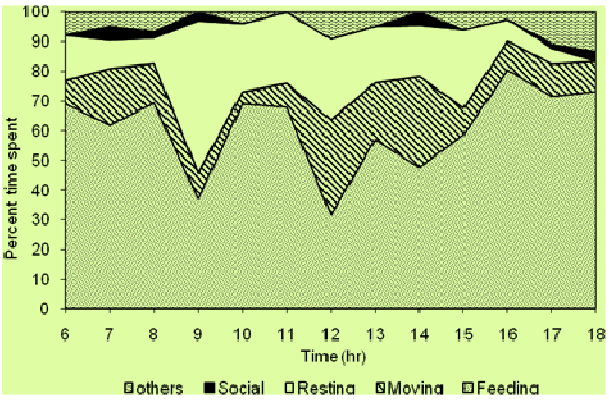

Figure-2.A
Activity Pattern of IB in Kuldiha Wildlife Sanctuary

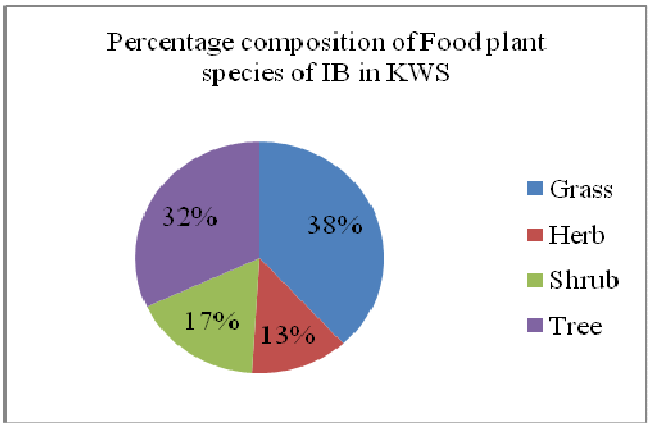

Figure-2.B
Composition of Food plant species of IB in KWS

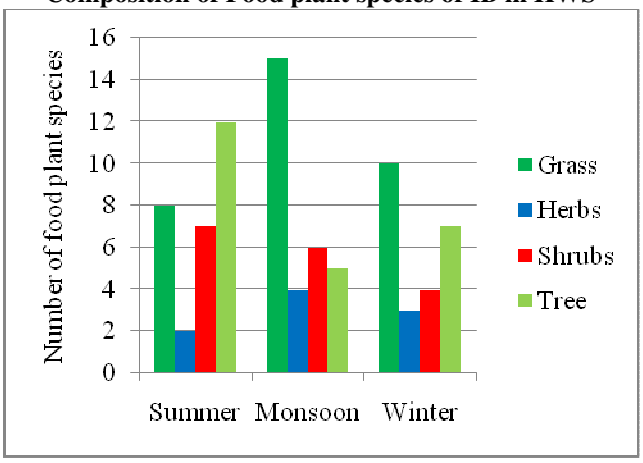

Figure-2.C
Comparative account of Food plant species of IB in KWS in different seasons

