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Food habits of gaur (*Bos gaurus gaurus* Smith, 1827) and livestock (cows and buffaloes) in Parsa Wildlife Reserve, central Nepal

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Food habits of gaur (*Bos gaurus gaurus*) and livestock (cows and buffaloes) have been studied from January to June 1998 in Parsa Wildlife Reserve, Nepal. The study aimed to understand the diet composition and common plant used by gaur and livestock. Gaurs are both grazers and browsers. The diet of gaur comprised of 38 plant species (20 species of grass, 11 species of browse and 7 species of herb and others) and that of livestock comprised of 35 plant species (19 species of grass, 13 species of browse and 3 species of herb and others). A comparative analysis of plants consumption revealed that gaurs are less selective feeder than livestock. A total of 24 plant species (16 species of grass, 6 species of browse and 2 species of herb and others) were common in the diet of gaur and livestock. 7 species of plants (5 species of grass – *Cymbopogon* sp., *Imperata cylindrica*, *Phragmites karka*, *Themeda* sp., *Vetiveria zizanoides*; 1 species of browse – *Phaulopsis imbricata* and 1 species of herb – *Piper longum*) are comparatively more utilized by both gaur and livestock.

Key words: Gaur, *Bos gaurus gaurus,* food habits, livestock, common plants

Introduction

Habitat degradation and epidemic diseases like rinderpest and murrain, which spread through infected cattle grazing in the forest, are major threats for the survival of gaur's population in the wild (Schaller 1967, Prater 1971, Krishnan 1972). In Nepal, their population is isolated and they are surviving only in some parks, reserves and adjoining forest areas. It is reported that disease brought the declination in the population of gaur in 1960 (Gurung 1983) and in 1972 and 1973 (Tamang 1982). Most of the adjoining forest habitats are destroyed due to encroachments. As a result by the end of 1980, only 17.4% land of the Nepal remained forested, including low-quality shrubs forest (Dhungel and O'Gara 1991). The forest areas are reducing by 1.3% or 8300 ha annually (Forest Survey Division 1993). A good quality forest remains only in the protected areas. But most of the protected areas are surrounded by villages and in some cases villages lie within the protected areas. In some places, lack of public grazing lands in and around the villages forces the people to graze their livestock inside the protected areas, which instigates conflict between the livestock keepers and the wildlife managers. Koshi Tappu Wildlife Reserve in east Nepal is a good example of the problem (Heinen 1993). Wild and domestic animals that forage in the same habitat may have potential for food competition (Wegge 1976, Schaller 1977) and particularly gaurs are very sensitive to any anthropogenic disturbances.

Comparative studies on the food habits of gaur and livestock have been conducted in India by Shukla and Khare (1988), Srivastava *et al.* (1996). The food habits of gaur and livestock along with their comparison in Parsa Wildlife Reserve (PWR) have been provided in this paper.

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Study area

PWR is located at 84°41'-84°58'E, 27°15'-27°33'N in central lowland Nepal. Spread over 499 km^2, it was established in 1984 by the government of Nepal under Department of National Parks and Wildlife Conservation. PWR lies between the altitude ranges of 100-950 masl. It is surrounded by four districts: Chitwan, Makwanpur, Parsa and Bara. PWR adjoins Royal Chitwan National Park (RCNP) to the west, and forms a biological corridor. The present study area spans over the Tarai and the Churia foothills (approx. 13.1 km^2, elevation 250-450 masl). Four small villages exist inside the PWR – two in the southern side of the Churia hills (Rambhori and Bhata) and two in the Inner Tarai along the Rapti river (Ramouli and Pratappur). The people in these four villages rear a large number of livestock, which graze inside the reserve. Besides the villagers, illegal settlers as herders (*Gothalas*) also herd large number of livestock from the adjoining villages.

