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# SEASONAL OCCURRENCE OF AVAILABLE PREY DENSITIES IN SIMILIPAL TIGER RESERVE, MAYURBHANJ, ODISHA, INDIA

Anup Kumar NAYAK[1], Satya Prakash YADAV[2], Satyaranjan BEHERA[1*]

[1]Similipal Tiger Reserve, Baripada, Odisha-757002
[2]National Tiger Conservation Authority, New Delhi, India

***Abstract***

*Prey densities were estimated in Similipal Tiger Reserve, Odisha, India from January 2012 to October 2012 by applying line transect distance methods. Season wise available prey density data was collected. The pre-monsoon and Post-monsoon seasons prey data was analyzed separately. In total, seven prey items were found on the transect lines from various parts of the reserve core and buffer area in an area of 2530.41 km$^2$. The common langur (Semnopithecus entellus) and rhesus macaque (Macaque mulata) population densities in the study area were the highest, followed by chital (Axis axis), wild pig (Sus scrofa), sambar (Rusa unicolor), barking deer (Muntiacus muntjac) and mouse deer (Tragulus kanchil). Common langur population was highest 10.2±2 SE/km$^2$ in pre-monsoon and 16±2.7 SE/km$^2$ in post-monsoon whereas mouse deer population was found to be low 0.6±0.2 SE/km$^2$ in pre-monsoon. Our preliminary results may indicate that in Similipal the density of the overall ungulates and each species seems to be fewer compared with other landscapes. Continuous prey population monitoring is going on in Similipal Tiger Reserve which may indicates the rising of prey populations in reserve subsequently. However, only one year data is presented here to know the preliminary prey status of this tiger reserve. Further analysis is under consideration in due course of prey population study. Therefore, the proper management plan is required for better conservation of the prey and their predator in Similipal Tiger Reserve.*

***Keywords:*** *Prey; Density; Transect; Similipal Tiger Reserve; Odisha*

## Introduction

Prey species can influence the population dynamics of their predators. Therefore, to conserve and manage endangered or threatened species, it is crucial to understand prey densities in their natural habitat [1]. Prey selection by large carnivore is a complex phenomenon [2, 3, 4]. In forested habitat the actual estimation of prey density, is a difficult task. There are several hypothesis that have been proposed to explain prey selection by predators [5]. These hypothesis pertain to ultimate causal factors such as energetic cost-benefit involved [6, 7] as well as to proximate mechanisms of selection such as search images or prey vulnerability [8, 9, 10]. The estimation of population size and status assessment of prey density in forested habitat is important for wildlife managements. Although ungulate (prey) census may be relatively easy in open grassland or meadow areas, it is much harder in forest habitats [11]. However, in recent past, continued depletion of prey population and fragmentation of natural habitats, apart from

* Corresponding author: behera.satyaranjan@gmail.com

poaching is a serious issue acknowledged by conservationists as well as managers. These two major factors led to the present dilemma of tigers in the wild and will determine its survival in future [12, 13].

In this connection we evaluated the ungulates prey density in Similipal Tiger Reserve in core as well as buffer area through distance sampling method, seasonal comparisons among available ungulate prey density, which is urgently required for survival of the large predators and their co-predators in terms of their available food resources.

There is a paucity of information regarding the estimate of population density of wild ungulates. The attempt was made to estimate the prey density in core as well as buffer area of Similipal Tiger Reserve in two different pre-monsoon and post-monsoon seasons. However, in recent past the prey density was estimated in Similipal Tiger Reserve, where the overall density to be 4.5/Km$^2$ [14]. Such information would be useful for other state wildlife agencies and wildlife managers that are charged with managing prey populations.

## Materials and Methods

### *Study Area*

The Similipal Tiger Reserve (Figure 1) is in the central part of the Mayurbhanj district of Odisha State, Eastern India (20° 17' to 22° 34' N and 85° 40' to 87° 10' E) covering an area of 5569km$^2$ which forms the one of the mega biodiversity zones of the country with rich flora and fauna, with Core Zone of 1194.75km$^2$, Buffer Zone 1335.66km$^2$ and Transitional zone 3038.39km$^2$. Similipal is largest Sal bearing forest. It is also a Tiger Reserve, a Sanctuary, and a proposed National Park. The landscape of Similipal encompasses numerous rolling hills covered with tropical semi-evergreen forest, tropical moist deciduous forest, dry deciduous hill forest, high level Sal forest, grass land and savannah [15]. There are still 3 villages inside the core area, 65 villages in the buffer zone and 1200 villages in the transitional zone of tiger reserve with a population of about 4.5 lakhs. The climate of the Similipal is tropical. Three distinct seasons are experienced inside the Similipal during the year. They include the rainy season (mid June till mid October), winter (mid October to February) and summer (March to mid June).

