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Research Article

Assessment of the distribution of carnivores and herbivores based on sign survey and line transect method in Segur Plateau, Nilgiri.

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Abstract

Segur Plateau is part of Mudumalai Tiger Reserve; the reserve extends over an area of 321 km^2 and forms a part of the Nilgiri Biosphere Reserve. The sanctuary is located in the Western Ghats, which is one of the 34 Biodiversity hotspots of the world. Population density, distribution pattern of herbivores is very important for conservation and if a herbivore population is present, we need to find carnivores activity of that particular habitat. Both herbivores and carnivore population density are important for management and conserving a particular habitat especially the biodiversity hot spots that sustain the existence of wild animals having a qualified and balanced habitat meeting out the pyramidal quotients that are required for the effective functioning of the biosystem. The line transects and grid survey (sign survey) methodology is used to estimate population densities of both the carnivores and herbivores in segur plateau. Hence, considering the potentiality of long term conservation value and existing and growing human population in the Segur plateau it is essential to know the status and distribution pattern of large carnivores and herbivores for conservation management.

Keywords: Carnivore, herbivores, signs, survey, density.

Introduction

India is a home of over 50% of world population of tigers and Western Ghats is one among the six major landscapes of tiger occupied area (*Jhala et al.*, 2011). Segur Plateau is part of the Mudumalai tiger reserve buffer area and which is intern located in Western Ghats. This landscape has been identified as one of the 34 Biodiversity hotspots of the world and it is also one of the potential area for long-term conservation of tigers and other carnivores in India (Jhala *et al.*, 2011). This area is also connects the Western Ghats with Eastern Ghats with narrow stretches of forest corridors (Sukumar, 1985; Desai, 1991). This area is also center of anthropogenic disturbance due to large concentration of human and livestock population inside as well as on the fringes of the Mudumalai tiger reserve (Silori and Mishra, 1995, 2001). Furthermore

the developmental activities in the form of construction of a series of hydroelectric power stations are also causing serious disturbance to larger mammals especially elephants during their seasonal movements. The developmental activities and increase in tourism attracted people from outside to settle in the corridors and putting additional pressure for the resources such as fuel wood, fodder, grass and a variety of non-timber forest produces. Thus considering the potentiality of long term conservation value and existing and growing human population in the Segur plateau it is essential to know the status and distribution pattern of large carnivores and herbivores for conservation management. This paper describes the carnivores sign evidences and herbivores population density, distribution pattern.

Materials and Methods

Study area:

Segur Plateau is part of Mudumalai Tiger Reserve buffer area and is located in the Nilgiri District of Tamil Nadu (11º 32´ and 11º 42´ N and 76º 20´ and 76º 45´ E). It extends over an area of 321 sqkm and forms a part of the Nilgiri Biosphere Reserve (5520sqkm). The sanctuary is located in the Western Ghats, which is one of the 34 Biodiversity hotspots of the world (Mittermeier *et al.*, 2008). Altitude in the study area varies from 485 to 1226 m above MSL with a general elevation of about 900 to 1000m. The annual rainfall varies from 1001mm to 1648mm. The study area receives rain from both Southwest (May to August) and Northeast (September to December) monsoons.

The study area has three major forest types' namely tropical moist deciduous forest (MDF), dry deciduous forest (DDF) and tropical thorn forest (TF) (Champion and Seth, 1968). The herbivores include elephant (*Elephus maximus*), three species of cervids: chital (*Axis axis*), sambar deer (*Rusa unicolor*) and barking deer (*Muntiacus muntjak*), two species of antelopes: the four-horned antelope (*Tetracerus quadricornis*) and the black buck (*Antilope cervicapra*). In addition predators like tiger (*Panthera tigiris*), leopard (*Panthera pardus*) and wild dog *Cuon alpinus* are found. Segur plateau is threatened by habitat degradation from overgrazing, poaching and human disturbance.

Distribution pattern of carnivores:

Sign survey for determining distribution pattern:

The feasibility of using carnivore signs (scats and scrapes) to generate quantitative indices of abundance that would allow monitoring of the species concerned. Carnivore's signs like scats, scrape and claw markings on tree poles are useful indicators of their presence and are used to derive the relative abundance. Carnivore signs will be recorded in terms of number per km length surveyed (Rodgers, 1991; Uma ramakrishnan, *et al.,* 1999) in the selected roads and foot paths. This method is also used to assess the relative abundance of carnivores in different habitats.