The climate is sub-tropical. The vegetation in the study areas exhibits sub-tropical ranging from early successional stages on the dry riverbeds and floodplains with colonizing *Saccharum spontaneum*, *Imperata cylindrica* to a mature climax type of sal (*Shorea robusta*) forest on the upper dry lands. As altitude increases in the north along the Churia hills, the sal forest is gradually replaced by pine (*Pinus roxburghii*) forest. The complexity of the Churia landscape supports a high level of biotic diversity including Asiatic elephants (*Elephas maximus*), Bengal tigers (*Panthera tigris*), leopard (*Panthera pardus*), wild dog (*Cuon alpinus*), striped hyaena (*Hyaena hyaena*), sloth bear (*Melursus ursinus*), four-horned antelope (*Tetraceros*

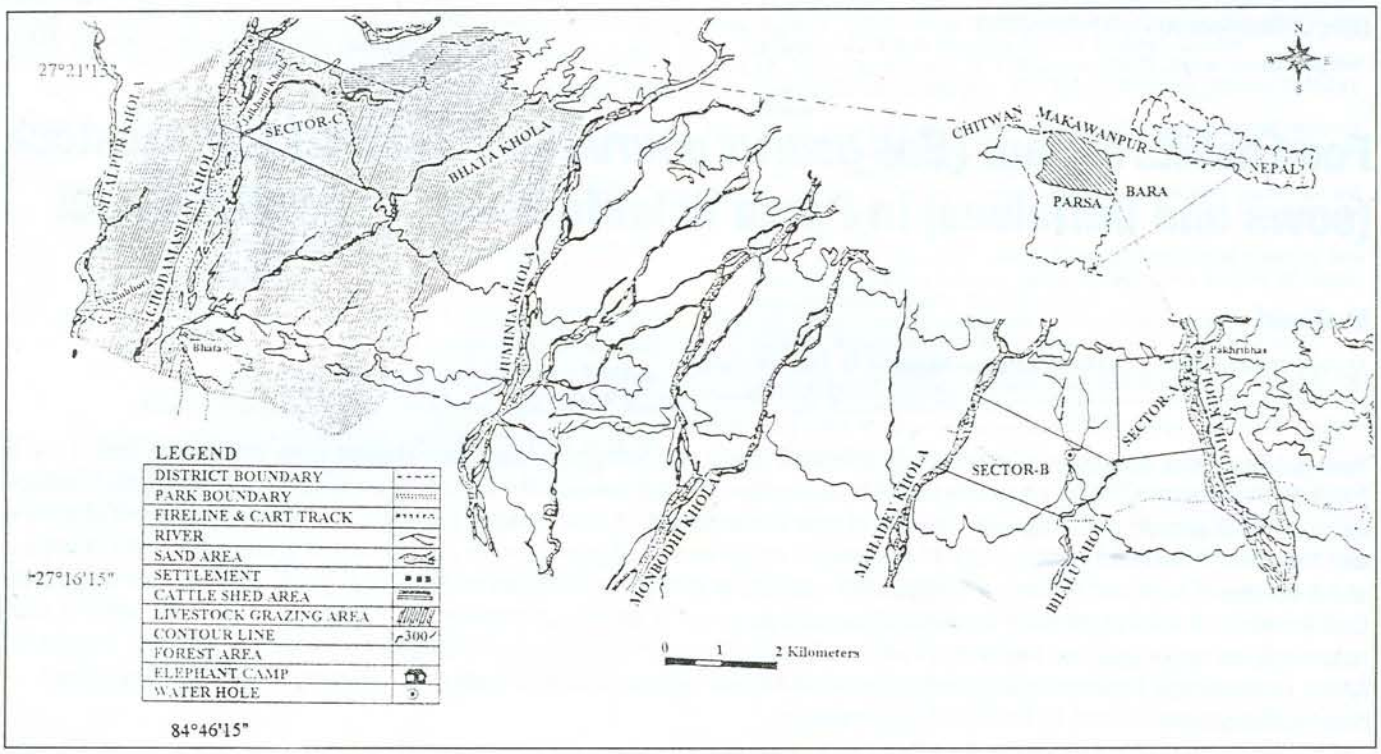

Figure 1: Map of the study area showing location and distribution of water hole used by gaur

quadricornis), barking deer (*Muntiacus muntjak*), spotted deer (*Axis axis*), sambar deer (*Cervus unicolor*), wild boar (*Sus scrofa*) and rich variety of reptiles and forest birds.

Materials and methods

To find out the major areas of gaur in PWR, two preliminary field surveys were conducted during November and December 1997. The field survey was conducted on foot, on the back of domestic elephants and occasionally by vehicles.