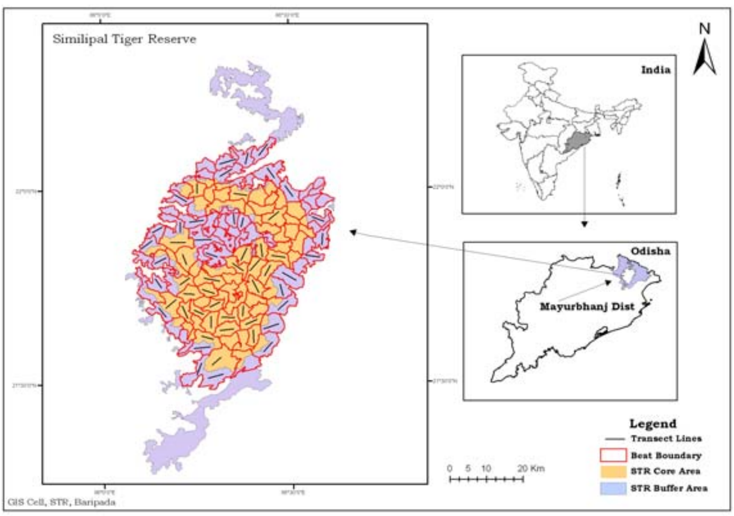


**Fig. 1.** Map of Similipal Tiger Reserve, Odisha, and showing line transects.

The annual rainfall ranges from 1200mm to 2000mm. The temperature varies from 5°C to 40°C. The southern and western portions are cooler and north-eastern portion are warmer. Periodic earth tremors, thunder storms during the rains and dust storms in late May and early June are other characteristic features of Similipal. The landscape comprises 1076 plant species with 94 species of orchids [16]. The identified species of fauna in Similipal includes 55 species of mammals, 304 species of birds, 62 species of reptiles, and 20 species of amphibians [17].

The major prey species found here are chital (*Axis axis*), sambar (*Rusa unicolor*), gaur (*Bos gaurus*), barking deer (*Muntiacus muntjac*), mouse deer (*Tragulus kanchil*) and wild pig (*Sus scrofa*). The carnivore species in Similipal are tiger *(Panthera tigris*), leopard (*Panthera pardus*), jackal (*Canis aureus*), hyena (*Crocuta crocuta*), wolf (*Canis lupus*), jungle cat *(Felis chaus*) and leopard cat (*Prionailurus bengalensis*). Primate species found are common langur (*Semnopithecus entellus*) and Rhesus macaque (*Macaque mulata*). The Indian porcupine (*Hystrix indica*), blacknaped hare (*Lepus nigricollis*), flying fox (*Pteropus giganteus*), flying squirrel (*Petaurista petaurista*), giant squirrels (*Ratufa indica*) and Indian pangolin (*Manis crassicaudata*) also occur in this Tiger Reserve. Human habitation is found in the intensive study area; however three villages reside in the core area.

***Methods***

Line transect method by distance sampling [18, 19] was used to estimate densities of prey species in the study area. This method has been widely applied to estimate densities of prey species in tropical forests [20, 5, 21, 22, 23, 24, 25, 26]. We did consider forest beat as sampling unit and laid transects on each beat (n = 73) and (n = 104) of the intensive study area in core as well as buffer area. One hundred seventy seven line transects whose length is 2km in each (Figure 1) were walked three times (total effort = 1062km) during pre-monsoon and post-monsoon for 2012. Transects were walked early in the morning in the first two hours after the sunrise when the animals are most active [27].

