Estimation of Indian Bison, *Bos gaurus* in varied forests of the Mookambika Wildlife Sanctuary, Western Ghats, Karnataka, India

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ABSTRACT

Encounter rate of large mammals were estimated using transect line method in the Mookambika wildlife sanctuary Western Ghats, Karnataka ,India, during April 2010 to March 2012. Our investigations indicated the predominance of gaurs in moist deciduous forest against others including evergreen forest which is least preferred. In the present study, the most frequent herd size of bison was found to be of 2-10 individuals (n = 45). Big herds consisting of more than 20 individuals were observed rarely.

KEY WORDS: Encounter rate, Indian bison, line transect method, wildlife census, Western Ghats

INTRODUCTION

Estimating the population size, encounter rate of an animal species in an area is fundamental in understanding its status, demography and to plan for its management and conservation. In spite of the development of sophisticated statistical methods of sampling animal populations, their application to estimating densities in tropical forests is difficult mainly because of poor visibility and relatively low density of these populations resulting in inadequate sample size for statistically precise results (Burnham *et al.,* 1980). The habitat topographic features also contributes to the practical difficulty of carrying random sampling, an additional constraint in sampling design.

A major management challenge in conserving large herbivores is monitoring their populations, which is crucial both to assess the success of management and to formulate future management strategies. Monitoring herbivore population dynamics also helps us better understand various ecological processes at landscape and ecosystem levels). However, reliable estimates of herbivore densities in the forests of tropical Asia are rare in spite of surveys conducted by several investigators to estimate ungulate densities in India (Schaller, 1967; Berwick, 1974; Johnsingh, 1983; Sankar, 1994), Nepal (Seidensticker, 1976; Dinerstein, 1979; Tamang, 1982).

Both direct and indirect methods of estimating mammal encounter rate in tropical forests have been used (Barnes and Jensen, 1987; Koster and Hart, 1988; Varman, 1988; Sale *et al,* 1990; Karanth and Sunquist, 1992; Varman *et al.,* 1995). Estimates based on indirect methods usually involve counting animal dropping, while

direct methods use visual sightings of animals through line transect sampling, which is practical, efficient and relatively inexpensive for many biological populations (Anderson *et al.,* 1979; Burnham *et al.,* 1980; Buckland *et al.,* 1993). Although, it has been extensively used in temperate regions for estimating densities for a variety of vertebrate taxa, one of the first rigorous applications of the method in a tropical forest was by Karanth and Sunquist (1992) to estimate encounter rate of mammals. The present study was aimed at estimating the Indian bison population through line transect method in Mookambika wild life sanctuary.

MATERIAL AND METHODS

Study area

The Mookambika wildlife sanctuary of kollur region has been named after goddess Mookambika, the presiding deity of the famous Mookambika temple at Kollur located at the heart of the sanctuary. It is situated in the Kundapura taluk of Udupi district in the Karnataka state. It lies between 13^0 42' and 13^0 59' north latitude 74^0 39' and 74^0 39' to 74^0 50' east longitude. The sanctuary is spread over 247 sq.kms with 15 reserved forest units. The climate is generally humid and warm throughout the year due to its proximity to sea and consequently under goes limited diurnal changes. Rainfall is very heavy from June to August and uneven. South west monsoon is really torrential. Average rainfall is close to 6000 mm/annum. The temperature at lower elevation ranges from 10 to 35^0 C. Rivers Charka and Sowparnika, the perennial rivers drain the

sanctuary. In addition there are a good number of stream and nalas some of which are also perennial. Forest types in the protected area are varied and rich. The moist deciduous forests occur at lower altitudes, especially in the foot hills. West coast semi evergreen and west coast tropical evergreen forest occur at the mid altitudes and while, typical shoal grass land vegetation is found at higher altitude.

Encounter rate estimation method

The study was carried from April 2010 to March 2012. This protocol outlines a simple method for quantifying ungulate abundance in an area based on visual encounters while walking along fixed line transects. Data collection was done employing the following procedure:

a) The shape, size, vegetation and terrain type of each beat were analyzed and accordingly specific transect lines of a minimum of 2 km and not exceeding 4 km were marked for sampling.

b) The transect lines traversed similar habitat types as far as possible. For beats comprising two or three distinct vegetation types, two separate lines transects were marked for sampling. Care was taken that no line transects were located near the highway or parallel to a river (to avoid biased sightings).

c) The broad forest type/s that each transects traverses was recorded.

d) Each transect was walked at dawn (6 am to 9 am), afternoon (1pm to 3 pm) and at dusk (5 pm to 7 pm) on a monthly basis.

e) 28 hours per month were spent observing the animals on field totaling to 1345 hours during the entire study period.

f) 6 hours per week were spent in direct contact observing the animals.

g) Gaurs sighted were recorded in a specific format (Appendix Ia) with necessary details.

h) Animals were considered to belong to two different groups if the closest animals were seen at a distance of over 20 m.

i) Each line transect was walked at least two different mornings, afternoons and evenings and the encounter rates (ER) of gaur were estimated as follows:

ER=No. of animals sighted/100km.