The signs that will be monitored in the study are scats and scrapes as both are discrete events and also clearly visible. Tracks on the other hand are continuous and require additional effort to separate into discrete encounters (ie. Requires some form of measurement or quantifiable criteria). Tracks are also not selected for monitoring as there will be strong temporal variation in the suitability of the substrate to record tracks (wet season will be more conductive to track formation). In the case of scats and scrapes we can reasonably assume that defecation and marking activity will remain equally visible in all seasons. Tracks on the other hand are more easily visible during the wet season when wet soil conditions are much more suitable for track formation and retention (depending on the rainfall). All scats and scrapes are identified in the case of tiger and leopard based on pugmarks that were associated with the scrape or in close vicinity of it.

Large herbivore population estimation:

Densities of wild prey species were estimated using line transects and distance sampling (Anderson *et al.,* 1979; Burnham *et al.,* 1980; Buckland *et al.,* 1993; 2001). The herbivore population were sampled systematically using transect lines. The number of transects lines and replications were determined based on vegetation types and reconnaissance survey and each transect line having 2 km distance. Each transect was walked 6 times from November to December. All transects were walked during morning hours between 06.00 am to 09.00 am. All the transect starting and ending points were marked with the help of Global Positioning System (Garmin72). The total length of line transects was 108 km. In the transect line the details such as time, species, group size, age-sex composition, sighting angle measured using hand held sighting compass (SUNNTO Compass) and sighting distance measured by laser range finder were recorded. Population densities of large herbivores were estimated using the software Distance v.6 Release 2 (Thomas *et al.,* 2006).

Results

The abundance of carnivores were studied through indirect evidences such as pug mark, scrape mark, scat etc in different habitat types. The study area were divided into many grids an each grid indirect evidences of carnivores were carefully observed.

In some grid tiger signs were more frequently observed eg. Congress mattam (regions within the study area), meant that tigers are preferring this area more. On the other hand leopard signs were observed more in chemmanatham (regions within the study area) indicated that leopards preferred or utilized chemmanatham area more than congress mattam. In the case of wild dog (dhole), presences were observed in all the grids indicating those wild dogs were using the entire area and not conspecifics. All three carnivores scat sign evidences were found in more percentages, rake signs were found considerably lower. The tiger sign percentage was 65%, leopard percentages signs occurred 38%, and wild dog signs were 24.6% (Table 1). The tiger pugmark encounter rate is 11.89%, leopard 4.75% and wild dog 4.75%, scrape percentages for tiger 8.72% and leopard 5.55% wild dog were not seen in the area. The tiger scats were found at values of 41.20%, leopard of 27.73% and wild dog of 19.81%. The rake was only observed those caused by tigers at 3.17%.(Table 2). All scats and scrapes were identified in the case of tiger and leopard based on pugmarks that were associated with the scrape or in close vicinity of it.

Table 1 : Total activity Percentage of Carnivores:

Species	Pugmark	Scrape	Scat	Rake	Percentage	
Tiger	15	11	52	4	82	65.0
Leopard	6	7	35	0	48	38.0
Wild dog	6	0	25	0	31	24.6

Table 2: Encounter rates (number per kilometer square) of Tiger, Leopard and Wild dog sign survey

Species	Pugmark	Scrapes	Scat	Rake
Tiger	11.89	8.72	41.20	3.17
Leopard	4.75	5.55	27.73	0
Wild dog	4.75	0	19.81	0

Groups and individual density of potential prey species of large carnivores were estimated along with their percent coefficient of variation, effective strip width and their associated standard error. Prey species were classified into major (chital, sambar, gaur, wild pig, common langur) and minor (four horned antelope, elephant, peafowl, and black-naped hare) based on their significant contribution in the diet of large carnivores. In total 8 prey species were detected on transects over the three month period with a sampling effort of 108 km (Table 3). Prey density estimation were analyzed using Distance software (version 6.0)

Table 3:Density and population estimated for herbivore population during the study period

