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First photographic evidence and distribution of the Indian Pangolin *Manis crassicaudata* (Mammalia: Pholidota: Manidae) in Sariska Tiger Reserve, Rajasthan, India

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Abstract: The Indian Pangolin, although considered to be widely distributed due to its elusive nature and low detection probability its status and distribution records are very limited. Rampant hunting for local consumption, and illegal wildlife trade for medicinal and ornamental purposes has pushed the species towards serious decline. Herein, we report the first photographic records of the Indian Pangolin in Sariska Tiger Reserve (STR), Rajasthan, India. During our camera trapping study from June 2018 to April 2019, out of 29,220 camera trapping nights the species was recorded on four occasions, at two different locations in STR. The species was recorded in the open forest areas near natural water bodies situated in the middle of dense *Anogeissus pendula* forests.

Keywords: Endangered, illegal wildlife trade, camera trap.

The order Pholidota is represented by eight species in a single family Manidae distributed from Africa to Asia. Out of eight, two species occur in India—the Indian Pangolin *Manis crassicaudata* (E. Geoffroy, 1803) is widely distributed across most parts of the country starting from the southern part of the Himalaya, also in southern Nepal, Bangladesh, Pakistan, and Sri Lanka (Tikader 1983; Srinivasulu & Srinivasulu 2012; Mahmood et al. 2020); and the Chinese Pangolin *Manis pentadactyla* is mainly distributed across the northeastern states of the country and Nepal (Srinivasulu & Srinivasulu 2012; Challender et al. 2019). The two are morphologically similar however they can be differentiated based on the size of the scales, the Indian pangolin's scales are relatively larger than those of the Chinese Pangolin; rows of scales, Indian Pangolin have scales 11–13 rows across the back while Chinese Pangolin have 15–18 rows across the back (Pocock 1924). Indian Pangolins are quite adaptive to modified habitats having abundant prey and less exploitation pressure (Mahmood et al. 2020). The Indian Pangolin is nocturnal and rests in burrows during the daytime. Two types of burrows have been reported for Indian Pangolins, i.e., feeding burrows and living burrows (Mahmood et al. 2020). It uses its long protrusible and glutinous tongue to predate on ants and termites; consuming the eggs, young and adults of ants and termites, also ingests grit, sand and small stones that

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aid mastication (Prater 2005). Thus, the species plays an important ecological role by consuming termites which are a serious insect pest for agricultural crops and buildings (Roberts 1997). Indian Pangolins are typically solitary in nature, except during the mating and rearing of the young ones; It is believed that scent markings by males using urine, scat or anal glands are the means to maintain territory and social relations (Mahmood et al. 2020). The species inhabits wide varieties of habitat and recorded from Indian subcontinent in both forested and non-forest areas (Roberts 1977; Mahmood et al. 2020). Pangolins occurs in very low densities, few available studies estimating densities for various species of Pangolins suggests density of 0.0001 individual per km^2 for the Indian Pangolin, 0.001 individuals per km^2 for the Chinese Pangolin and 0.8 individuals per km^2 for the White-bellied Pangolin *Phataginus tricuspis* in Africa (Wu et al. 2004; Akpona et al. 2008; Mahmood et al. 2014, 2018).

The Indian Pangolin is protected under Appendix I of the Convention on International Trade in Endangered Species (CITES) and Schedule I species in the Wildlife (Protection) Act 1972, it is also listed as 'Endangered' in the IUCN Red List of Threatened Species due to its rapid decline in their numbers (Mahmood et al. 2020). Despite being protected under many regimes of the law, the population of this species is declining rapidly; mainly because of hunting for local use as meat, for traditional medicines and rampant illegal international trade for medicinal and ornamental purposes (Mahmood et al. 2012; Mohapatra et al. 2015). The scales of the species are used as a whole, or in powdered form in the preparation of traditional medicines in southeastern Asia, mainly China and Vietnam (Baillie et al. 2014; Mohapatra et al. 2015; Challender & Waterman 2017; Mahmood et al. 2019). In India, hunting and illegal trade of 119 pangolin seizures were recorded from year 2009 to 2018 and an estimated 7,500 individuals were killed (Kumar et al. 2020). Additionally, the Indian Pangolins in their habitat were killed due to the belief that they dig up graves and pull out the buried dead bodies. In addition, farmers kill the animal allegedly for damaging their crops and agricultural lands by digging the burrows (Mahmood et al. 2018).

