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Abundance of Large Carnivore and its Prey Species after Removal of Cattle Grazing in Mundanthurai Plateau of Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu, India

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Abstract

Large carnivores are experiencing massive decline in their population and abundance due to loss of habitat and loss of prey species. The present study was carried out in Mundanthurai Pleateu of Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu, India. In Mundanthurai Plateau, Tiger *Panthera tigris* has been absent in past two decades which is linked with low density of large ungulate prey species such as gaur and sambar. In this study we examined the status of large carnivore and prey species after the removal of cattle grazing in the plateau. The study reveals that the overall density of ungulate prey species was 12.4 ± 1.5/Km^2 and gaur density found to be 3.37 ± 1.40/Km^2. The available prey biomass of 3282.02 kg can support around 11 tigers/100 Km^2 and it may be lower due to biomass which is shared by other sympatric carnivores. The present estimated leopard density in the plateau is 24.32 ± 4.38 using camera traps spatially explicit capture-recapture method. Overabundance of leopard may be due to the absence of tiger in the plateau and we have confirmed the presence of one male tiger in the plateau so far. The present study may provide baseline information on monitoring tigers and co-predators in the Mundanthurai Plateau of Kalakad Mundanthurai Tiger Reserve.

Keywords: Prey species; Biomass; Western Ghats; Mundanthurai plateau

Introduction

The abundance of larger carnivores is directly related to the large herbivore abundance and its distribution [1,2]. Terrestrial mammalian prey is important to maintain the large carnivore population and insufficient prey will leads to locally extinction of the carnivore species [3]. For example, the decline in tiger population worldwide mainly liked with prey density [4] along with habitat loss and poaching [5]. The Ungulate density is the key determinants for large felids [6] and in majority of the Indian forest large ungulates play a major role in shaping the carnivore communities especially in South, Central and Eastern Indian forests [7,8]. Prey preference of large carnivores such as tiger *Panthera tigris* mainly depending upon the prey size and age [7] and fluctuation in prey abundance may change the rate of prey consumption of mammalian vertebrate predators [9].

The present study was conducted in Mundanthurai Plateau of Kalakad Mundanthurai Tiger Reserve, Tamil Nadu. Past studies imply that absence of tiger in the Mundanthurai plateau of Kalakad Mundanthurai Tiger Reserve, Tamil Nadu which is mainly linked with low density of large herbivores [4] like gaur and sambar. After the year of 2000, cattle grazing was banned from the Plateau and the recent surveys revealed the movement of larger prey in plateau and its increased abundance. In the present study, we examined how, ban on cattle grazing is influenced the prey species recovery in Mundanturai plateau. The major question here is to answers, are there enough prey biomass in Mundanthurai Pleateu to support large carnivores? What is population status of sympatric large carnivores such as Tiger *Panthera tigris*, leopard *Panthera pardus*, dhole *Cuon alpinus* and sloth bear *Melursus ursinus* in the Mundanturai plateau.

Study area

The study was carried out intensively in Mundanthurai plateau (8° 23'- 9° 0' N and 77° 8'- 77° 33' E) of Kalakad Mundanthurai Tiger Reserve, Tamil Nadu which is situated in the Ashambu Hills of the southern Western Ghats (southern India), with core area of 895 km^2. This region is topographically diverse and supports vegetation such as dry thorn forests, deciduous forests, grasslands and wet evergreen rain forests. It is a priority area for conservation of its rich floral and faunal diversity, both in terms of species richness and endemism. The forests of the Reserve are important catchment for as many as fourteen rivers and streams originating from the reserve, hence is also called a River Sanctuary [10]. KMTR also supports viable populations of endangered mammals such as the Tiger (*Panthera tigiris*), the Asian elephant (*Elephas maximus*) and the endemic Lion tailed Macaque (*Macaca silenus*) [11]. It is the only plateau in KMTR with varying altitudinal range from 180 m to 220 m. Annual rainfall averages about 1189 mm. Dry deciduous forests, riparian fringe forest, plantations and thorny scrub forests collectively comprise the most prevalent habitat types in the plateau (Figure 1).