Potential prey species of large carnivores were recorded during transect line along with following parameters such as species, cluster size, animal bearing (with compass) and angular sighting distance (using laser range finder). The density of prey species was calculated using software DISTANCE *Version 4.0* [28]. Student t-test [29] showed significant difference ($p<0.05$) on visibilities of sighting distance of prey species between two seasons (pre-monsoon and post-monsoon) but not between same season of the year. Hence we pooled pre-monsoon and post-monsoon line transects data separately. The density estimated of major prey species such as common langur, rhesus macaque, chital, sambar, wild pig, barking deer and mouse deer. Although gaur, elephant, hare and pea fowl were sighted on the line transects in both pre-monsoon and post-monsoon their densities were not estimated because of low sample size. No livestock were sighted on transects. Line transect data were analyzed using the software DISTANCE for each ungulate species. We fitted several plausible detection probability models generated under hazard-rate, half-normal and uniform detection functions to the observed distance data, to select the most appropriate models [30]. We generated estimates of detection probability, animal cluster densities, cluster size and animal densities [31].The software fits a series of functions to the distance data and the model best fitting the data was selected by the Akaike Information Criterion [30]. There are a number of important assumptions regarding the use of *Distance* sampling and key one is that all animals on the line are detected.

## Results

The estimated individual prey species densities are given in Table 1. Common langur was found to be the most abundant prey species in the intensive study area (10.2 ± 2SE/km$^2$ in pre-monsoon and 16 ± 2.7SE/km$^2$ in post-monsoon) followed by rhesus macaque (6 ± 1.6SE/km$^2$ in pre-monsoon and 7 ± 1.4SE/km$^2$ in post-monsoon ), chital (5 ± 2.2SE/km$^2$ in pre-monsoon and observed data not sufficient in post-monsoon), wild pig (3.2 ± 0.7SE/km$^2$ in pre-monsoon and 4.8± 1SE/km$^2$ in post-monsoon), sambar (2.8 ± 1.8SE/km$^2$ in pre-monsoon and 4± 1.8SE/km$^2$ in post-monsoon), barking deer (1.6 ± 3.2SE/km$^2$ in pre-monsoon and 1.6±0.4SE/km$^2$ in post-monsoon), mouse deer (0.6 ± 0.2SE/km$^2$ in pre-monsoon and data not sufficient in post-monsoon) (Table 1).

**Table 1.** Seasonal variation of prey densities in Similipal Tiger Reserve, Odisha (2012)

| Prey | Observations (Pre-monsoon) | Observations (Post-monsoon) | D±SE (Pre-monsoon) | D±SE (Post-monsoon) | DS±SE (Pre-monsoon) | DS±SE (Post-monsoon) | AIC (Pre-monsoon) | AIC (Post-monsoon) |
|---|---|---|---|---|---|---|---|---|
| Barking Deer | 230 | 211 | 1.6±3.2 | 1.6±0.4 | 1.4±0.4 | 1.4±0.5 | 634.4 | 443.2 |
| Chital | 40 | 36* | 5± 2.2 | | 5.4±0.7 | | 104.5 | |
| Sambar | 91 | 89 | 2.8±1.8 | 4± 1.8 | 2.3±0.1 | 2.6±0.2 | 262.4 | 191.4 |
| Mouse Deer | 43 | 23* | 0.6±0.2 | | 1 ± 0.3 | | 43.3 | |
| Wild Pig | 145 | 131 | 3.2±0.7 | 4.8± 1 | 4.6±0.3 | 4.2±0.2 | 466.6 | 324.8 |
| Rhesus Macaque | 60 | 59 | 6 ± 1.6 | 7± 1.4 | 8.5±0.8 | 8.2±0.8 | 151.8 | 107.6 |
| Common Langur | 248 | 227 | 10.2 ±2 | 16± 2.7 | 7.6±0.3 | 8 ± 0.3 | 619.6 | 431.5 |
| Overall Prey | 835 | 774 | 4.9±0.6 | 6.9±0.8 | 4.7±0.1 | 4.4±0.1 | 2279.9 | 2667.5 |

* Concern species data not sufficient

D - Individual Density, SE - Standard Error, DS - Group Density, AIC - Akaike Information Criteria

In buffer area the potential prey like barking deer, common langur, wild pig, pea fowl, hare and elephants were encountered in the transect lines, however only common langur and wild pig was taken into consideration for density estimation. Remaining other species was not included in the analysis due to less sample size. Common langur was found to be abundant prey species (2.3 ± 0.5SE/km$^2$) followed by wild pig (1 ± 0.2SE/km$^2$) in pre-monsoon season (Table 2). However, the data represent here only pre-monsoon season.

