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## **COMMUNICATION**

## MAMMALIAN FAUNA IN AN URBAN INFLUENCED ZONE OF CHANDAKA-DAMPARA WILDLIFE SANCTUARY IN ODISHA, INDIA

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# Mammalian fauna in an urban influenced zone of Chandaka-Dampara Wildlife Sanctuary in Odisha, India

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Abstract: A camera trapping survey to estimate the species richness and relative abundance of different mammalian fauna and various anthropogenic activities was carried out for four months within an urban influenced zone of Chandaka-Dampara Wildlife Sanctuary, Odisha. The survey extended over 120 days in January–April 2019 over 10% of the total sanctuary area. With nine cameras and a total effort of 771 trap days, 2,855 independent photographs including 14 species of wild mammals and birds, human traffic, and movement of stray animals were captured. Among the mammalian fauna, Golden Jackal was the most photographed species whereas the Asian Elephant, Striped Hyaena, and Common Palm Civet were the least photographed species. Various anthropogenic activities need to be addressed in management activities for long term conservation of the area and its mammalian fauna. In order to enhance biological connectivity and improve movement of wildlife between the main part of the Chandaka Sanctuary and its near-detached reserved forests in Jagannathprasad-Bharatpur, the study recommends removal of feral cattle, extensive plantations, and construction of a fly-over for vehicular traffic.

Keywords: Bhubaneswar, camera trap survey, eastern India, Odisha, relative abundance, urbanization.

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Author contribution: Study design: KKS and SD; field work, data analysis and writing the article: SD.

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## INTRODUCTION

Information on the presence and distribution of species within a region is important for planning and evaluating conservation strategies (Tobler et al. 2008) and it is particularly vital if the area is experiencing threats from adjoining urban development. Globally around half of the human population are currently living in urban areas and it is predicted that it may cross 70% by the year 2050 (United Nations 2011, 2012). So, the increasing pressure for urban development will lead to continued urban expansion resulting in loss, degradation, fragmentation and isolation of the remnant natural habitats (Biamonte et al. 2011). This changing environmental condition affects biodiversity at local, landscape and regional scales (Jokimaki & Kaisanlahti-Jokimaki 2003; Wilby & Perry 2006).

The Chandaka-Dampara Wildlife Sanctuary (CDWS) covering an area of 193.39km<sup>2</sup> is situated in Khurda District adjoining Bhubaneswar, the capital city of Odisha, eastern India. The sanctuary exists in two different parts; the major part contains an area of 172.12km<sup>2</sup> while the other part, Bharatpur-Jagannathprasad sector is 19.27km<sup>2</sup> (Image 1). Out of the 19 wildlife sanctuaries in Odisha CDWS experiences severe biotic interference out of the growth and development of Bhubaneswar City. For the last six decades, Bhubaneswar has expanded many times from just 26.09km<sup>2</sup> in 1951 to 422km<sup>2</sup> in 2011 (Routray et al. 1996; Naik 2013). In fact, expansion of the northern region of the city has resulted in fragmentation and isolation in the sanctuary. The Bharatpur and Jagannathprasad reserve forests of CDWS have already been isolated from the sanctuary and surrounded by human habitations of Bhubaneswar City. Therefore, it can be predicted that the negative effect of urban growth might have resulted in the local extinction or population depletion of many species particularly the mammalian fauna in this fragmented habitat. Unfortunately, there is sporadic information on the status of different mammalian fauna in this urban influenced zone of CDWS. Therefore, documenting the status of different mammalian fauna and various ongoing anthropogenic activities is important to assist subsequent conservation interventions.

In this study, we carried out a camera trapping survey within the urban influenced and isolated zone of CDWS with the objectives of: (a) documentation of the mammalian species richness, (b) estimation of their relative abundance based on photo-capture rate, and (c) monitoring of various anthropogenic activities. The results obtained from the study can be used as baseline data in future inventories to ascertain the change over time and develop appropriate conservation interventions.

### MATERIAL AND METHOD

#### **Study Area**

The Bharatpur and Jagannathprasad forest sector of CDWS, Odisha (Image 1) lies between 20.286-20.360 <sup>o</sup>N & 85.756–85.810 <sup>o</sup>E. This sector covers an area of 19.27km<sup>2</sup> (Bharatpur 11.88km<sup>2</sup> and Jagannathprasad 7.39km<sup>2</sup>) that represents around 10% of the total area of the sanctuary. The climate of the area is tropical and the three distinct seasons—summer (March–June), monsoon (July-October) and winter (November-February)-are experienced here. The annual mean temperature of the area varies between 12°C during January to 42°C during May with an average annual rainfall of 1,542mm. Vegetation of the area is an admixture of mixed deciduous, semi-evergreen and bamboo brakes and the major portion of the area is covered with bushy and shrubby vegetation. As the area is situated adjoining Bhubaneswar City, a major portion of the boundary line is covered with stone wall concertina fencing to check human interference and straying of wild animals. Although currently, there is no human habitation and human activities within the area, it is experiencing severe biotic pressure from the growth and development of Bhubaneswar City.