Name of the Species	Parameter	Point Estimate	Standard Error	Percent coef. Of variation	95% confidence interval	
					Min	Max
Chital	Density	68.0	22.9	33.7	35.3	131.0
	Numbers	21832	7373.2	33.7	11335	42052
Sambar	Density	7.7	1.8	24.2	4.8	12.5
	Numbers	2495	604.3	24.2	1547	4022
Gaur	Density	8.6	1.7	20.8	5.7	12.9
	Numbers	2765	575.7	20.8	1836	4163
Blacknaped Hare	Density	5.31	0.73	13.8	3.9	7.13
	Numbers	1704	235.2	13.8	1269	2288
Elephant	Density	1.7	0.23	13.7	1.3	2.2
	Numbers	538	73.9	13.7	407	712
Wild pig	Density	3.0	0.16	59.9	0.95	10.06
	Numbers	994	65.4	59.9	306	3229

Chital

Chital density was 68.0 individuals/sqkm in the period of November to January. Hazard rate /Cosine model was selected as best fit by the programme distance. Overall population of chital was 21832 in the study area during the period (Table 3).

Sambar

The estimate denstity of Sambar was 7.7 individuals/sqkm programme was selected Neg Exp/Cosine as a best modelfor this specie, the Overall estimated population was 2495. found in the study area during the study period (Table 3).

Gaur

The Density of gaur was 8.6/individuals/sqkm in the deciduous forest. The model selection was Half-normal/Cosine. on the whole, gaur population was 2765. Individuals were found in the study area during the study period(Table 3).

Wild pig

The Density of wild pig was 3.0977/sqkm. Neg Exp/Cosine model was the best fitted. On the whole,number of wild pig was 994. Individuals were found in the study area during the study period (Table 3).

Black napped hare:

The estimated density of black napped hare was 5.31/sqkm. Half-normal/Cosine model was the best fitted. On the whole, populations of wild pigs were 1704 (Table 3).

Elephant:

The elephants are not a prey species for any of the carnivore found in the study area, but their density was estimated in order to understand their co-existence with the prey species, the elephant density was 1.7/ sqkm. The data was best fitted with Uniform/Cosine model. The overall population of elephant was 538 individuals in the study area during the study period (Table 3).
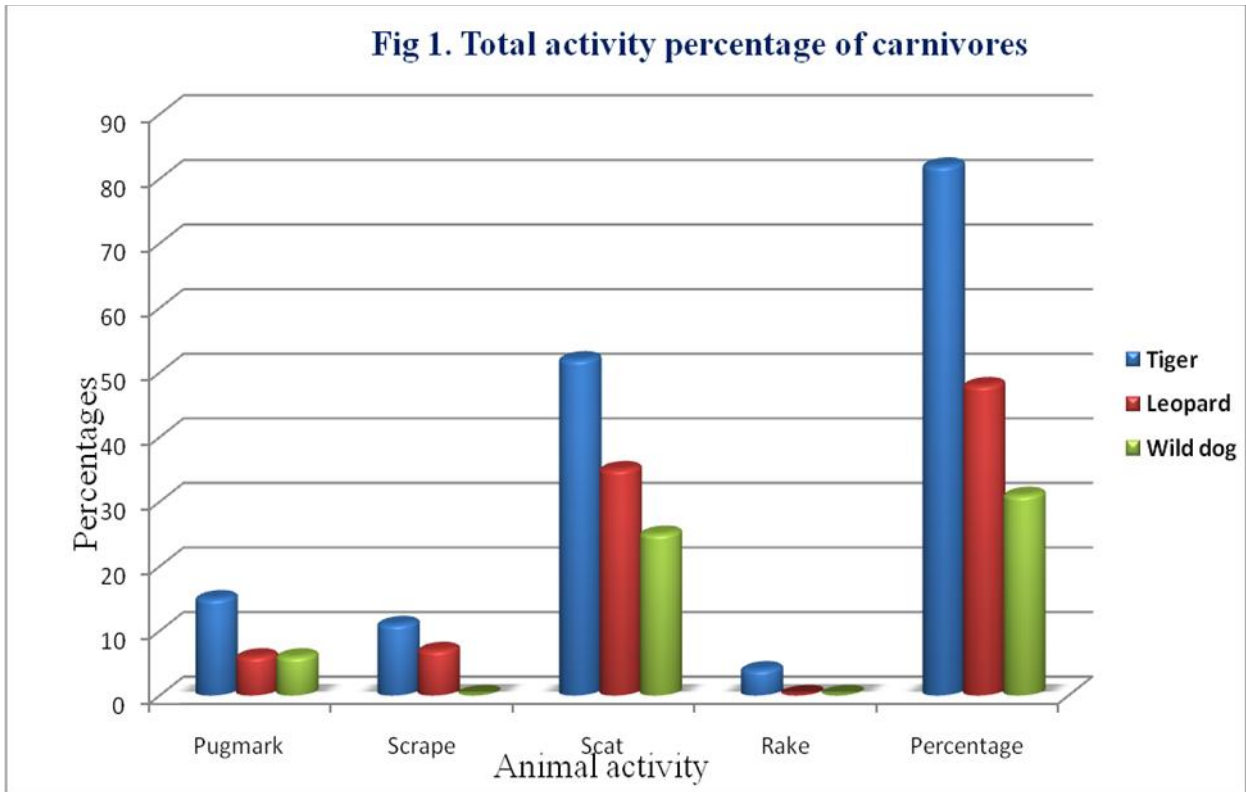

