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# Mammals of Khalasuni Wildlife Sanctuary, Western Odisha, India: An overview

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**ABSTRACT**

Camera traps were deployed at 180 stations in Khalasuni Wildlife Sanctuary between 14th November 2021 to 28th April 2022 that provided the effort of 4500 trap-days. Out of the 2,767 photo captures, 1,304 were mammals belonging to 13 families and 24 large and medium-sized mammals were recorded in the study area. Photos of six threatened species categorised under the IUCN Red List were captured, namely leopard (*Panthera pardus)*, sloth Bear *(Melursus ursinus)*, Asian elephant *(Elephas maximus)*, gaur (*Bos gaurus)*, sambar *(Rusa unicolor)*, and four-horned Antelope *(Tetracerus quadricornis)*. Sambar *(Rusa unicolour)* was found to be the most frequently photographed and four-horned antelope was the most widespread species of this sanctuary. Photographic evidence of mammalian species documented and the importance of conservation of threatened and vulnerable species in the study area were studied. The current camera trap survey is expected to help in formulating management strategies for long-term conservation of mammalian species in Khalasuni Wildlife Sanctuary.

**Key words:** Camera trapping, mammalian diversity, Odisha, relative abundance index

## INTRODUCTION

Camera trapping has been proved to be an effective method in monitoring elusive and nocturnal species along with population estimation of naturally marked individuals using spatially explicit capture-recapture models (Karanth and Nichols 1998; Harihar et al. 2014). Camera traps have become an important tool for inventorying for estimating species diversity at a site (Cutler and Swann, 1999; Silveira, Jacomo and Diniz-Filho, 2003; O'Connell, Nichols and Karanth, 2011). Mammals can also act as apex predators, regulating the populations and behavior of their prey, which can impact the structure and composition of the forest community (Ripple et al., 2014). Despite their vital role in forest ecosystems, they face a multitude of threats that can significantly impact their populations. Habitat destruction and fragmentation due to human activities such as deforestation, mining, and urbanization are some of the most significant threats to mammal communities in the world (Ripple et al., 2014, 2015; Nayak et al., 2020). Camera trapping is an increasingly popular method to study wildlife. While there are several types of camera traps, all models have the same basic principle: a photo (and / or video) camera protected by some sort of weather proof housing, coupled to a mechanism that allows the camera to be triggered

automatically when an animal moves in front of it. Since camera traps were first used to estimate the density of tiger *(Panthera tigris)* populations in India (Karanth 1995), this methodology has been widely used to study a variety of species: leopards *Panthera pardus* (Henschel and Ray 2003; Kostyria et al. 2003). Due to increasing anthropogenic pressure, half the world's 5491 known mammalian species are declining and a fifth are clearly at the verge of extinction (Anon 2016). Although the use of relative abundance index (RAI) generated from camera trap encounter rates is controversial as it gets biased with animal body mass and study design (Sollmann et al., 2013), there are examples of a linear relationship between RAI and abundance, estimation, especially of cryptic species (Gonthier et al., 2013; Karantha et al., 1998; Datta et al., 2008; Rovero and Marshall, 2008; Rovero and Marshall 2009; Jenks et al., 2011 and Lahker et al., 2018).

In Odisha several mammalian studies have been reported; (Tiwari et al., 2002) first compiled 37 species of mammals from Chandaka-Dampara Wildlife Sanctuary. In Similipal Biosphere Reserve 55 species species, Kotagarh Wildlife sanctuary 43 species, Kuldia wildlife Sanctuary 20 species, Sunabeda Wildlife Sanctuary 22 species, Hadgarh Wildlife Sanctuary 19 species Debrigarh Wildlife Sanctuary 27 species, Sundargarh Forest division 27 species, Nayagarh District 29 species, Keonjhar Forest Division 25 species and Bonai Forest Division 28 species recorded (Ramakrishna et al., 2006; Mohapatra et al., 2009; Debata and Swain, 2020; Debata et al., 2018; Palei et al., 2020; Palei et al., 2021; Palei et al., 2023a; Palei et al., 2023b; Sarangi et al., 2024; Dhanraj et al., 2025 and Patra et al., 2025). In this study, we used camera-trap surveys to study the presence of largeand medium-sized mammals on the Khalasuni Wildlife Sanctuary, North-Western periphery of Odisha State.