Figure-2.D
Fruits of *Dillenia pentagyna, fruit eaten by IB in KWS*

Figure 3.A
Indian Bison - Feeding

Figure-3.B
Indian Bison – Standing posture

Figure-3.C
Mother IB with her calf

Figure-3.D
Indian Bison in a Vigilant Stance

Food and Feeding of Indian Bison: The Indian Bison in Kuldhia wildlife sanctuary was observed to feed on diverse species of food plants comprising of 47 species of plants belonging to 17 families (table-1). The food plants of IB were represented by 18 species of grasses, 6 species of herbs, 8 species of shrubs and 15 species of trees. The food plants from the families of Poaceae and Fabaceae constituted nearly 50% forming the major food plant species of IB in KWS. Among physiognomic types grass constituted a greater proportion of 38% while shrub and tree species (Browse) constituted 49%. The contribution of different food plant categories is represented in figure-2B. Vairavel reported that IB was observed to feed on 151 species of plants belonging to 37 families in evergreen forest with Poaceae and Cyperaceae as the major constituents. A sum total of 32 species of plants belonging to17 families were identified as food plants plants of IB in two protected areas of Goa[18]. IB were observed to feed on 155 species of plants belonging to 38 families in tropical dry deciduous forest of Mudumalai. Arrendran has recorded that the diet composition consists of 78 species of plants belonging to 28 families and the major part of the diet consists of Leguminaceae (18 per cent) and Poaceae (15 per cent) in Teak dominant forests in Pench. Studies carried out by M. Chetri[19] in Nepal shows that IB is observed to feed on 49 species of plants in Sal forest. Their diet chiefly includes shoots and foliage of trees, shrubs, herbs and grass and also feeds on fruits like of *Diospyros melanoxylon* and *Aegale marmalos*, tender seeds of bamboo and barks of trees like *Adina cordifolia* and *Tectona grandis*. The IB in KWS was a generalist feeder and was found resorted to both grazing and browsing. The contribution of different food plant species to the diet of IB season wise is represented in figure-2.C In KWS Browsing is high in summer while grazing dominates in monsoon. IB has been basically described as a grazer[20]. Ashok kumar has reported that grasses are major component of IB diet in Mudumalai Tiger Reserve. Their diet chiefly includes shoots and foliage of trees, shrubs, herbs and grass. The IB in KWS consumed different parts like leaves, young shoots, flowers and fruits with leaves as most favorite food item. These observations are in agreement with the reports of Shukla and Khare who reported that Indian Bison grazed and browsed on a much wider variety of plants than any other ungulate species of India, showing preference for the upper portions of plants, such as leaf blades, stems, seeds and flowers of grass species. In contrast, some earlier study by Sathyanarayana and Murthy[21] shows that Indian Bison feeds selectively on grass-dominated areas and are primarily grass eaters. The IB in KWS were observed feeding on fruits of *Dillenia Pentagyna* and *Diospyros melanoxylon* in KWS. The IB were found to feed on the bark of tree species like *Adina cordifolia*, *Anacardium occidentale* and *Tectona grandis*. However it is in contrast with the aforesaid findings that though teak plants are available in plenty in KWS, still IB are not observed to feed on these. IB in KWS was very often found in feeding state. The highest feeding activity was observed in the early morning (0600 to 0800 hr) and in the evening (1600 to 1800 hr) (figure-2.A). During the hot hours of the day i.e 1300 to 1500 hr the animals were found resting

beneath the trees. Being an obligatory drinker IB in KWS needed water every day and visited water bodies at least once a day. Drinking time varied from mooring 0600 to 1930 hours.

Fecal analysis clearly indicates that the IB is the generalist feeder, showing great flexibility of food habits and consumed a variety of food belonging to different species. Because of their large size and energy demand they swallow large quantity of food in comparatively short feeding hours. So selection of foods species is not as strong as compared to other ungulates. The diet composition varied according to season and food availability.

Conservation: The Red list of IUCN of threatened species categorizes gaur or IB as a vulnerable species and today it is found in 11 countries. The estimated population is around 13,000 to 30,000 with approximately 85 per cent of population being present in India. Thus India is having the broader prospects for long-term conservation of this species. The populations in other countries are declining alarmingly. IB is listed in CITES table-1, which bans all international trade of gaur products. IB is protected under Schedule I of Wildlife (Protection) Act 1972 of India.

One of the major limitations is lack of accurate information regarding the population dynamics and habitat requirements of gaur in most protected areas like KWS. The current population estimates provides only a snap shot in the overall dynamic system. Furthermore, the estimates varied due to differences in methods of data collection, predator density of the respective area, spatio-temporal variations of IB and influence of other mega herbivore in the ecosystem. Thus long term monitoring of population is required other than density estimates to understand the dynamics of the system.

Habitat loss has been largely responsible for the large scale decline of IB range and it remains a major threat to IB conservation in KWS. The habitat degradation and fragmentation affect IB population in KWS. The anthropogenic factors include selective felling of matured trees for timber, forest fires in summer and illicit felling of trees by local people for honey, wax and resin. Although no systematic record of poaching of IB is available in KWS, there are incidences of poaching in Kerala-Tamil Nadu and Kerala-Karnataka boundary. Epidemic diseases such as Foot and Mouth Disease (FMD) and rinderpest cause widespread death of IB and these diseases have been reported in Southern and Central India[22]. The disease usually spread from domestic cattle that graze inside the forest.

Conclusion

Most IB range countries are developing countries with limited financial resources to commit to conservation. So funds remain major constraints in IB conservation. Inadequate forest staff in KWS for monitoring population and IB habitat is another concern area. Along with respective Government, the Non Governmental organizations, International organizations and agencies should support research and conservation oriented activities. Besides, IB is one of the important prey species for flagship species (Tiger) and thus considerable population monitoring research along with, community level research, carnivore population monitoring activities are urgent need areas. Long term survival of conservation of herbivores depends on the availability of suitable habitats, hence reduction of anthropogenic pressure, protection of food plant species and restoration of suitable habitats are significant factors in conservation biology of KWS.