In the gaur inhabiting areas direct observation was done by various means ranging from walking on foot to using elephants and trees and *machans* (raised platform constructed in the trees for viewing). Observations were mainly done during the early morning and in the evening. When the animal was sighted with the help of binoculars they were observed undisturbed. The feeding site was visited immediately as soon as the animal left the area to record the number of plant species consumed. The plant species consumed were ranked into high, medium and low preference as follows: high = feeding frequency >20/ species/day, medium = feeding frequency 11-20/species/day, low = feeding frequency 1-10/species/day. Indirect observations based on fresh signs of plants recently eaten such as exudation of sap, crushed tissues and fresh clippings as mentioned by Jarman (1971) and Koirala and Shrestha (1997) were also made. The plant species utilized by the animals were categorized into three groups - grass (plants of grass families), browse (all woody plants) and herb and others (broad leaved herbaceous plants, pteridophytes and fruits). Based on direct sighting of feeding animals and Rapid Rural Appraisal (RRA), the plant species consumed by livestock (cows and buffaloes) during May was recorded. The plant species eaten by the livestock were categorized according to their preference similar to the gaurs' diet. Herbarium sheets of all food plant species consumed by gaur and livestock were prepared and brought to the Central Department of Botany, Tribhuvan University (T.U.) for identification and further authentication. For the comparison of diet composition of the gaur during May, microfecal analysis done by Chetri (1999) was utilized.

Results and discussion

Food and food habits of gaur

Field observation revealed that gaur consumes a total of 36 plants species (12 species of grass, 16 species of browse and 8 species of herb and others) (Table 1). Schaller (1967) recorded 40 plant species consumed by gaur through direct observations in the Kanha National Park, India during late March to early June and Shukla & Khare (1998) recorded 45 plant species through direct observations in the Pench Wildlife Reserve, central India. In this study, low numbers of plant species were recorded through direct observation, which was probably due to short study period and availability of plant species. Some of the food species recorded from Kanha National Park and Pench Wildlife Reserve (Schaller 1967; Shukla & Khare 1998) were not recorded in PWR (Chaudhary 1995).

The grass *Cymbopogon* sp., *Phragmites karka* and *Themeda* sp. were observed most frequently consumed by the animals and that ranked high preference during all the months from January to June. *Imperata cylindrica* and *Sacchrum spontaneum* also received the highest preference from March to June. Shukla & Khare (1988) also reported *Themeda triandra, Themeda quadrivalis* and *Saccharum spontaneum* as the main grass species in the diet of gaur in the Pench Wildlife Reserve, India. The browse species *Phaulopsis imbricata* and *Wendlandia*

exserta were observed most frequently consumed by the animals. This is mainly due to the abundance of these species in the foothills of the study area. Study conducted elsewhere does not record these species in the diet of gaur (for e.g., Schaller 1967, Krishnan 1972, Shukla and Khare 1988, Srivastava *et al.*1989). The discrepancy is probably related to different vegetation composition of the habitats. From January to April, animals were observed extensively browsing on leaves of *Dendrocalamus strictus*. Schaller (1967) and Krishnan (1972) have also recorded *Dendrocalamus* sp. in the diet of gaur. Among herb and others, *Asparagus racemosus* was the most preferred species and ranked high preference during April and May due to the availability of new shoots which sprout after the forest fire. This species is scarce in the foothills and distributed more at the edge and in the southern part of the foothills. Schaller (1967) has also recorded *Asparagus racemosus* in the diet of gaur in Kanha National Park.

Plate 1 : A herd of gaur in the dry river belt of mixed deciduous riverine forest

In this study, in comparison to grass species (12 species), higher number of browse species (16 species) is recorded. Mostly the animals are either observed in the foothills or at the edge feeding on browse species in the northern part of the Inner Khola and Bhalu Khola areas. These areas are criss-cross by numerous foothills and gullies, where the grass species are either scarce or patchy distributed only near the water sources and on the open canopy gaps. The highest number of plant species during March and April (25 and 24 species respectively) is due to high visibility. During these months, shortage of food and water in the foothills forces the animals down at low altitudes. They can be readily seen in the Inner Khola, Bhedaha Khola, Kaminidaha and Pakhribas areas of the reserve.