## MATERIALS AND METHODS

### Study area

The Khalasuni Wildlife Sanctuary is located between latitude of $21^0$-15' to $21^0$-25' N and longitude of $84^0$15' to $84^0$35' E (Fig. 1). The sanctuary covers 116 sq km and it is dominated by moist peninsular low-level Sal Forest, Northern moist mixed deciduous forest, moist peninsular valley sal forest, dry peninsular sal forest, northern dry mixed deciduous and dry bamboo breaks (Champion and Seth's 1968). Due to good rainfall in the Sanctuary area, moist peninsular high-level Sal and moist mixed deciduous forests are noticed, along with extensive bamboo forests. The sanctuary shares its boundaries with which covers forest areas of Deogarh Forest Division, Rairakhol, Sambalpur South Forest Division and Bamra Wildlife Division. The mean daily temperatures of winter range from 5˚C to 20˚C and that of summers range from 30˚C to 49.5˚C. There are three distinct seasons that is summer (March to June), rainy (July to October) and winter (November to February). The rainfall of the Sanctuary and the nearby areas varies from 698 mm to 1962 mm.

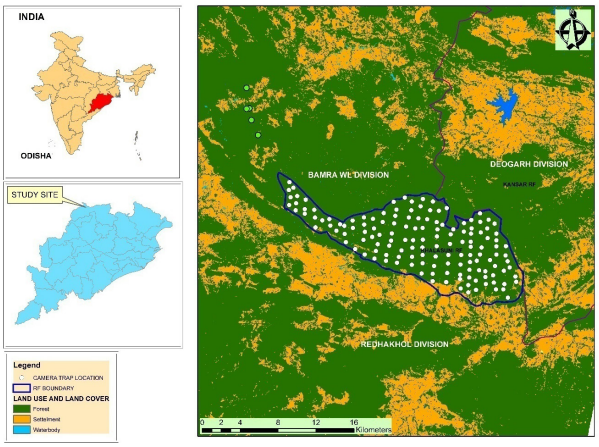


**Fig. 1.** Location map with camera trap installation in Khalasuni Wildlife Sanctuary, Sambalpur, Odisha

### Methodology

Camera trap surveys were conducted in the sanctuary in four phases from 14th November to 21st December 2021: first phase with 45 camera trap stations, 26th December 2021 to 25th January 2022 second phase with 45 camera trap stations and 29th January to 13th March 2022 third phase with 45 camera trap stations and fourth phase 15th Mar to 28th April 2022 with 45 camera trap stations (Table 1). Finally,180 motion sensor camera traps

(Cuddeback Model C1) in Grid wise were set up in the sanctuary. Authors used 2X2 $km^2$ grids to guide camera placement hole ranges. Camera traps were predominantly set along forest roads, game trails and footpaths. All camera traps were strapped to trees approximately 45 cm above ground. At each location, a pair of traps on either side of the path facing each other was set up to photograph simultaneously both flanks of the animal passing between the cameras. Each location consists one pair camera trap and sets to operate 24 hour with programmed to delay sequential photographs by 30 second delay time for capturing 25 days, yielding a total of 4500 trap nights. Each camera traps were checked at least once a week for battery level, positioning and to replace memory (SD) cards. Each and every photograph was manually checked to identify the species. Total sampling effort was calculated as the sum of the effective days across all stations that each camera was functioning (Boitani and Powell, 2012). The photos were separated by at least 30 minutes as independent events (Ohashi et al., 2013; Guo et al. 2017). Data on large and medium sized mammals, birds, reptiles, human traffic and livestock including date time, year and behaviour were collated from camera trap photographs. Data on large and medium sized mammals, human traffic and livestock including date time, year and behaviour were collected from camera trap photographs. Relative abundance index (RAI) was calculated as RAI = (A/N) X100

Where A is the total number of independent detections of a species by all cameras and N is the total number of camera trap days by all the cameras throughout the study area following Jenks et al., 2011.

**Table 1.** Summary of camera trap sampling in Khalasuni Wildlife Sanctuary from November 2021 to May 2022

| Sampling Period | Sampling days | No. of camera stations | Trap nights (effort) | Total photo captured |
|---|---|---|---|---|
| 14th Nov 21 to 21st Dec 2021 | 25 | 45 | 1125 | 5476 |
| 26th Dec 21 to 25th Jan 2022 | 25 | 45 | 1125 | 4426 |
| 29th Jan 22 to 13th Mar 2022 | 25 | 45 | 1125 | 2569 |
| 15th Mar 22 to 28thApr 2022 | 25 | 45 | 1125 | 5169 |
| Total | | 180 | 4500 | 17640 |