In Rajasthan, the pangolin was once believed to be widely distributed but now it has become rare (Sharma et al. 2003). The species is recorded from Ajmer, Bikaner, Churu, and Nagaur districts in the state (Sharma et al. 2003; Dookia & Jakher 2004). It is also reported in three protected areas in the state namely Sajjangarh Wildlife Sanctuary, Mukundra Hills Tiger Reserve and Keoladeo National Park (Bhatnagar et al. 2013; Latafat & Sadhu 2016; Singh et al. 2017); one individual was rescued in Dhani Talai area of Pratapgarh forests in southern Rajasthan in 2007.

Study Area

The Sariska Tiger Reserve (STR) is situated in the Aravalli Hills in Alwar District of the Indian State of Rajasthan between 76.241°–76.545°N & 27.095°–27.648°E. The climate is subtropical, with distinct summer, monsoon and winter seasons; temperature ranges 2–47 °C with an average rainfall of 621 mm (Shekhawat 2015). The total area of the reserve is 1,213.31 km^2, with 881 km^2 critical tiger habitat (CTH) and 332 km^2 buffer area (Shekhawat 2015). In STR the altitude varies 240–777 m rugged terrain, numerous narrow to large valleys, and plateaus are main characteristic feature of habitat; Kankwari (524 m) and Kiraska (592 m) are two main plateaus. In vastly scattered forest has various geological formations and soil depth varies from few centimetres on hill slopes to 1 m in valleys (Yadav & Gupta 2006). The vegetation is tropical dry deciduous forest (Champion & Seth 1968) with Dhonk *Anogeissus pendula* as the dominant tree species, other species include *Butea monosperma*, *Boswellia serrata* and *Ziziphus mauritiana*. Apart from reintroduced Tigers *Panthera tigris*, Leopard *P. pardus*, Striped Hyena *Hyaena hyaena*, Jackal *Canis aureus*, and the Jungle Cat *Felis chaus* are the major carnivores in the reserve; while Chital *Axis axis*, Sambar *Rusa unicolor*, Nilgai *Boselaphus tragocamelus*, and Wild Boar *Sus scrofa* are major prey species (Shankar et al. 2010). STR is subjected to an extensive anthropogenic pressure, as 2,254 families reside in 26 villages situated in the area (Shekhawat 2015). In addition to that very high pilgrimage inside the reserve, habitat fragmentation due to state highways passing through the STR, increasing human-wildlife interactions and low staff strength for law enforcement are other major problems in the reserve (Bhardwaj 2018).

Materials and methods

This record was obtained as part of a camera trapping exercise that was being undertaken by the authors for monitoring of tigers in STR in three different phases. For camera trapping, the STR was divided into 440 grids of 2 km^2 each, the grids are equally distributed into two blocks (north block and south block) having 220 grids each covering an area of 440 km^2 for management purpose. Among all, 84 grids, distributed randomly among both the blocks, were identified and used as