Food and food habits of livestock

Field observation revealed a total of 18 plant species (11 species of grass, 5 species of browse and 2 species of herb and others) are consumed by livestock during the month of May (Table 1). The result showed that livestock generally prefer the new shoots of grass during the month of May. Kirby & Parman (1986) also found that the selection of grass by cattle was significantly greater in summer when compared to the early fall grazing period. A total of 8 species (7 species of grass – *Cymbopogon* sp., *Cynodon dactylon*, *Eleusine indica*, *Imperata cylindrica*, *Phragmites karka, Themeda* sp., *Vetiveria zizanoides* and *Tysanolaena maxima* and 1 species of browse – *Phaulopsis imbricata)* are found highly preferred by livestock.

Food habits: gaur vs. livestock

The pooled data from microfecal analysis, RRA and field observation revealed that a total of 38 plant species (20 species of grass, 11 species of browse and 7 species of herb and others) are consumed by gaur, whereas livestock consumes only 35 plant species (19 species of grass, 13 species of browse and 3 species of herb and others) in May (Annex 1). The consumption of plant species as food by gaur and livestock is much less in comparison to the availability of food plants. A total of 333 plants species were recorded from PWR (Chaudhary 1995). This may be due to short study period. Comparison between gaur and livestock revealed that gaur exploits more plants and are less selective in diet selection than the livestock. A comparative checklist of the food plants of gaur and livestock during May (Annex 1) revealed that 24 plant species (16 grasses, 6 browse and 2 herb and others) are commonly utilized. Shukla & Khare (1988) reported from direct observation that gaur and livestock in the Pench Wildlife Reserve commonly utilize 12 grass species during 1987 to 1989. Srivastava *et al.* (1996) from microfecal analysis reported that gaur and livestock in the Periyar Tiger Reserve commonly utilize 12 grass species in winter. 7 species (5 species of grass – *Cymbopogon* sp., *Imperata cylindrica, Phragmites karka, Themeda* sp., *Vetiveria zizanoides*, 1 species of browse – *Phaulopsis imbricata* and 1 species of herb – *Piper longum*) are highly exploited by both gaur and livestock. Srivastava *et al.* (1996) reported 30.4% diet overlap between gaur and livestock in the Periyar Tiger Reserve. Though the diet overlap percentage was not estimated in this study, the percentage contribution would be definitely higher because a high density of cattle (132/km^2) and buffalo (7/km^2) were recorded grazing in the gaur habitat (Chetri 1999). Livestock are selective feeders, and overgrazing results in the suppression and eventual elimination of the preferred species, creating a less productive vegetation composition. Excessive livestock grazing during summer may also limit forage availability during winter for the wild ungulates if they do not move out of the area (Koirala & Shrestha 1997). It will also increase the chances

Table 1. List of plant species preferred by gaur from January to June and livestock during May in Parsa Wildlife Reserve

Plant species	Gaur				Livestock		
	Months (January -June)				Month (May)		
	Jan.	Feb.	Mar.	Apr.	May	Jun.	
Grass							
Apluda sp.	**	**	***	***	-	-	-
Cymbopogon microtheca (Hook. F.) A. Camus	-	-	*	*	*	-	-
Cymbopogon sp.	***	***	***	***	***	***	***
Cynodon dactylon (L.) Pers.	-	*	*	-	-	-	***
Dendrocalamus strictus Ness	***	***	***	***	-	-	**
Eleusine indica (L.) Gaetrn							***
Erianthus ravennae (L.) P. Beauv.							**
Imperata cylindrica (L.) P. Beauv.	**	**	***	***	***	***	***
Panicum paludosum Roxb.	-	-	-	**	**	-	-
Phragmites karka (Retz.) Trin ex Steud.	***	***	***	***	***	***	***
Saccharum spontaneum L.	**	**	***	***	***	***	*
Setaria glauca (L.) P. Beauv.	-	-	-	*	*	-	**
Themeda sp.	***	***	***	***	***	***	-
Thysanolaena maxima (Roxb.) Kuntze.	-	-	-	-	-	-	***
Vetiveria zizanoides (L.) Nash	-	-	-	***	***	-	***
Browse							
Albizia sp.					*		-
Bombax ceiba		*					-
Colebrookea oppositifolia Sm.	-	**	**	**	-	-	*
Fiscus semicordata Buch.-Ham.ex Sm.	-		*	-	-	-	-
Garuga pinnata Roxb	-	-	-	*	*	-	*
Nyctanthes arbor-tristis L.		**	**				*
Phaulopsis imbricata (Forssk.) Sweet	***	***	***	***	***	***	***
Randia sp.	-	*	*	-	-	-	-
Shorea robusta Gaertn.	-	-	**	**	**	-	-
Sterculia villosa Roxb.	-	-	-	*	*	-	-
• *Tharotherthere*	***	***	***	***	-	-	-
Thespesia lampus (Cav.) Dalz. & Gibs.	***	***	***	**	-	-	**
Trema orientalis (L.) Bl.			*				-
Urena lobata L.	**	**	-	-	*	-	-
Viscum album L.	-	-	***	***	-	-	-
Wendlandia exserta (Roxb.) DC.	***	***	***	**	**	*	-
Herb and Others							
Asparagus racemosus Willd.	**	**	**	***	***	**	-
• *Banspate*					*		-
Ipomoea hederifolia L.	***	***	***	***			-
Phoenix humilis Royle.					*	*	*
Piper longum L.			***	***	***		-
Reinwardtia indica Durmortier	-	-	*	-	-	-	-
Sida rhombifolia L.	***	***	*	*			*
Smilax ovalifolia Roxb. ex D. Don					*		-