Fig 1. Total activity percentage of carnivores
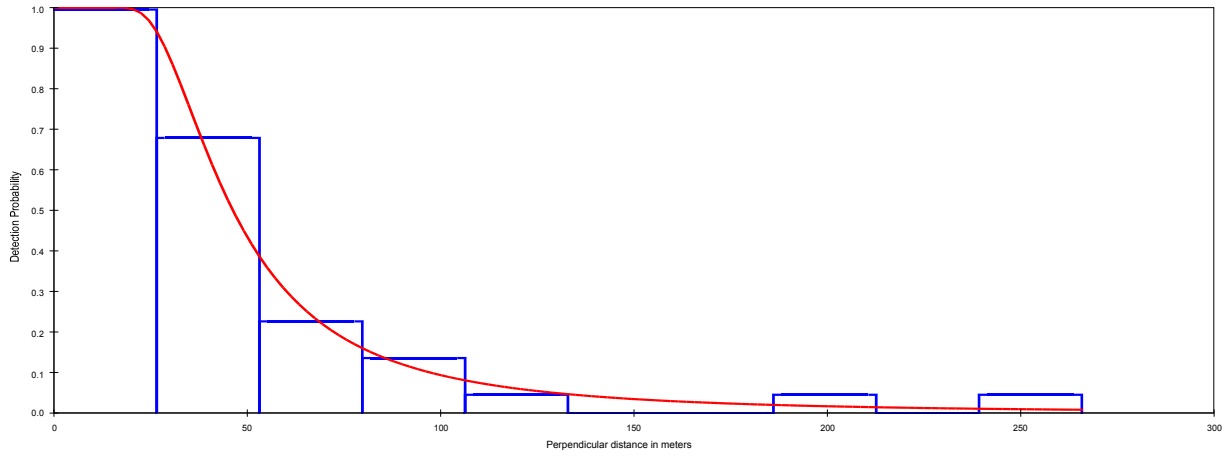
Fig 2. Detection probability of Chital in Segur Plateau
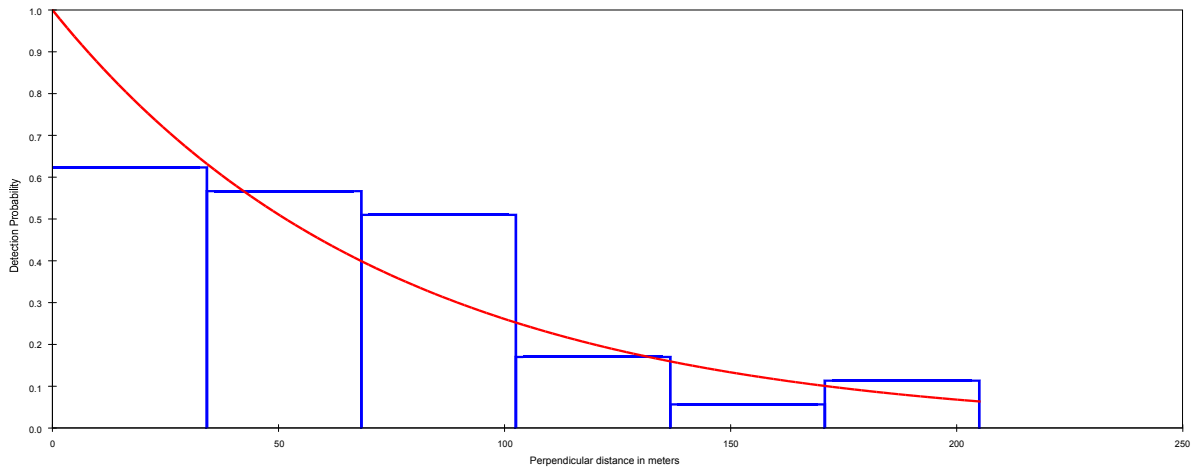