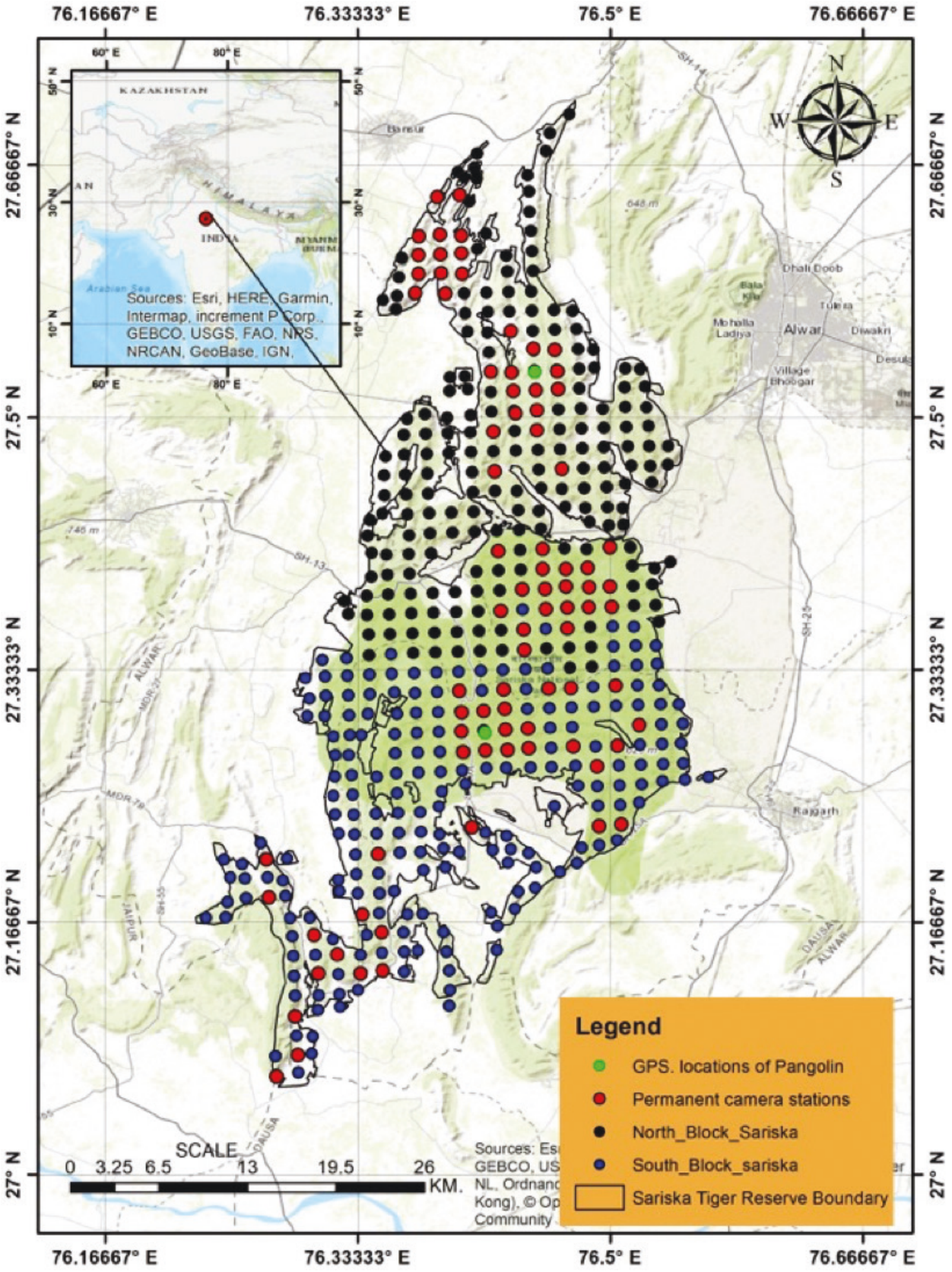

Image 1. GPS locations (shown as green dot) of Indian Pangolin camera trap captures in Sariska Tiger Reserve.

permanent camera trap stations (Image 1). The details of camera trap study is provided in Table 1. Camera traps were deployed in each block with at least one pair of camera deployed in each grid. Cuddeback 1279 20 Mega-pixel trail cameras were used for the exercise. The camera traps were deployed 40–50 cm above ground at a distance of 5–6 m on both sides from the centre of the trail. The delay between subsequent photographs was kept at 5 seconds so that young ones with mother don't get missed. Cameras were operated on a 24-hour basis. All the cameras were regularly checked in the field for proper functioning and status of the batteries. Geo coordinates of the location were recorded using handheld GPS (Garmin eTrex 20x) device set to datum WGS 84.