Methodology

Prey estimation

Transect method [12,13] was used to estimate densities of prey species in the study area. This method has been widely applied to estimate densities of prey species [6,7,14-17]. Totally five line transects of varying length from 1.5 to 2.0 km were laid in the study area covering all major vegetation types to ensure uniform distribution without leaving any large gaps between transects. The total transect length of 50

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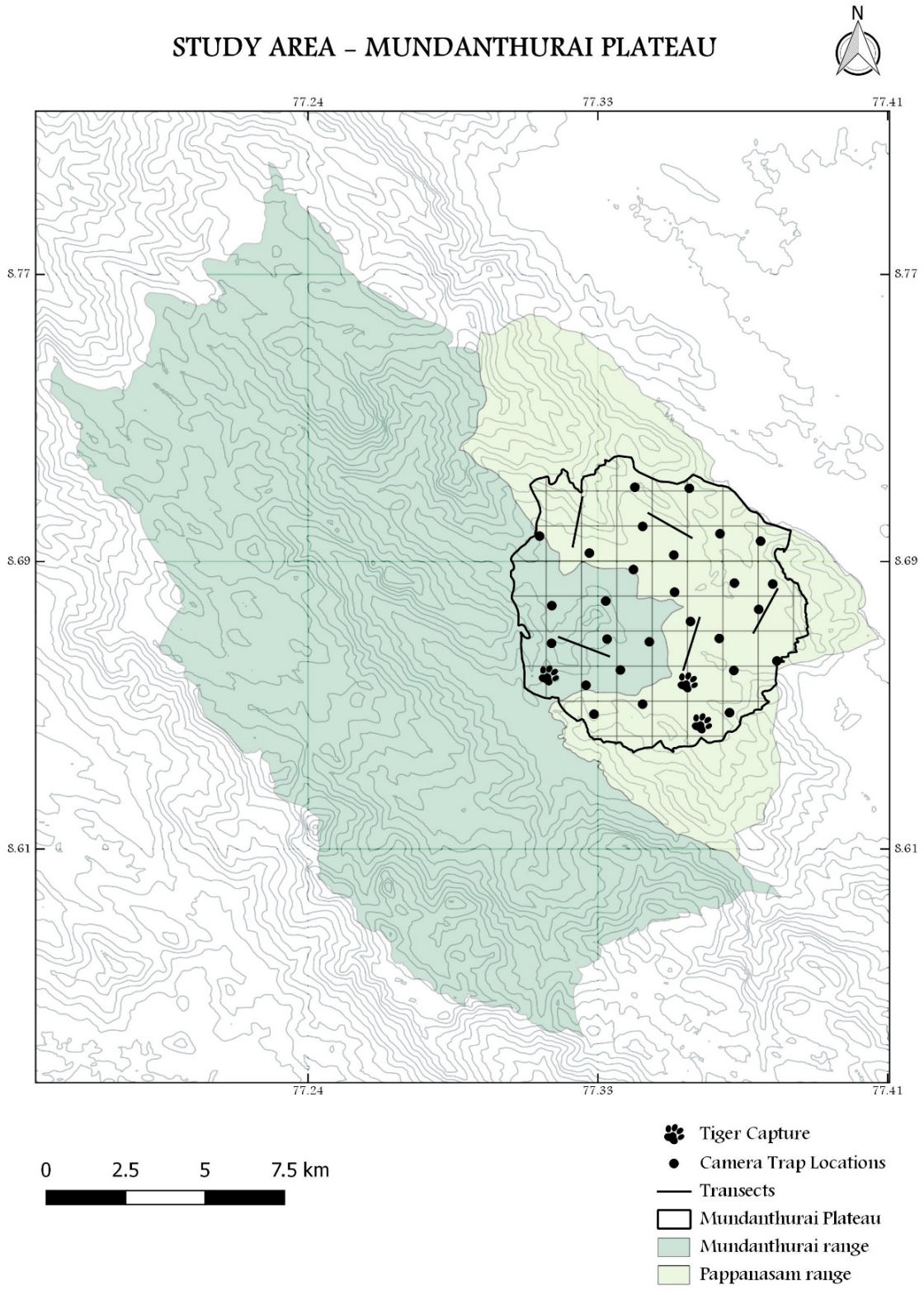

Figure 1: Study area map showing the Camera trap and line transects locations in the Plateau.

km was monitored five times during the beginning of the day (06:30-09:00 hrs). For each sighting along transect, the following parameters were recorded:

1. Sighting angle using a hand held compass
2. Sighting distance using a range finder (Bushnell)
3. Group size
4. Sex and age class of individuals (whenever possible).