RESULTS

Based on the characteristic tree species predominant within the study area, following four broad habitat types were recognized in the Mookambika wildlife sanctuary of Kollur region.

1. Moist Deciduous forest (MDF)

2. Semi-evergreen forests (SEF)

3. Evergreen forests (EF)

4. Shola Grassland (SGRS)

Density estimation:

Significant differences in the gaur density in the above four habitats analyzed by one-way analysis of variance (ANOVA) is represented in Table 1. The analysis showed that gaur showed preference for moist deciduous type over evergreen forests. The results are also supported by its wide distribution in moist deciduous habitat as compared to semi-evergreen forests, evergreen forests and grassland.

The results suggest that Mookambika wildlife sanctuary of Kollur region supported a large population of gaur 330±25 individuals. Gaur showed a high overall individual density of 31.2 ± 6.20 individuals/ sq. km (Data at 95% Confidence interval) in MDF as compared to SGRS 20.2 ± 6.1, SEF 16.0±2.1 and EF 5.4±1.5. Density estimates, percentage coefficient of variation and χ^2 values of different habitats grouped into distance classes and class intervals are represented in table 1.

Encounter rate:

Encounter rate (ER) of gaur in different habitats are represented in table 2. It was found to be highest in moist deciduous forests (123±4 individuals/100 sq. km) and lowest in evergreen forests. (22±1.7 individuals/100 sq. km).

Table 1: Habitat-wise comparison of the density of gaur using ANOVA

S.No	Habitat type	Group density (Sq. km) ± SE	Density of individuals (Sq. km) ± SE	p>0.05
1	MDF	12.2±1.8	31.2± 6.2	0.919
2	SEF	5.1±0.29	16.0±2.1	0.290
3	EF	2.0±0.8	5.4±1.5	0.430
4	SGRS	9.2±1.7	20.2±6.1	*

*Low sample size for valid statistical analysis

Table 2: Encounter rate of gaur in different habitats

Vegetation /Habitat type	ER/100 km
MDF	123±4.0
SEF	43±2.1
EF	22±1.7
SGRS	58±2.7

Table 3: Composition of gaur herd (n=95)

Herd Size	Mean herd size	No. of times observed
Single Individual (1)	1	40
Small Herd (2-10)	5.6±2.0	45
Medium Herd (11-20)	13±2.4	11
Big Herd (>20)	22 ± 3.5	04

Herd size and composition:

Composition of gaur herd is represented in table 3. Of the 100 observations made, total 90 herds were observed consisting of 361 individuals. This included 40 solitary bulls, 45 small herds and 11 medium sized herds. Each herd consisted of bulls, cows, yearlings and sub-adult gaurs. Big herds consisting of more than 20 individuals were observed only twice. Altogether 117 bulls and 111 females were observed. The adult black bulls were always found to be solitary. The most frequent herd size was that of small sized herd with mean herd size 5.6 ± 2.0.
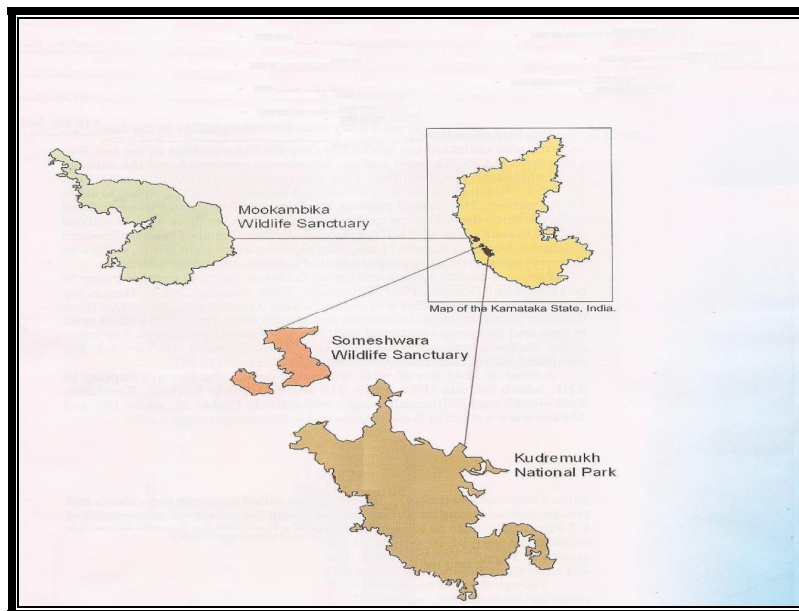
Fig. 1: Mookambika Wildlife Sanctuary in Kudremukh National Park