## RESULTS AND DISCUSSION

During a sampling period of 4500 trap-nights using 180 camera traps, a total of 24 species of wild mammals, belonging 14 families in 6 orders, were in the study area (Table 2). Carnivora was the most diverse order with 13 species, followed by artiodactyla with 6 species, primates with two, and all other orders with a single species each (Table 2; Fig. 2). Of the 24 species recorded, 7 were Threatened (two 'Endangered', four 'Vulnerable'), 2 'Near Threatened' and 15 'Least Concern' on the IUCN Red List (IUCN 2023) as reflected in Table 1. According to the Indian Wildlife ProtectionAmendment Act (2022), 19 species were listed in Schedule I, and 2 in Schedule II and 3 schedule III category (Table 2). According to RAI, the most abundant mammal in the study area was sambar (RAI=4.69), followed by wild boar (1.96), Indian gaur (RAI=1.73), Asian elephant (RAI=1.64), hanuman langur (*Semnopithecus entellus*) [RAI=1.20] and sloth bear; (RAI=1.02).


**Fig. 2.** Camera trap images of threatened mammals recorded in the study area of Khalasuni Wildlife Sanctuary, Odisha: a- Leopard (*Panthera pardus);* b- Rusty spotted cat *(Prionailurus rubiginosus;* c- Indian grey wolf *(Canis lupus);* d- Sloth bear (*Melursus ursinus);* e- Asian elephant (*Elephas maximus);* f- Gaur (*Bos gaurus);* g- Sambar (*Rusa unicolor*); h- Four-horned antelope (*Tetracerus quadricornis)*

**Table 2.** Comparative Relative Abundance Index (RAI) of different wildlife species and others based on camera trap photographs in Khalasuni Wildlife Sanctuary during the field-work with their current IUCN status

| Sl. No | Common name | Order | Family | Scientific names | WPA status | IUCN status | Total photo captured | RAI |
|---|---|---|---|---|---|---|---|---|
| 1 | Leopard | Carnivora | Felidae | *Panthera pardus* | I | VU | 64 | 1.42 |
| 2 | Jungle cat | Carnivora | Felidae | *Felis chaus* | I | LC | 32 | 0.71 |
| 3 | Rusty spotted cat | Carnivora | Felidae | *Prionailurus rubiginosus* | I | NT | 8 | 0.18 |
| 4 | Indian grey wolf | Carnivora | Canidae | *Canis lupus* | I | LC | 12 | 0.27 |
| 5 | Golden jackal | Carnivora | Canidae | *Canis aureus* | I | LC | 32 | 0.71 |
| 6 | Striped hyeana | Carnivora | Canidae | *Hyaena hyaena* | I | NT | 8 | 0.18 |
| 7 | Indian fox | Carnivora | Canidae | *Vulpes bengalensis* | I | LC | 9 | 0.20 |
| 8 | Sloth bear | Carnivora | Ursidae | *Melursus ursinus* | I | VU | 46 | 1.02 |
| 9 | Ratel | Carnivora | Mustelidae | *Mellivora capensis* | I | LC | 26 | 0.58 |
| 10 | Small Indian civet | Carnivora | Viverridae | *Viverricula indica* | I | LC | 10 | 0.22 |
| 11 | Common palm civet | Carnivora | Viverridae | *Paradoxurus hemaphroditus* | I | LC | 15 | 0.33 |
| 12 | Grey mongoose | Carnivora | Herpestidae | *Herpestes edwardsii* | I | LC | 13 | 0.29 |
| 13 | Ruddy mongoose | Carnivora | Herpestidae | *Herpestes smithii* | I | LC | 6 | 0.13 |
| 14 | Asian elephant | Proboscidae | Elephantidae | *Elephas maximus* | I | EN | 74 | 1.64 |
| 15 | Indian gaur | Artiodactyla | Bovidae | *Bos Gaurus* | I | VU | 48 | 1.07 |
| 16 | Sambar | Artiodactyla | Cervidae | *Rusa unicolor* | I | VU | 105 | 2.33 |
| 17 | Four-horned antelope | Artiodactyla | Bovidae | *Tetracerous quadricornis* | I | EN | 40 | 0.89 |
| 18 | Barking deer | Artiodactyla | Cervidae | *Muntiacus muntjak* | I | LC | 28 | 0.62 |
| 19 | Mouse deer | Artiodactyla | Tragulina | *Tragulus moschiola* | I | LC | 12 | 0.27 |
| 20 | Wild boar | Artiodactyla | Suidae | *Sus scrofa* | III | LC | 45 | 1.00 |
| 21 | Indian crested porcupine | Rodentia | Hystricidae | *Hystrix indica* | I | LC | 26 | 0.58 |
| 22 | Rhesus macaque | Primates | Cercopithecidae | *Macaca mulatta* | II | LC | 47 | 1.04 |
| 23 | Hanuman langur | Primates | Cercopithecidae | *Semnopithecus entellus* | II | LC | 54 | 1.20 |
| 24 | Indian hare | Lagomorpha | Leporidae | *Lepus nigricollis* | III | LC | 28 | 0.62 |

**RAI-** Relative Abundance Index, IUCN- International Union for Conservation of Nature, EN- Endangered, VU- Vulnerable, NT- Near threatened, LC- Least concern, IWPA- Indian Wildlife Protection Act (2022).