#### Data collection and analysis

The study was carried out for four months (1 January-30 April 2019) by using nine automatically triggered camera traps (Cuddeback and Moultrie, USA). The area was first divided into square shaped 1km<sup>2</sup> grids on map (Image 1) followed by installation of one camera trap in each grid for a minimum of 25 days. Because of limitations from the number of camera traps we could only sample nine grids at a time. Cameras were strapped on to trees approximately 50cm above ground along the motorable roads and forest paths by aiming the censor parallel to the ground. Cameras were set to operate 24 hours-a-day and programmed to take two consecutive photos registering date and time for each exposure with 30 seconds delay for the next exposure. Cameras were checked once a week for photo download and battery replacement. For each station, the date and time of installation and retrieval of each camera trap was recorded to calculate the total number of trap days (Each trap day = 24 hours).



Image 1. Chandaka-Dampara Wildlife Sanctuary (CDWS) showing the study area and camera trap locations.

After retrieving the camera traps, all the photographs were carefully observed and grouped as wild animals, domestic animals and human traffic. Wild animals were identified up to species level following Menon (2014). Each photo was rated as an independent capture, if the time between consecutive photographs of the same subject was more than 30 minutes apart at a particular location (O'Brien et al. 2003). Photos with multiple individuals of the same species in the frame were also counted as single detection for that species. Based on the principles given by Jenks et al. (2011), the relative abundance index (RAI) of each species/ activity was calculated as

## $RAI = A/N \times 100$

Where 'A' is the total number of detections of a species/ activity by all cameras and 'N' is the total

number of camera trap days by all the cameras.

To understand the impact of various anthropogenic activities on mammalian species detection rate, we calculated the correlation coefficient (r).

## RESULTS

During the study period, the camera trapping effort resulted in 771.31 trap days and captured 2,855 independent photographs of which 53.2% were of wild animals followed by movement of departmental vehicle (23.68%), staff (13.27%), and domestic animals (9.84%).

In all, 14 species of wild mammals were photographed (Table 1; Images 2 to 15) and among them, the Asian Elephant is Endangered and Striped

Table 1. Number of independent photographs and relative abundance index (RAI) of different mammalian species and birds in Bharatpur and Jagannathprasad forest sector of Chandaka-Dampara Wildlife Sanctuary in Odisha, eastern India, January–April 2019.

Family	Species	Common name	IUCN status	Number of photos	RAI (%)	Sno. of cameras where animal species recorded
Mammals						
Elephantidae	Elephas maximus	Asian Elephant	Endangered	1	0.13	5
Cervidae	Axis axis	Spotted Deer	Least Concern	301	39.02	1–14, 17
Cercopithecidae	Macaca mulatta	Rhesus Macaque	Least Concern	36	4.67	1–6, 11
	Semnopithecus entellus	Northern Plains Grey Langur	Least Concern	2	0.26	4
Hystricidae	Hystrix indica	Indian Crested Porcupine	Least Concern	52 6.74		1–5, 8, 10, 11, 13
Leporidae	Lepus nigricollis	Indian Hare	Least Concern	68	8.82	1, 3, 4, 6–10, 14
Suidae	Sus scrofa	Wild Boar	Least Concern	110	14.26	1–15, 17
Felidae	Felis chaus	Jungle Cat	Least Concern	60	7.78	1–5, 8, 10, 11, 13, 14, 17
Canidae	Canis aureus	Golden Jackal	Least Concern	552	71.57	1–11, 13, 14, 17
Hyaenidae	Hyaena hyaena	Striped Hyaena	Near Threatened	1	0.13	5
Viverridae	Veverricula indica	Small Indian Civet	Least Concern	60	7.78	1–6, 8, 10, 14, 17
	Paradoxurus hemaphroditus	Common Palm Civet	Least Concern	1	0.13	1
Herpestidae	Urva edwardsii	Grey Mongoose	Grey Mongoose Least Concern 6 0.78		0.78	1, 2, 9
Mustelidae	Mellivora capensis	Honey Badger	Least Concern	2	0.26	5
Birds						
Phasianidae	Pavo cristatus	Indian Peafowl	Least Concern	244	31.61	1–13
	Francolinus pondicerianus	Grey Francolin	Least Concern	13	1.68	3–7
	Galloperdix spadicea	Red Spurfowl	Least Concern	4	0.51	13
	Gallus gallus	Red Junglefowl	Least Concern	6	0.77	1–4, 7–11



## Mammalian species

Figure 1. Relative abundance index of mammals in Bharatpur and Jagannathprasad forest sector of Chandaka-Dampara Wildlife Sanctuary, Odisha from January–April 2019.