Results

The Indian Pangolin was recorded on four occasions at two different locations from an effort of 29,220 trap nights. Three occasions of the four was in a single camera trap location in Jahaj beat of Tehla range (27.286°N, 76.418°E) (Images 1–3), which was located in a valley near a water body. The observed habitat of the camera trap location was undulating with moderately dense vegetation *Zizyphus mauritiana* and *Butea monosperma* vegetation in the valley and dense undisturbed *Anogeissus pendula* forest on the upper regions. We also recorded one active burrow in the area based on fresh signs of digging and another inactive burrow (Image7). The burrows were deeper, the inactive burrow had a depth of 1.6 m while the active burrow was 2.8 m deep. Both the burrows had round openings. The second site of Indian Pangolin capture location was in Bija forest area near Panidhal Village (27.524° N 76.440° E).

In addition, one Indian Pangolin was observed in a moderately dense *Anogeissus* forest on a small hillock in Loj Beat of Talvriksh range during the morning hours on 29 August 2019 (Image 6). It tried to hide itself among the shrubs sensing the presence of humans in close vicinity and ultimately it disappeared into a thicket. All the camera trap images of Indian Pangolins were captured during the late night hours from 2348 h to 0219 h that demonstrates the fact that the species is active in

Image 2. Camera trap image of Indian Pangolin in Beat Jahaj, Tehla.

Image 3. Camera trap image of Indian Pangolin in Beat Jahaj, Tehla.

Image 4. Camera trap image of Indian Pangolin in Beat Jahaj, Tehla.

Table 1. Details of camera trapping survey design used in the study.

Period of Survey session	Extent of study area	Survey effort
01.vi.2018 to 30.xi.2018	84 grids (2km^2) permanent camera trap locations in both north and south block	10,080 camera trap nights
17.xii.2018 to 16.i.2019	220 grids (2km^2) of south block	6,820 camera trap nights
04.ii.2019 to 01.iv.2019	220 grids (2km^2) of north block	12,320 camera trap nights

Image 5. Camera trap image of Indian Pangolin in Loj Beat, Talvriksh.

Image 6. Image clicked through mobile phone of Indian Pangolin, in Beat Loj, Talvriksha. © Vinod Dulariya

Image 7. Living burrows of Indian Pangolin: A—active burrow | B—inactive burrow in beat Jahaj, Tehla. © Rajesh Kumar

night except for one individual which was observed in the morning.

Discussion

Despite being one of the most traded species throughout the globe, very little is known about the distribution and current status of the pangolin in most of its range including Rajasthan. This can be attributed to its elusive nature and low density, as evident from the study that the species was captured only four times out of 29,920 camera nights. STR is one of the most researched protected areas (Bhardwaj 2018), but there are no published records barring a single mention in text on Indian Pangolin in the STR (Bhardwaj 2018). The camera trap pictures of the Indian Pangolin confirm its presence in the STR and adds to its biological diversity. Further, this will aid in formulating robust strategies for the conservation of the species in STR. Although the effort was intensive, the cameras were mainly installed on trails and areas for capturing the big cats, as big cats have larger home ranges and they prefer regular trails and paths for walking to avoid injuries, but the same cannot be assumed for the smaller vertebrates like the Indian Pangolin so a little bias in less detection of pangolin during the study cannot be ruled out. Since the species inhabits wide varieties of habitats and outside protected areas (Mahmood et al. 2020), the comprehensive study in STR as well as adjoining areas on the ecological aspects and population dynamics of the species would give more insight on the Indian Pangolin. The measures like creating awareness among the local people and frontline staff, including local communities to protect the Indian Pangolin from traditional hunting would help in conserving the species.

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