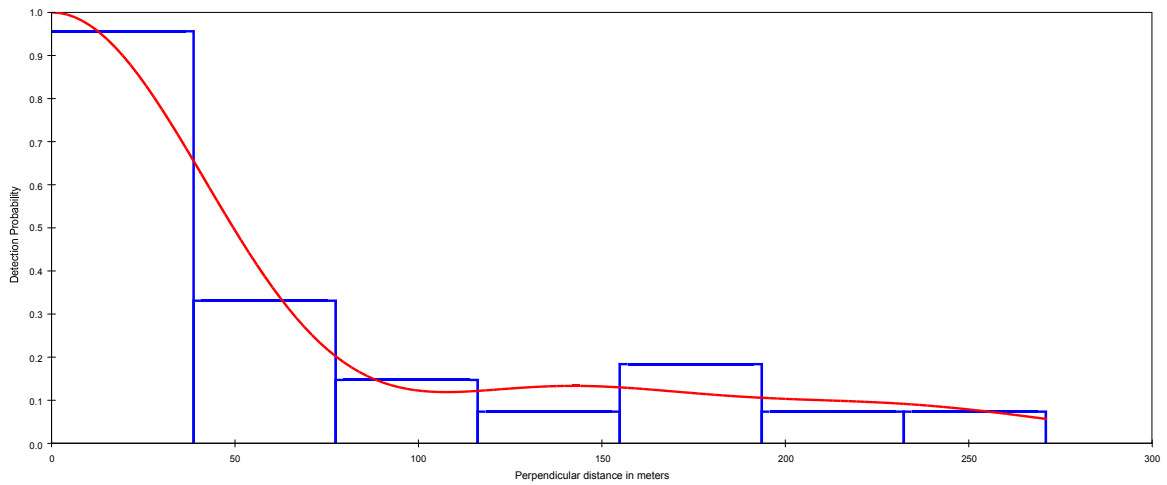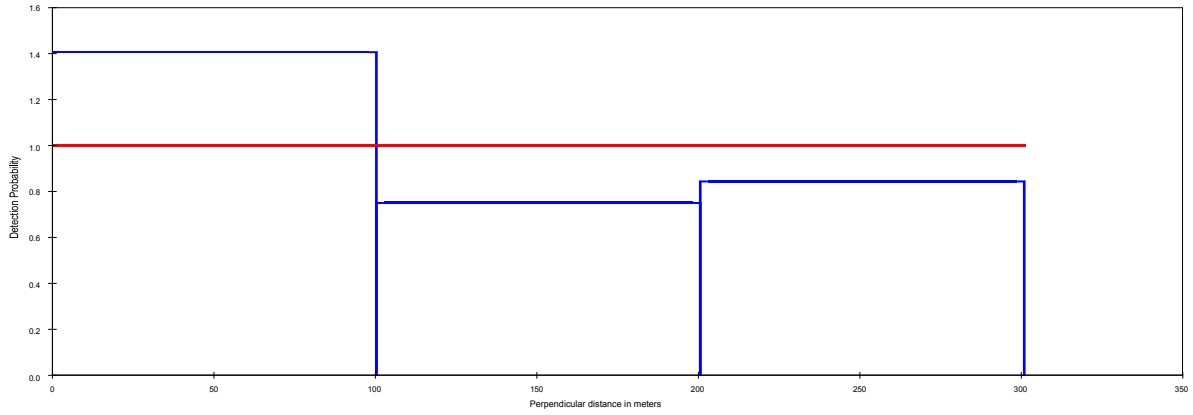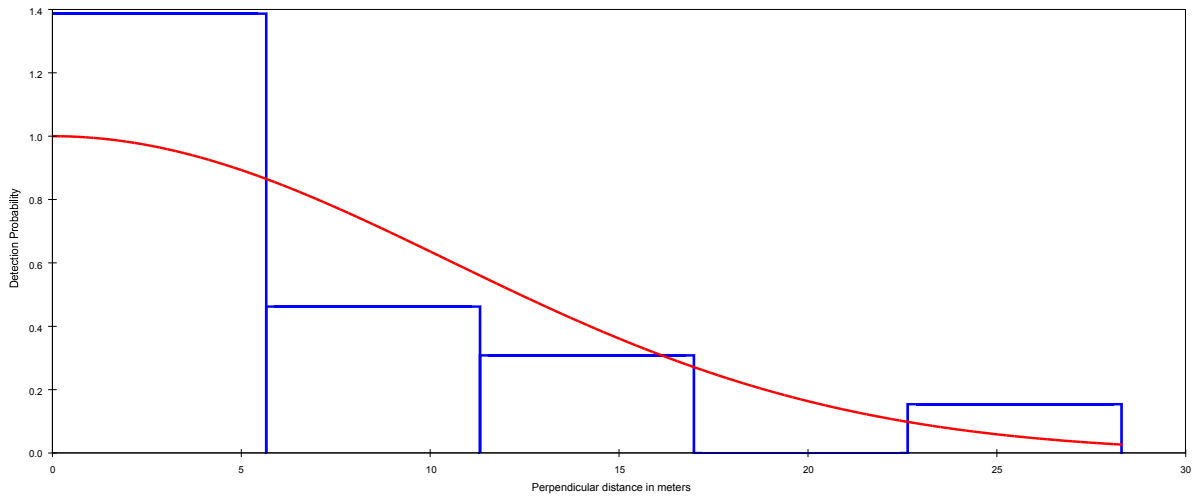## Fig 3. Detection probability of Sambar in Segur Plateau