Hyaena is Near Threatened as per the IUCN Red List of Threatened Species (IUCN 2017). Among the seven species of mammalian herbivores, the Spotted Deer was the highest photographed (RAI = 39.02) and the Asian Elephant was the lowest photographed (RAI = 0.13) species. Similarly, among the carnivorous mammals, the Golden Jackal was the highest photographed (RAI = 71.57) whereas the Striped Hyaena and Common Palm Civet were the lowest photographed (RAI = 0.13each) species. Overall, the Golden Jackal was the most photographed species whereas Asian Elephant, Striped Hyaena, and Common Palm Civet were the minimally photographed species. The detailed information on the number of independent photographs and RAI of all the mammalian species is given in Table 1. The histogram showing the RAI of different mammalian species is given in Figure 1.

Photographs captured during the study depicting various anthropogenic activities include movement of departmental vehicles, staff, feral livestock, and free ranging dogs and cats. Among these, movement of vehicles was the maximum photographed activity (RAI = 87.64) than movement of staff (RAI = 49.13), stray dogs (RAI = 17.50), feral buffalos (RAI = 15.81), feral cattle (RAI = 2.46), and domestic cat (RAI = 0.65) (Table 2). Among all the sampling grids, the anthropogenic activity was extremely low at the camera trap location in grid number 10 due to no vehicular movement and it might be due to the absence of motorable roads. Detailed information on the number of independent photographs and RAI of all the mammalian species and anthropogenic activities in each sampling grid is given in Table 3. It was observed that the detection rate and RAI of different mammalian species was found to be negatively correlated with level of anthropogenic disturbances (r = -0.66, p< 0.05).

## DISCUSSION

The CDWS is home to 37 species of mammals of which rodents, bats, shrews, and tree-shrews are represented by 14 species (Tiwari et al. 2002). So a comparison of the 14 species of mammals recorded during the present study from Bharatpur and Jagannathprasad forest sector with the rest of the species from the entire sanctuary represents around 61%. Excluding bats, rodents, and shrews, species like Sambar *Rusa unicolor*, Barking Deer *Muntiacus muntjak*, Indian Chevrotain *Moschiola indica*, Leopard *Panthera pardus*, Asiatic Wild Dog *Cuon alpinus*, Bengal Fox *Vulpes bengalensis*, Small Indian Mongoose *Urva auropunctatus*, Sloth Bear *Melursus ursinus*, and Indian Pangolin Manis crassicaudata that were earlier reported to occur in CDWS (Tiwari et al. 2002), were not recorded during the present study in Bharatpur and Jagannathprasad forest sector. For non-occurrence of these species, there could be several possible factors. For example, the forest cover of Bharatpur and Jagannathprasad was earlier connected with CDWS, however, with increasing urbanization, development of road network and other anthropogenic activities, it has already been fragmented and isolated. Studies across the world have revealed that fragmentation and isolation of wildlife habitats bring negative effect on abundance and distribution of animal communities (Mullu 2016). It was also observed that the photocapture rate of various anthropogenic activities accounted for around 47% of all the detections and it was even much higher than Similipal Tiger Reserve (Palei et al. 2015) and Kuldiha Wildlife Sanctuary (Debata & Swain 2018). Furthermore, the presence of domestic animals can have a detrimental effect on the distribution and assemblage of wild animal communities (Palei et al. 2015; Debata & Swain 2018) and movement of feral buffalos, cattle and stray dogs were recorded throughout the study area. Therefore, species like Sambar, Barking Deer, and Indian Chevrotain prefer comparatively large undisturbed forest patches and are highly sensitive to human disturbance and due to livestock pressure might have left the habitat or became locally extinct. Similarly, these factors might be responsible for the absence of Leopard, Asiatic Wild Dog, and Sloth Bear which prefer similar habitat conditions (Srivastava & Singh 2003). Even the current status of these carnivores is uncertain in the entire sanctuary (S. Debata pers. obs. 2020). Other species like the Small Indian Mongoose might have been missed out from the cameras because of small body size. Usually the body size and behavior of individual animals greatly influence the detection probability (Sollmann et al. 2013), however, the photo-capture rate and RAI of Asian Elephant was estimated to be extremely low. It can be inferred that this mega herbivore rarely visit the area during seasonal migration. Although the habitat of the study area is ideal for the Bengal Fox, the presence of the species in the area was not confirmed.

Among all the species, Golden Jackal, Spotted Deer, and Wild Boar were the most frequently photo-captured and widely distributed species compared to others indicating their higher abundance in the study area. These animals are habitat generalists and can tolerate a wide range of anthropogenic disturbances (Prater 2005). Additionally, with the absence of large predators and poaching activities, their population is gradually Table 2. Number of independent photographs and Relative Abundance Index (RAI) of various anthropogenic activities in Bharatpur and Jagannathprasad forest sector of Chandaka-Dampara Wildlife Sanctuary in Odisha, eastern India, January–April 2019.