For each prey species sighting on a transect, the following were recorded:

1. Total number of individuals
2. Animal bearing
3. Angular sighting distance.

Prey density was calculated using the program Distance 6.0 [18]. Density was calculated after 1% truncation of the farthest sighting data from line transect. Different detection functions were fitted to the observed data and the best model was selected on the basis of the lowest Akaike Information Criterion (AIC) values [12,13]. To achieve reliable estimates and model detection functions, a minimum of 40 observations are required. Chital, sambar, gaur, wild pig, and langur are substantially active in the morning, therefore their density and available biomass were estimated.

Camera trap survey

We intensively monitored prey and predator population using camera traps in KMTR. The camera traps were placed in entire Mundanthurai plateau of KMTR and the plateau was gridded by 2 km × 2 km (n=30) and each grid was placed with pair of Cuddy back camera. The camera was placed in metal cage so as to avoid the damaged by Asiatic elephant or being theft. We maintained inter camera distance of 1.5 km to 2 km and the cameras were active for 24 hrs. Capture-Mark-Recapture method was used for individually identifiable species such as Tiger and leopard and Photographic encounter rate was used for individually non identifiable species like dhole and sloth bear. Lowest AIC value was considered best for parameter estimates in program MARK [19]. To estimate the population density of leopard program DENSITY 4.4 [20] was used. The leopard density (± SE)/100 km^2 using 1/2 MMDM and MMDM and Maximum Likelihood methods were estimated.

Results

Prey density and prey biomass

A total of 50 Km transects were surveyed and several prey species were detected. Density estimates for five potential prey species were computed (Gaur, Chital, Sambar, Nilgiri langur, Wild pig, and Jungle fowl). The overall density of ungulate prey species was 12.4 ± 1.5/Km^2 and the density of sambar (4.59 ± 1.25/Km^2) was highest followed by gaur (3.37 ± 1.40/Km^2) and wild boar (3.11 ± 1.67/Km^2). We surveyed entire Mundanthurai plateau and were able to distinguish nine herds of chital with 70 -80 individuals. The herd size varied from 3-12 individuals and density of chital was 1.33 ± 0.43/Km^2. The density of jungle fowl was 33.89 ± 15.04/Km^2. The total available prey biomass in the study area was estimated to be 3282.02 kg. The estimated mean biomass/sq.km of different prey species in the study area was chital 46.87 kg, gaur 1011 kg, sambar 688.5 kg, nilgiri langur 64.62 kg and wild pig 124.4 kg.

Large carnivores abundance

The total sampling effort of 1,800 trap nights for 60 days yielded 9 photographs of tiger (five right flanked and four left flanked), 148 photographs of leopard (74 right flanked and 74 left flanked), dhole 481 and sloth bear 89 photographs. One individual tiger was identified from both right and left flank photos. Twenty-three individuals of leopard were identified from the left flank photos and twenty individual leopards from the right flank photos.

A total of 77.6 Km was surveyed for large carnivore signs during the study period. The study recorded a highest sign encounter rate for sloth bear (0.70/km^{-1}), followed by leopard (0.67/km^{-1}) and dhole (0.41/km^{-1}) within the Mundanthurai plateau. Tiger signs were also recorded during the survey. Sign survey results showed the presence of all three large carnivores (Sloth bear, leopard and dhole) across all vegetation types of the plateau. The highest encounter rate of carnivore was recorded in dry deciduous forest (0.79/km^{-1}) followed by scrub jungle (0.63/km^{-1}), riparian forest (0.32/km^{-1}) and plantations (0.06/km^{-1}) (Table 1).

The leopard density ranged from 16.62 to 27.36 individuals 100 km^2 using different statistical methods. Statistical tests for population closure supported for leopard is P=0.97 (Table 2).

Mean photographic encounter rate (no of photo captures/100 trap nights) was calculated for tiger, leopard, dhole and their prey species. Among the carnivores dhole (1.14 ± 0.24) has highest photographic encounter rate followed by leopard (0.44 ± 0.08) and tiger (0.03 ± 0.02).