**Table 2.** Prey densities in Similipal Tiger Reserve (Buffer area), Odisha during pre-monsoon seasons (2012)

| Prey | Number of observations | D ± SE | DS ± SE | AIC |
|---|---|---|---|---|
| Common Langur | 98 | 2.3 ± 0.5 | 7.8 ± 0.7 | 263.4 |
| Wild Pig | 46 | 1 ± 0.2 | 5.1 ± 0.7 | 105 |

Half normal-Cosine was best fitted model with lowest AIC value for overall prey density during pre-monsoon and post-monsoon seasons. The ESW (effective strip width) was 15.2m, estimated from 1609 sightings. The estimated prey density was 4.9/km$^2$ in pre-monsoon followed by 6.9/km$^2$ during post-monsoon (CV=10.2%) (Fig. 2).

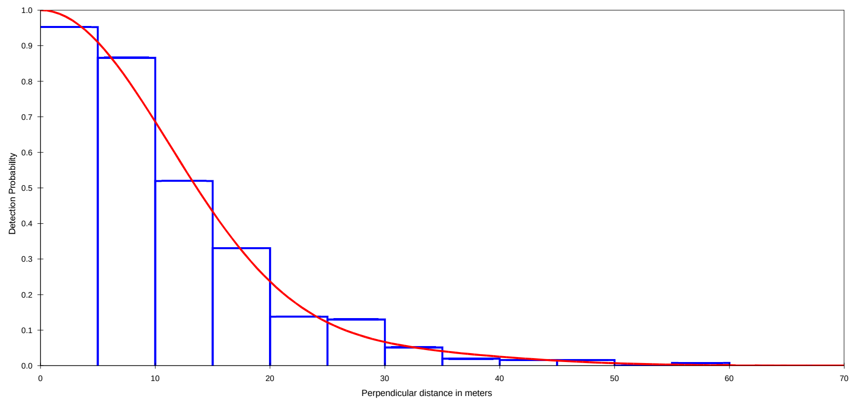


**Fig. 2.** Overall ungulates vs. distance and the fitted detection function (Half normal-Cosine, n = 1609).

The potential prey density in core area between the pre-monsoon and post-monsoon seasons are not significant different (Univariate ANOVA: $F = 0.5$, $df = 12$, $p > 0.001$) (Fig. 3).

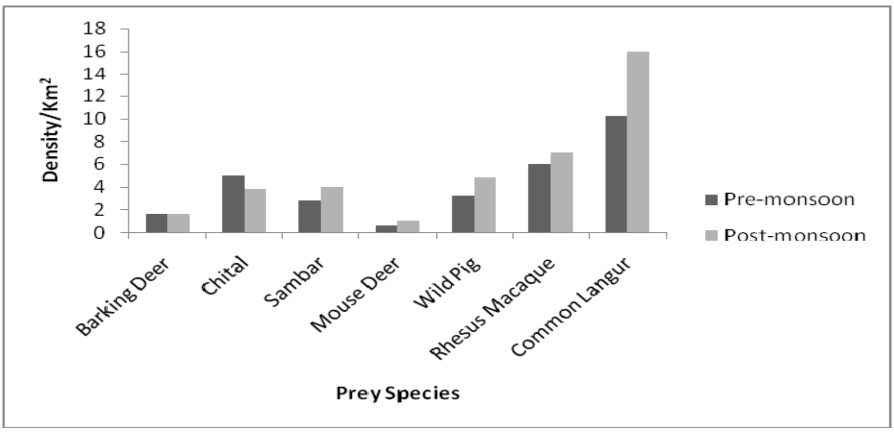


**Fig. 3.** Available prey densities in Similipal Tiger Reserve during pre-monsoon and post-monsoon seasons.

## Discussion

The estimated common langur and rhesus macaque densities in the study area were the highest followed by chital, wild pig and sambar. Common langur density portray in this study signify sixth ranking abundance in the sub-continent. This study also signifies Chital density which is comparable with Bhadra and Bori-Satpura tiger reserve (Table 3). However, wild pig density which is similar with Nagarahole and Bardia Tiger reserve. Though the area has numerous rolling hills and undulating landscape, it supports considerable density of sambar, which is similar in Mudumalai Tiger reserve (Table 3). The chital sighting was observed high in pre-monsoon season compared to post-monsoon and barking deer population remained the same in pre-monsoon as well as post-monsoon seasons. Common langur density is more than other prey in Similipal Tiger Reserve. That may be due its adaptive nature to all types of habitats and less affected by anthropogenic pressure. Chital density is low in Similipal Tiger Reserve as the species is restricted to some areas like Chahala, Debasthali and Nawana.