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Table-1
List of food plant species consumed by Indian Bison in Kuldiha Wildlife Sanctuary, Balasore, Odisha

Family	Species	Local Name	Plant parts eaten	Seasonal Distributation		
				Summer	Monsoon	Winter
Grass						
Poaceae	*Apluda mutica*	Mugar	S	+	-	-
Poaceae	*Aristida setacea*	Khadikaghasa	S	+	-	-
Poaceae	*Bambusa arundinacea*	Baunsa	L, S	+	+	+
Poaceae	*Chloris dolichastachya*	Banoghasa	S	+	+	+
Poaceae	*Chrysopogon aciculatus*	Guguchia	S	-	+	-
Poaceae	*Cynodon dactylon*	Duba	S	+	+	+
Poaceae	*Cyperus rotondus*	Muthaghasa	S	-	+	-
Poaceae	*Dendrocalamus strictus*	Baunsa	L, S	+	+	+
Poaceae	*Fimbristylis miliaceae*	Suanli	S	-	+	-
Poaceae	*Heteropogon contortus*	Dauria	S	-	+	+
Poaceae	*Imperata cylindrica*	Chhana	S	+	+	+
Poaceae	*Oplimenus compositus*	Mohora	S	-	+	+
Poaceae	*Panicum maximum*	Ginighasa	S	-	+	-
Poaceae	*Paspalidian flabidion*	Bileilanji	S	-	+	-
Poaceae	*Paspalum scrobiculatum*	kodoghasa	S	-	-	+
Poaceae	*Saccharum spontaneum*	Kasatandighasa	S	+	+	+
Poaceae	*Thysanolaena maxima*	Phulajhadughasa	S	-	+	+
Poaceae	*Vetivera zizanioides*	Benasghasa	S	-	+	-
Herbs						
Fabaceae	*Cassia tora*	Chakunda	L	+	+	-
Boraginaceae	*Cordia obliqua*	Bhuanla	L	-	-	+
Fabaceae	*Desmodium heterocarpus*	Dangarbuta	L	-	+	+
Euphorbiaceae	*Euphorbia hirta*	Chitakutei	L	+	-	-
Lamiaceae	*Leucas aspera*	Gayas	L	-	+	-
Malvaceae	*Urena lobata*	Bilakapasia	L	-	+	+
Shrubs						
Fabaceae	Bauhinea vahlii	Sialilata	L	+	+	+
Rubiaceae	*Gardenia latifolia*	Dambaru	L	+	+	+
Verbinaceae	*Lantana camara*	Jaikoli	L	+	+	-
Fabaceae	*Mimosa pudica*	Lajokuli	L	-	+	-
Arecaceae	*Phoenix acaulis*	Banokhajure	L	+	-	-
Rubiaceae	*Randia dumetorum*	Mohana	L	+	-	-
Acanthaceae	*Strobilanthes auriculatus*	Pania	L	+	+	+
Verbinaceae	*Vitex negundo*	Begunia	L	+	+	+
Trees						
Rutaceae	*Aegle marmelos*	Bela	L	+	-	-
Fabaceae	*Bauhinia purpurea*	Amber	L	+	-	-
Euphorbiaceae	*Bridelia retusa*	Panikasi	L	+	-	-
Fabaceae	*Butea superba*	Latapalasa	L	-	-	+
Fabaceae	*Cassia fistula*	Sunrnari	L	+	+	-
Dilleniaceae	*Dillenia pentagyna*	Rai	Fr	+	-	+
Ebenaceae	*Diospyros melanaxylon*	Kendu	Fr	+	+	-
Tiliaceae	*Grewia tilifolia*	Asana	L	+	-	-
Rubiaceae	*Mitragyna parviflora*	Kelikadamba	Fl	+	-	-
Euphorbiaceae	*Phyllanthus emblica*	Anla	L	+	-	+
Dipterocarpaceae	*Shorea robusta*	Sala	L	-	+	+
Myrtaceae	*Syzygium cumini*	Jamukoli	L	+	+	+
Combretaceae	*Terminalia arjuna*	Arjuna	L	+	-	-
Combretaceae	*Terminalia chebula*	Horida	L	-	-	+
Rhamanaceae	*Zizyphus mauritiana*	Barokoli	L	+	+	+
Abbreviations: L-Leaf, Fl- Flower, Fr- Fruit, S- Shoot						

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