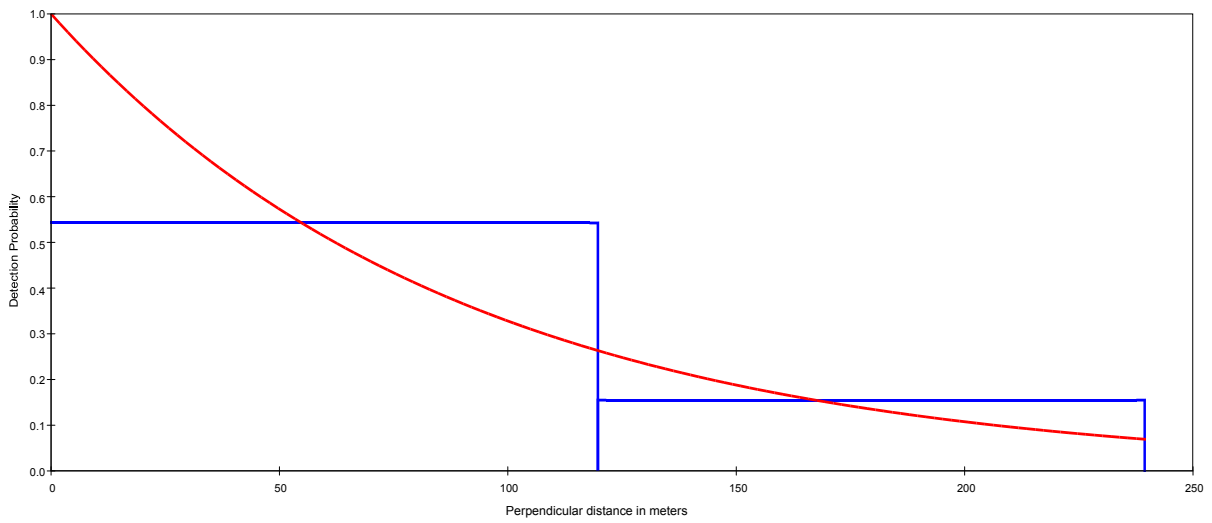## Fig 4. Detection probability of Gaur in Segur Plateau