**Table 3.** Densities of prey species of tiger, leopard, dhole from different study area in the Indian sub-continent.

| Location | Chital | Sambar | Wild pig | Common langur |
|---|---|---|---|---|
| Kanha | 49.7 | 1.5 | 2.5 | NA |
| Nagarahole | 38.1 | 4.2 | 3.3 | NA |
| Bandipur | 40 | 7 | 2.5 | 7.5 |
| Pench | 80.7 | 6.1 | 2.6 | 77.2 |
| Gir | 57.3 | 3.5 | NA | NA |
| Bhadra | 4.5 | 0.9 | NA | 22.6 |
| Bardia | 29.7 | NA | 4.2 | NA |
| Chitwan | 17.3 | 2.9 | 5.8 | NA |
| Kaziranga | NA | NA | 2.6 | NA |
| Ranthambore | 31 | 17.2 | 9.8 | 21.7 |
| Chilla | 56.2 | 24.2 | 6.1 | NA |
| Bori-Satpura | 5.4 | 4 | 1.8 | 28.3 |
| Mudumalai | 55.3 | 2.8 | 0.4 | 25.9 |
| Pench | 62.1 | 7.7 | 10 | 83.9 |
| Present study* | 5 | 2.8 | 3.2 | 10.2 |

Source: (Majumder *et al*., 2012), NA - Data not available, * Present only in (pre-monsoon) season data

In a landscape of ever increasing fragmentation of tiger habitat, the potential for sustaining small but productive tiger populations depends primarily on maintaining high prey densities [12]. However, in Similipal the density of the overall ungulates and each species seems to be very low compared with other landscapes. For the same reason the low abundance of prey species may be attributed to the unavailability of large grass meadows and their suitable habitat. Other speculations may be attributed of the large anthropogenic pressures around the 65 villages present in buffer areas of Similipal Tiger Reserve [32].The Similipal area harbours 12 perennial rivers which flow throughout the year. Study area is dominated by dense canopy cover, semi evergreen, tropical moist deciduous and with open large grassy meadows. This elevated condition of habitat heterogeneity perhaps favored by the observed density of browsers and grazers [33]. The moist deciduous area offered favorable feeding grounds for wild pig during summer. In addition according to the local people and old forest staffs the Maoist attack in Similipal during 2009 and disturbances thereafter affected too much the population of the ungulates and that impact is still persisting. All these factors are responsible for less number of sightings on transect lines that lead to low density of ungulates or prey species observed in Similipal Tiger Reserve.

The ungulates or prey species play very important role in maintaining the population of predator. Thus it is essential to collect the data on the status and distribution of ungulate species and their fluctuations during adequate time intervals. Population size is an indicator by which the success of a management programe is ultimately judged. Ecologists have emphasized the important role that wild prey species play in ecosystems through their influences on the composition, productivity, nutrient cycle and succession [34] and ultimately on the population of the predator. In Eastern Ghat Similipal Tiger Reserve is one of the richest biodiversity areas containing highest population of tigers in Odisha and declared as a Biosphere Reserve by UNESCO. This preliminary line transect survey gave an idea about the ungulate density available in core as well as buffer area of Similipal Tiger Reserve. However proper management plan is required for better conservation of the ungulates whose presence is predestined for survival of predator species like tiger (*Panthera tigris*) and leopard (*Panthera paradus*) which is a high profile endangered species.

## Conclusion

As part of our ten months rigorous field efforts ( from January 2012 to October 2012) in Similipal Tiger Reserve, Odisha, outcomes that the density of the overall prey species and each prey species seems to be very less occurrence which is being compared with other landscapes. The same reason for the less abundance of prey species may be attributed to the unavailability of large grassy meadows and their suitable habitation. However, another reason that can not be ignored is the very large anthropogenic pressure and human interference present around the buffer area of tiger reserve. It needs urgent attention of the line departments and local inhabitants to conserve the Similipal Biosphere Reserve before it is too late.

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