Family	Number of photos	RAI (%)	Sno. of cameras where anthropogenic activities were recorded	
Vehicles	676	87.64	1-8, 11-14, 17	
Human traffic	379	49.13	1–6, 8, 9, 11–15, 17	
Feral cattle and buffalos	141	18.28	1–15, 17	
Free ranging dogs	135	17.5	1–9, 11, 13, 14, 17	
Free ranging cats	5	0.65	3, 14	

Table 3. Total number of photographs and relative abundance index (RAI) of different mammalian species and anthropogenic activities in different camera trap locations in Bharatpur and Jagannathprasad forest sector of Chandaka-Dampara Wildlife Sanctuary in Odisha, eastern India, January–April 2019.

Sno. of	Total nu	mber of	RAI		
sampling grids	Mammal photographs	Anthropogenic activity photographs	Mammals	Anthropogenic activities	
1	154	192	19.97	24.89	
2	113	120	14.65	15.56	
3	225	54	29.17	7	
4	172	147	22.30	19.06	
5	204	310	26.45	40.19	
6	83	71	10.76	9.21	
7	19	17	2.46	2.20	
8	68	194	8.82	25.15	
9	32	36	4.15	4.67	
10	74	2	9.59	0.26	
11	36	48	4.67	6.22	
12	5	63	0.65	8.17	
13	29	16	3.76	2.07	
14	31	31	4.02	4.02	
15	1	3	0.13	0.39	
16	-	-	-	-	
17	6	32	0.78	4.15	
18	-	-	-	-	
Overall	1252	1336			

increasing. Similarly with abundant prey species, particularly the Spotted Deer and no competitor, the Golden Jackal population is thriving well. On the other hand, the increasing Golden Jackal population might be the factor for absence or local extinction of Bengal Fox population as a result of increasing competition for space and food.

## Implications for conservation management

Although human disturbances from the peripheral areas in Bharatpur and Jagannathprasad have been completely controlled due to stone wall concertina fencing along the boundary, the area is still experiencing severe biotic pressure from intensive movement of vehicles, feral livestock and stray animals. In the long run if these disturbances continue, it may greatly affect the abundance and composition of the existing mammalian fauna. Therefore, for long term conservation of the area and its wildlife, it is essential that the feral livestock population be removed first. Studies have shown that wild herbivores benefit from the reduction of livestock (Madhusudan 2004). Lethal control and sterilization of stray dogs can be useful in controlling their population. Vehicular movements negatively affect the ranging



Image 2. *Elephas maximus* Asian Elephant; 1 photo from 1 camera, RAI 0.13



Image 4. Macaca mulatta Rhesus Macaque; 36 photos from seven cameras, RAI 4.67



Image 3. Axis axis Spotted Deer; 301 photos from 15 cameras, RAI 39.02

behaviour and activity pattern of wild animals (Cole et al. 1997; Samson et al. 2016) and it accounted for 23.65% of the total photo-capture rate in our study area. It should be controlled to a minimum unless required. The forests of Bharatpur and Jagannathprasad area are completely isolated from the sanctuary. To ensure the connectivity of the study area with the sanctuary, the area between Dalua Protected Forest in Chandaka Wildlife Range and Jagannathprasad forest sector in Bhubaneswar Wildlife Range should be considered for extensive plantation activities. Moreover, the road passing through the area may be converted to a flyover to avoid vehicular traffic. These implications may aid movement of wild animals between habitats and thereby ensure biological connectivity.



Image 5. Semnopithecus entellus Northern Plains Grey Langur; two photos from one camera, RAI 0.26

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Image 6. *Hystrix indica* Indian Crested Porcupine; 52 photos from nine cameras, RAI 6.74



Image 7. *Lepus nigricollis* Indian Hare; 68 photos from nine cameras, RAI 8.82



Image 8. Sus scrofa Wild Boar; 110 photos from 16 cameras, RAI 14.26



Image 9. Felis chaus Jungle Cat; 60 photos from 11 cameras, RAI 7.78



Image 10. Canis aureus Golden Jackal; 552 photos from 14 cameras, RAI 71.57



Image 11. Hyaena hyaena Striped Hyaena; one photo from one camera, RAI 0.13



Image 12. Veverricula indica Small Indian Civet; 60 photos from 10 cameras, RAI 7.78



photo from one camera, RAI 0.13



Image 14. Urva edwardsii Grey Mongoose; six photos from three cameras, RAI 0.78

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Image 15. *Mellivora capensis* Honey Badger; two photos from one camera, RAI 0.26

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