Species	Total Effort (Km)	Model	No of group	ESW ± SE	P	Dg ± SE	D ± SE
Gaur	50	Uniform/Simple Polynomial	8	47.93 ± 10.24	0.98	1.66 ± 0.43	3.37 ± 1.40
Sambar	50	Uniform/Simple Polynomial	10	32.11 ± 3.84	0.64	3.11 ± 0.78	4.59 ± 1.25
Wild boar	50	Uniform/Simple Polynomial	6	39.04 ± 12.94	0.84	1.28 ± 0.71	3.11 ± 1.67
Nilgiri Langur	50	Uniform/Simple Polynomial	8	62.24 ± 6.48	0.77	1.28 ± 0.67	7.18 ± 3.57
Jungle fowl	50	Half normal/Cosine	39	12.44 ± 1.59	0.5	-	33.89 ± 15.04

Table 1: Prey density estimation in Mundanthurai Plateau. ESW=Effective stripe width; SE=Standard error; G=Group size; Dg=Group density; D=Individual density km^2.

Species	No of individual captured	Best Model	Methods	P hat	N ± SE	ETA	D ± SE
Leopard	23	Mo	1/2 MMDM	0.05	24.0 ± 1.3	87.72	16.62 ± 3.42
			MMDM			144.435	27.36 ± 3.37
			Max likelihood				24.32 ± 4.38

Table 2: Population estimation of leopard in the intensive camera survey area. Mo=Null model; 1/2 MMDM=Half mean maximum distance moved; P hat=Capture probability; N=Population size; SE=Standard error; MMDM=mean maximum distance moved; ETA=Effective trapping area; D=Number of individuals/100 km^2.

Among the prey species sambar (1.94 ± 0.78) has highest photographic encounter rate followed by gaur (1.59 ± 0.49), wild pig (1.45 ± 0.31) and peafowl (0.95 ± 0.27).

Discussion

The present study was conducted to estimate the abundance and densities of large carnivore and its prey species in Mundanthurai Pleateu after the ban on cattle grazing. Since last two decades' tiger was absence in the pleateu though its connected with tiger presence area. Predator densities have been attributed to habitat availability [21], prey availability [22] and protection level [23]. The high abundance of different prey species in the present study may be due to the availability of space and food plants. Ban on cattle grazing would have been opened up variety of habitat availability to the native ungulate species, this could probably have led to the high abundance of herbivore species. Sambar has been observed to be the most abundant prey species in the study area followed by gaur. The density of gaur is high in Mundanthurai plateau and the movement of gaur was recorded up to lower dam of Papanasam range. Totally seven different herds of gaur were found in the plateau and the number of individuals vary from 1 to 17. The Mundanthurai forest area has become so thick, wooded and presence of *Strobilanthes sp* also may support the guar presence. *Strobilanthes sp* is observed to be preferred food plants of gaur and this indicates the qualitative improvement of habitat. However, the extent of gaur presence insists the establishment of tiger in Mundanthurai plateau in near future.

The chital population seems to be decreasing due to the declining open grasslands which have been replaced by thick vegetation or by fire resistant grass species like lemon grass and dense thorny vegetation in many parts of the dry deciduous habitat. It has been observed that chital do not prefer lemon grass dominated grasslands. The finding of this study suggests that the density of prey species is lower than other deciduous forests in India, however the low density of large prey may not adversely affect the leopard population. Leopards are opportunistic and are very flexible in their diet and can thus survive in a region where ungulate densities are low. Their ability to feed on both small and large prey, to climb trees and scavenge [24] helps to survive in a highly disturbed habitat where prey is scarce. Leopard density determined in our study is fairly high in comparison to other reported estimates in the country [25-27] and it can survive with smaller prey such as rodents and langurs [28]. Though the study could not estimate the actual density of Asiatic wild dog, there could be 5 packs (Avg pack size 6 ≤ 3) operating in the Plateau area. The overall estimated prey biomass is 3282.02 kg/sq.km which easily can support around 11 tigers/100 km^2, since the tiger shares the biomass with co-predators it can be low in abundance. Though, present study has confirmed the movements of tiger in the plateau, till it is not assured whether the tiger has established its territory since the recapture rate is low. However, there are higher chances of territory establishments of dispersed tigers in the Mundanthurai Plateau. Given a chance of tiger establishing its territory, further study would be requiring to understand the intra-guild competition between these two predators. If tiger forces leopard to periphery [29], there might be a chance for human leopard conflict in the fringe villages.

Kalakad Mundanthurai Tiger Reserve being the most important conservation unit linking Western Ghats requires habitat protection along with regular monitoring of large carnivores and their prey population with the incorporation of robust scientific methods. This study has provided important baseline information for long-term monitoring of tigers and co-predators in Kalakad Mundanthurai Tiger reserve.

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