Note: Preference level: * = high (feeding frequency >20/species /day), ** = medium (feeding frequency 11- 20/species/ day), * = low (feeding frequency 1-10/ species/day) • = local name**

Annex 1. Checklist of the plant species and their parts utilized by gaur and livestock during May in Parsa Wildlife Reserve

Species utilized by gaur	Parts eaten	Species utilized by livestock	Parts eaten
Grass		**Grass**	
Apluda sp.	Leaves, shoots	*Apluda* sp.	Shoots
**Cymbopogon microtheca* (Hoof. f.) A. Camus	Leaves, shoots	*Cymbopogon microtheca* (Hoof.f.) A. Camus	Leaves, shoots
**Cymbopogon* sp.	Leaves, shoots	**Cymbopogon* sp.	Shoots
Cynodon dactylon (L.) D. Don	Whole plants	**Cynodon dactylon* (L.) D. Don	Whole plants
Cynotis cristata (L.) D. Don	Leaves	*Cynotis cristata* (L.) D. Don	-
Cyperus exaltatus Retz.	Leaves	*Cyperus exaltatus* Retz.	-
Dendrocalamus strictus Ness	Leaves	**Dendrocalamus strictus* Ness	Leaves
Eleusine indica	-	**Eleusine indica* (L.) Gaetrn	Whole plants
Erianthus ravennae (L.) P. Beauv.	-	**Erianthus ravennae* (L.) P. Beauv.	Leaves, shoots
Fimbristylis miliaceae (L.) Vahl	-	*Fimbristylis miliaceae* (L.) Vahl	Shoots
**Imperata cylindrica* (L.) P. Beauv.	Leaves, shoots	**Imperata cylindrica* (L.) P. Beauv.	Shoots
**Panicum paludosum* Roxb.	Leaves, shoots	*Panicum paludosum* Roxb.	Leaves, shoots
**Phragmites karka* (Retz.) Trin ex Steud.	Leaves, shoots	**Phragmites karka* (Retz.) Trin ex Steud.	Leaves, shoots
**Saccharum spontaneum* L.	Leaves, shoots	**Saccharum spontaneum* L.	Shoots
**Setaria glauca* (L.) P. Beauv.	Whole plants	**Setaria glauca* (L.) P. Beauv.	Whole plants
**Themeda* sp.	Leaves, shoots	*Themeda* sp.	Shoots
**Vetiveria zizanoides* (L.) Nash	Leaves, shoots	**Vetiveria zizanoides* (L.) Nash	Shoots
Leersia hexandra Sw.	Leaves	*Leersia hexandra* Sw.	-
Oplimenus compositus (L.) P. Beauv.	Leaves	*Oplimenus compositus* (L.) P. Beauv.	Whole plants
Oplismenus burmanii (Retz.) P. Beauv.	Leaves	*Oplismenus burmanii* (Retz.) P. Beauv.	Leaves, shoots
Paspalidium punctatum (Burm.) A. Camus	Leaves	*Paspalidium punctatum* (Burm.) A. Camus	Leaves, shoots
Paspalum scrobiculatum L.	Leaves	*Paspalum scrobiculatum* L.	-
Thysanolaena maxima (Roxb.) Kuntze.	Leaves	**Thysanolaena maxima* (Roxb.) Kuntze.	Leaves
Browse		**Browse**	
**Albizia* sp.	Leaves, shoots	*Albizia* sp.	-
Bauhinia purpurea L.	-	*Bauhinia purpurea* L.	Leaves, shoots
Bauhinia vahlii Wight & Arn.	-	*Bauhinia vahlii* Wight & Arn.	Leaves, shoots
Colebrookea oppositifolia Sm.	Leaves, stems, shoots	**Colebrookea oppositifolia* Sm.	Leaves, shoots
Ficus hispida L.f.	-	*Ficus hispida* L.f.	Leaves, shoots
Ficus racemosa L.	-	*Ficus racemosa* L.	Leaves
Ficus semicordata Buch.-Ham.ex Sm.	-	*Ficus semicordata* Buch.-Ham.ex Sm.	Leaves, shoots
Gmelina arborea Roxb.	-	*Gmelina arborea* Roxb.	Leaves, shoots
**Garuga pinnata* Roxb.	Leaves, shoots	**Garuga pinnata* Roxb.	Leaves, shoots
Litsea monopetala (Roxb.) Pers.	-	*Litsea monopetala* (Roxb.) Pers.	Leaves, shoots
Nyctanthes arbor-tristis L.	Leaves	**Nyctanthes arbor-tristis* L.	Leaves
**Phaulopsis imbricata* (Forssk.) Sweet	Leaves, stems, shoots	**Phaulopsis imbricata* (Forssk.) Sweet	Leaves, stems, shoots
**Shorea robusta* Gaertn.	Leaves, shoots	*Shorea robusta* Gaertn.	-
**Stericulia villosa* Roxb.	Leaves, shoots	*Stericulia villosa* Roxb.	-
Thespesia lampus (Cav.) Dalz & Gibs.	Leaves, stems	**Thespesia lampus* (Cav.) Dalz & Gibs.	Leaves, shoots
**Urena lobata* L.	Leaves, shoots	*Urena lobata* L.	-
Viscum album L.	Leaves	*Viscum album* L.	-
**Wendlandia exserta* (Roxb.) DC.	Leaves, stems, shoots	*Wendlandia exserta* (Roxb.) DC.	Leaves, shoots