The camera trapping study revealed the presence of high diversity of terrestrial mammals, as evident from a comparison with camera trap studies in other nearby forest landscapes, e.g. 24 mammals over 6413 trap nights in 187 camera trap stations in Similipal Tiger Reserve (Palei et al. 2016), 20 mammals over 916 trap-nights in 65 camera trap stations in Kuldiha wildlife sanctuary (Debata and Swain 2018), and 19 mammals over 2049 trap-nights in 60, camera trap stations in Hadgarh wildlife sanctuary, Odisha, India (Palei et al. 2022). 18 mammals over 750 trap night; in 25 camera trap station in Northern Reserve Forest, Athmallik Forest Division (Palei et al. 2024); 25 mammals over 6329 trap night in 165 camera trap station in Badrama Wildlife Sanctuary (Palei et al., 2022); 27 mammals over 3150 trap

night in 123 camera trap station in Debrigarh wildlife sanctuary (Palei et al., 2023); 27 mammals over 3134 trap night in 81 camera trap station in Sundargarh Forest Division (Palei et al., 2023); 29 mammals over 2850 trap night in 122 camera trap station in Nayagarh Forest Division (Sarangi et al., 2024); 25 mammals over 3214 trap night in 53 camera trap station in Keonjhar Forest Division (Dhanraj et al., 2025). Here 24 mammals over 4500 trap night in 180 camera trap station in Khalasuni wildlife sanctuary were reported.

The study confirmed that out of the 24 mammalian species recorded during the camera trap survey, carnivore species were the most common at each study site followed by herbivores. Sambar was the most frequently detected species. The species is considered common in India because of adaptability nature (Menon, 2014). The elephant is a large-bodied herbivore that occurs throughout the sanctuary. Other species like gaurs, sambars, Mouse deer *Moschiola indica*, northern muntjaks and wild boars are widely distributed in the entire Khalasuni Wildlife sanctuary. The Indian grey wolf is confined to the sanctuary and photo captured in one location whereas the golden jackal shows patchy distribution, and is not recorded in the southern part of the sanctuary, though it is occasionally seen in the central and the northern part of the sanctuary. As per camera trap record there is no photo capture of *(*chitals *Axis axis)*, in the sanctuary. The common palm civet *(Paradoxurus hermaphroditus)*, the small Indian civet (*Viverricula indica),* the grey mongoose *(Herpestes edwardsii)* are widely distributed in the sanctuary, while the ruddy mongoose *(Herpestes smithii)* is confined to the limited area of the sanctuary. The sight records of the jungle cats (*Felis chaus)*, and rusty spotted cats *(Prionailurus rubiginosus)* are available from limited area of the sanctuary. The honey badger *(Mellivora capensis)* is known only from a few locations of the sanctuary. Sloth bear was the second most detected species may be due to their high population size contrary to other studies (Palei et al. 2016; Debata and Swain 2018; Palei et al. 2022). Indian Gaur is common in our study area and has the high detection rate, contrary to other studies conducted in nearby localities (Palei et al., 2016; Debata and Swain 2018; Palei et al., 2018, 2023; Palei et al., 2019) Odisha, India. Two individuals of Indian grey wolf were recorded during the survey offering the first photographic evidence of the Indian grey wolf outside protected areas of Odisha. This record increases knowledge on the distribution of the species. More extensive surveys are needed to understand the distribution and population dynamics of Indian grey wolf in the area. We provide photographic evidence of Indian grey wolves and highlight the importance of Odisha forest for species conservation. Photographic evidences of Indian grey wolf *(Canis lupus pallipes)*. The species was considered rare in the state of Odisha (Debata and Palei 2020). This survey provides crucial evidence to inform and support conservation efforts within the Khalasuni wildlife sanctuary and neighbouring regions. To improve species detection, we recommend that future camera trapping campaigns cover a broader elevational range and a wider variety of microhabitats. In addition, evaluating livestock depredation by leopards and developing compensation strategies for herders are essential steps towards the long-term conservation of this species. Finally, we urge that the area's protection status be upgraded.

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