Fig 5. Detection Probability of Elephants in Segur Plateau

Fig 6. Detection Probability of Black napped Hare in Segur Plateau

Fig 7. Detection Probability of Wild pig in Segur Plateau

Discussion

There are very few studies on habitat use by carnivores based on signs, because signs are difficult to find in most of the carnivores ranges. Johnsingh *et al.* (2004) documented a high use by tiger in Corbett Tiger Reserve (41%) and adjoining forest divisions (Ramnagar Forest Division; 20.7%) based on frequency of indirect tiger signs along 82 km of survey. Segur plateau had an activity percentage 65.

The density of the defecation signs was highest in grasslands because tigers preferred defecating in small dry sand dunes and besides footpaths, both of which were available in grasslands. The fact that most of the tiger kills were found away from open areas is supported by findings of Karanth and Sunquist (2000). Based on tiger signs, Karanth and Sunquist (2000) concluded that most of the tiger attacks (55%) on its prey took place in moist-deciduous habitat type at Nagarhole, India. Reza *et al.* (2001b) found the highest percentage of tracks at waterholes (42%) and lowest percentage on riverbanks (5%). They found only 6% of tracks in forests, but in my study, the highest density of tracks (i.e. 'movement signs' in my study) was found in forests (i.e. 'open grass land' in my study).

Among a few sign studies elsewhere, Sankhala (1978b) reported the distribution and habitat preferences of tigers in India. Based on the distribution patterns of tigers in different habitat types he concluded that moist deciduous forests support over 40% and dry deciduous forests support 30% of the tiger population in India. The preference of the tiger is for the habitat type that not only supports wide prey range and good prey populations, but also ensures freedom from competitive co-predators. Segur plateau is distributed not only with grasslands but also preferred thorn and dry deciduous forest, tiger activity was evident in these places.

Johnsingh (1983) worked on the differential use of habitat by tiger, leopard (*Panthera pardus*) and Asiatic wild dog (*Cuon alpinus*) in Bandipur, India. Out of a total of 219 quadrats, he found predator signs in 138 quadrats. Of the 138, indications of all three predators were seen in 31 (23%) of the quadrats and only tigers were seen in 7 (5%) quadrats. Based on the signs of tiger and leopard, a possible 'intolerance' was suggested between these two species. In 56 quadrats in each of the two habitat types (thin vegetation and

dense vegetation), tiger signs were found in only two quadrats in thin vegetation area, whereas tiger signs were found in 28 quadrats in dense vegetation area. This indicates the preference of tigers for dense vegetation. The result also supported the present conclusion, because the density of tiger signs was higher in grasslands, but there was significant difference of tiger sign density in other habitat types. Tiger activity was found to be 65%, leopard 38% and 24.6% (Figure 1). So tigers have more evidences of their presence in grasslands compared to other two carnivores. Johnsingh (1983) also reported that all 19 tiger kills were found in thorn areas. The present result also support this, because the highest density of feeding signs (i.e. kill remains) was in thorn forest areas. In Kerinci Seblat, Indonesia, Linkie *et al.* (2003) recorded the occurrence of tiger signs (pugmarks, scats and sightings). Of 141 locations surveyed, tiger signs were found in 126, 43 of which were outside of the National Park. Tiger signs were found in seven out of nine logging concessions surveyed. Tigers were recorded at altitudes of 502,440 m, and across all the major habitat types. In the segur plateau, a wide distribution of tiger signs in all the major habitat types was found. It indicated that the tiger's adaptability in different habitat types was very high. The tiger pugmark encounter rate was estimated 11.89%. According to Schaller (1967), Sunquist (1981), and Johnsingh (1983) tigers do not normally kill prey in open habitats including short grass. There were no hunting signs on the river areas and short grass. Additionally the carnivores scat were mostly seen in the thorn and dry deciduous forests, scat encounter percentages was estimated tiger 41.20%, leopard 27.73% and wild dog 19.81%.