DISCUSSION

Our investigations indicated the predominance of gaurs in moist deciduous forest against others including evergreen forest which is least preferred by them. Although gaurs have been reported as essentially a hill animal (Prater, 1971), during the present study we could find them often in plains. This observation of ours is in agreement with the reports of Choudhury (2002) and Suman and Shayama (2012) that low-lying areas seem to comprise the optimal habitat for gaur. Further, as winter advances and the green grasses turn coarse with the advancing summer they were mostly found inhabiting semi-evergreen/evergreen forests and fed on the predominant species of that region. Often during summer gaurs were seen to visit paddy plantations may be because of the availability of both water and food in abundant quantity. The semi-evergreen and evergreen patches seem to be less preferred or never used in these seasons. Moist deciduous and grasslands were the most used habitats in monsoon and winter may be because of the abundance of grass species in

this season. Schaller (1967) opined that gaurs occur in forests with abundance of water and forage availability (in form of grasses, shrubs and trees).

Wharton (1968) reported that gaurs avoid evergreen rainforest, preferring foothill tracts of deciduous forests. In the present study, we could find gaurs in grasslands also apart from moist deciduous, semi-evergreen and evergreen forest as per the predominant vegetation of this study area.

In the present observation gaurs were found to occur at 100m MSL to 800m MSL. Earlier studies also reported them to occur within this range (Wood 1937, Wharton 1968, Choudhury 2002). Duckworth *et.al* (2008) reported that gaurs can better tolerate rugged terrain and denser forest with adequate water sources. However in our present study, we observed that gaurs avoid denser forests and prefer grasslands/open forests. The preference for grasslands may be due to the availability of grasses as food.

Animal population and density

Balkrishnan and Easa (1986) based on their studies on mammals of Parambikulam Wildlife Sanctuary in Kerala, reported that density of gaur population was higher in grassland than in moist deciduous forests. However, we could find maximum density of gaurs in moist deciduous forests followed by grasslands (Fig. 3). This may be due to the domination of moist deciduous forests in our study area.

Herd size and composition

In the present study, the most frequent herd size was that of 2-10 individuals (n=45). Big herds consisting of more than 20 individuals were observed rarely, fig 4. The mean herd size reported was 5.6±2.0 and this observation is in agreement with Brander (1923), Hubback (1937), Hislop (1961), Schaller (1967), Sahai (1972), Belsare *et.al* (1984) and Vairavel (1998) who reported herd size to be in the range of 5–12 animals. In the present study, the ratio of bulls to cows was 0.98. Ahrestani *et.al* (2010) reported this ratio to be 0.86 at birth in captive population at Mysore zoo. Schaller, (1967) also reported that bulls and cows are equal in proportion.

We could observe that the fully-grown adult black bulls were always solitary and were never seen joining a herd. Such observations were also reported by Schaller (1967), Belsare *et.al* (1984) and Forsyth (1989). According to Brander (1923) the old bulls lead a solitary life and seem to have lost sexual instinct at a comparatively early age. In the present observation in a single occasion, adult black bull was seen on the same place for two consecutive days. This is in agreement with the report of Schaller (1967) that solitary bulls might take up residence along a particular area for several days.