Herb and Others			
Amaranthus spinosus L.	Leaves	*Amaranthus spinosus* L.	-
**Asparagus racemosus* Willd.	Shoots	*Asparagus racemosus* Willd.	-
••*Banspate*	Shoots	• *Banspate*	-
Equisetum sp.	Leaves	*Equisetum* sp.	-
**Phoenix humilis* Royle	Shoots	* *Phoenix humilis* Royle	Shoots
**Piper longum* L.	Whole plants	*Piper longum* L.	Whole plants
Sida rhombifolia L.	-	**Sida rhombifolia* L.	Leaves, shoots
**Smilax ovalifolia* Roxb. ex. D. Don	Shoots	*Smilax ovalifolia* Roxb. ex. D. Don	-

Note: * = plant species obtained from direct observation, Unmarked = plant species obtained from microfecal analysis in case of gaur and from RRA in case of livestock, • = Local name

of transmitting epidemic diseases like rinderpest and murrain, which took a heavy toll of gaur population throughout its range (Schaller 1967, Prater 1971, Krishnan 1972, Brander 1982, Tamang 1982, Gurung 1983, Tikadar 1983, Ranjitsinh 1991). Besides, heavy grazing of large-bodied herbivores also decreases the nutrient cycling and succession, changes community organization, and causes loss of biodiversity (Fleischner 1994).

During summer the gaur might migrate towards the northeastern side because of the abundant food plants and water. Moreover according to the villagers of Rambhori and Bhata villages, gaur annually visit in an around Bhata area during March, April and May. If this is true, food interaction between gaur and livestock during June to February will not occur in the areas where villagers' livestock graze. But the illegal herders herd their livestock throughout the year in the slope of the Churia foothills and there is a chance of interaction between gaur and livestock. While facilitation or competition between gaur and livestock needs further investigation, a risk of transmitting cattle borne epidemic diseases like rinderpest and murrain, which may directly affect their survival and distribution, is always there (Chetri & Basnet 2001). ■

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