Tigers preferred soft-barked trees for scratching, because it was probably more comfortable and more effective to use soft-barked trees to mark the territory and sharpen the claws. This emphasizes the importance of conserving the entire landscape for the conservation of the tiger, a soft-barked tree is a minor requirement of the tiger; we are yet to know other minor requirements. Both male and female tigers use scratching to mark their territories (Smith *et al.* 1989). This action perhaps also sharpens the claws by peeling and the conclusion of this study regarding tiger scratches were similar to the conclusion of Kotwal and Mishra (1995) that trees with soft bark having a good amount of sap were more frequently scratched than those having rough bark, though the latter were more

abundant. In Kanha, India, Kotwal and Mishra (1995) found that the girth of marked trees varied between 37-324 cm. The height of scratches from the ground level varied between 0.7-2.7 m, which was higher than the height recorded in this study .

The high abundance of different prey species in the present study may be attributed to the availability of variety of vegetation types ranging from dry thorn forests to grass land, availability of food plants, water resources and forest protection. Chital, which were observed to be the most abundant prey species in the study area, were largely found in forest edges having palatable grass species as undergrowth. The study area has good network of roads and fire lines creating a mosaic of openings, an optimal habitat for chital. Chital is known to prefer ecotone or forest edges (Schaller 1967; Johnsingh and Sankar, 1991). It was also found to be the dominant prey species in Bandipur (Johnsingh 1983) and Nagarhole (Karanth and Sunquist 1992) in India and many other habitats. The densities of chital in the study area are comparable to the findings of (Varman and Sukumar 1995) and they estimated a density of 25/sqkm in Mudumalai. (Karanth and Sunquist1995) estimated a density of 4 /sqkm in Nagarhole. A similar survey of prey densities conducted in Bandipur revealed an estimated density of 44 /sqkm (Johnsingh, 1983). We estimated chital density was 68.0/sqkm, indicating a high population of chittal in segur plateau compared to other herbivores (Figure 2).

The estimated sambar density was 7.7 /sqkm and it was mostly found in the grass land area and next to water beds (Figure 3). Eisenberg and Lockhart (1972) reported that water holes are places where sambar populations come together in late evenings to form temporary aggregations before dispersing for food. In segur plateau large aggregations were seen near river area, swampy grasslands. Johnsingh (1983) also recorded large association of sambar near water holes and feeding sites in Bandipur recording a density of estimated 10.0/sqkm higher than the estimation.

The mega herbivore gaur density was estimated 8.6/ sqkm due to open grass(Figure 4) .In Western Ghats Wynaad – Nagarhole – Mudumalai – Bandipur complex has the most extensive existing stronghold of gaur are in good numbers (Ranjitsinh 1997, Sankar *et al.*, 2001). Rinderpest disease heavily suppressed the

population of gaur in Bandipur and Mudumalai in 1968 and Periyar in 1974-75 (Ranjitsinh 1997).

Accorting to Kumaraguru *et al* 2010 elephant density was estimated with Dindugul forest division (0.76 /sqkm) having more than double the density of Theni forest division (0.26 /sqkm). Our study area density higher than as 1.7/sqkm was estimated mostly seen in the deciduous forest (Figure 5). The black napped hare density was estimated 5.31/sqkm (Figure 6). The observed black-napped hare densities are low in the study area and the reason for the same may be attributed to nocturnal habitats of this species (Varman and Sukumar 1995).The wild pig density was 3.099/sqkm and is estimated lower than Rao (1991) from Sariska Tiger Reserve, Rajasthan in the range of 18.7 ± 12.3 for winter and 26 ± 15.9 ($\pm$ SE). The wild pig mostly observed in the near village transect line because attraction of crop in agricultural field (Schultz 1986) the result also similar (Figure 7).

Conclusion

The distribution and the density of carnivores and herbivores give a bright scenario of the situation that a habitat is governed. However, the individual animal counts should be carried out to not overlap the field signs that are caused by the same animal. Further, importance to individual species with the specifics including the day to day meteorological, physiological concerns may be pivotal in arriving rigid conclusions.

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