CONCLUSION

The present study indicated the predominance of gaurs in moist deciduous forest and least occurrence in others
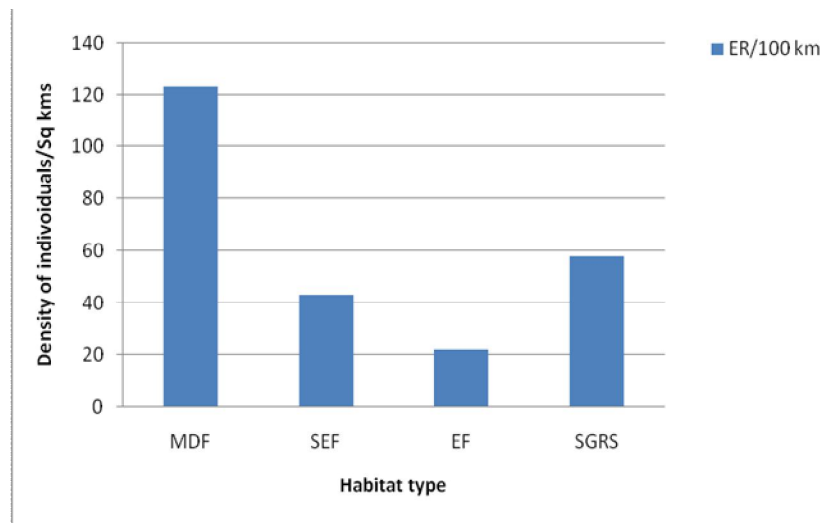
including evergreen forest. It was also observed that gaurs avoid denser forests and prefer grasslands/open forests and the most frequent herd size was that of 2-10 individuals and big herds consisting of more than 20 individuals were observed rarely.
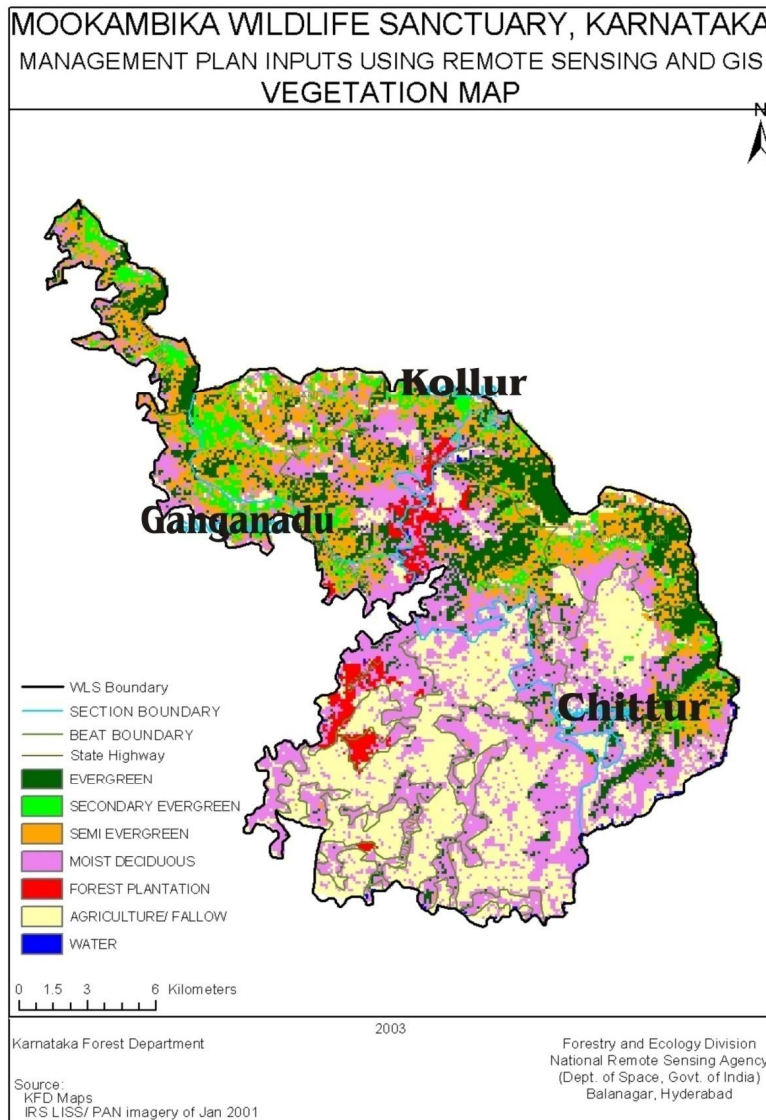
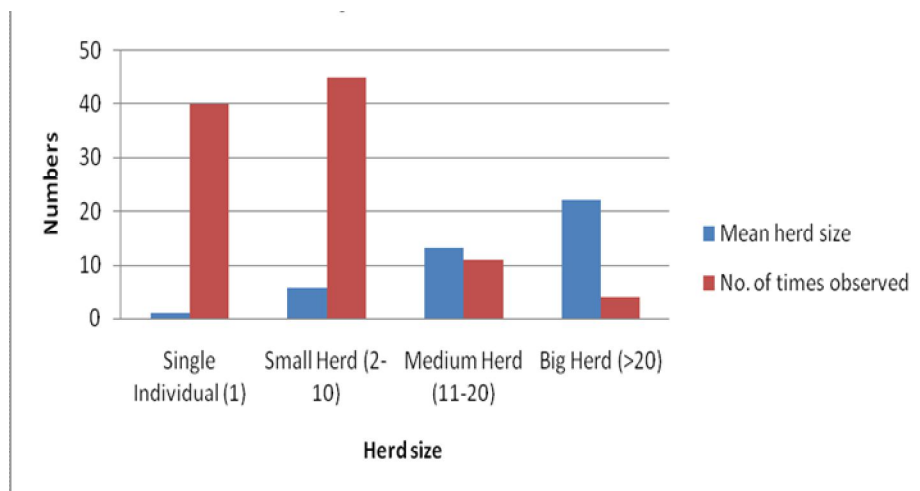**Fig. 2:** Distribution of gaur in different habitats

Fig. 3: Density of gaur in different habitats

Fig. 4: Composition of gaur herd

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