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Dhole *Cuon alpinus* (Mammalia: Carnivora: Canidae) rediscovered in Bardia National Park, Nepal

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Abstract: An increasing intensity of camera traps recorded the presence of poorly known and globally Endangered Asiatic Wild Dogs *Cuon alpinus* from different locations in recent years in Nepal. After 18 years since the previous report, we recorded 29 photos and a video of Dholes in four independent detections with an effort of 4,035 trap-nights during camera trap surveys targeted at tigers in the winter of 2016/2017. Solitary dholes were camera-trapped from four locations within 27.45km^2 area in Bardia National Park. The evidence of a dead Dhole probably killed in retaliation shows the threat to the species. Dholes co-exist in Bardia with sympatric carnivores like Tiger *Panthera tigris*, Leopard *Panthera pardus*, and Jackal *Canis aureus*.

Keywords: Asiatic Wild Dogs, camera trapping, jackal, leopard, retaliation, sympatric, tiger.

The Endangered Asiatic Wild Dog or Dhole *Cuon alpinus* (Pallas, 1981) is now confined to <25% of the historic range with an estimated 4,500–10,500 individuals globally (Kamler et al. 2017). They occur in Nepal historically (Pocock 1949) from the southern plains of the Terai to the Himalayan Alpine rangelands but their sighting is not common. Their status in Nepal is poorly understood (Thapa et al. 2013). The studies of Dholes such as status, space use, diet, and conflict with communities come mostly from India and Bhutan (Karanth & Sunquist 1995; Karanth & Sunquist 2000; Srivastava & Singh 2003; Wang & McDonald 2009).

In recent years, with increasing studies and with an extensive coverage of non-invasive camera trap surveys, the presence of Dhole has been recorded in different parts of Nepal. It has been reported from Kanchanjungha conservation area in the eastern Himalaya (Khatiwada et al. 2012), Chitwan and Parsa national parks in central Terai (Thapa et al. 2013), Barandabhar Corridor Forest, Chitwan (Lamichhane et al. 2018), and Api-Nampa conservation area in the western Himalaya (Raju Ghimire, Pers. Comm. 2015). Local people indicate or park records show their presence in Rara and Khaptad national parks, and Dhorpatan Hunting Reserve in the western Himalaya of Nepal.

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No photographic evidence has been presented from the western Terai in Nepal including the Bardia-Banke complex since the 1990s despite the continuous and extensive camera trap surveys and other ecological research on carnivores and their prey base. A pack of Dholes was reported but not confirmed by local people nearby Baghaura Phanta of Karnali Flood Plain in the park (Binti Ram Chaudhary, Pers. Comm. 2019). Thapa et al. (2013) reported the unconfirmed evidence of Dholes from the western Terai. We present here the first photographic evidence of Dhole in Bardia.

Materials and Methods

As part of tiger monitoring in the western Terai complex, a camera trapping survey was conducted in the entire Bardia National Park (968km²) and the adjoining forest patches from December 2016 to February 2017. The park is located in the southwestern part of Nepal (28.249⁰ – 28.666⁰ N & 81.164⁰ –81.794⁰ E; Fig. 1). It is a part of the trans-boundary Terai Arc Landscape (Wikramanayake et al. 2004). A total of 269 grid cells of 2x2 km² were superimposed on a map of Bardia National Park (BNP), and 257 of these were surveyed in

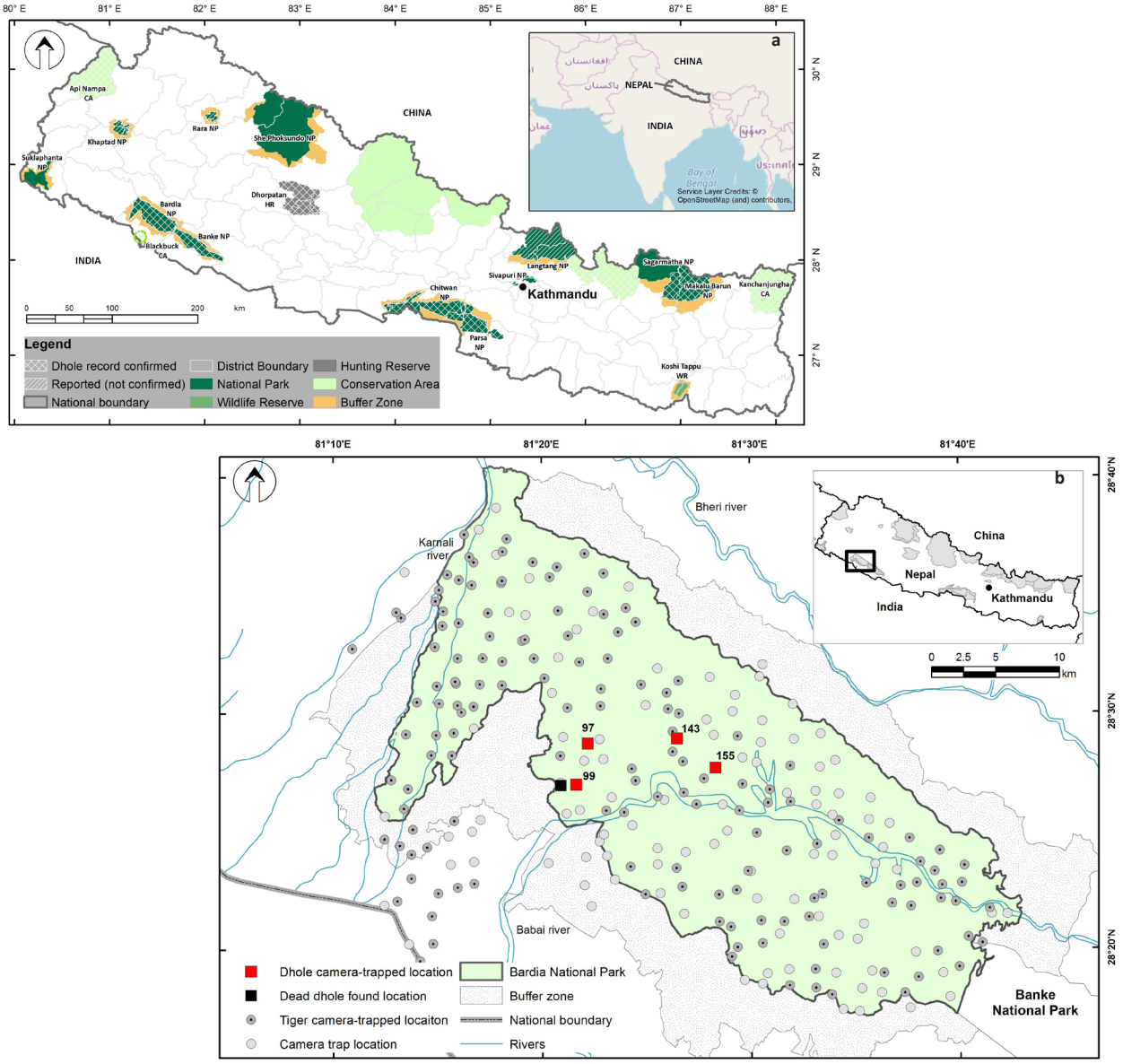

Figure 1. a—Protected areas where Dhole is reported and/or confirmed in Nepal | b—Dhole and Tiger recorded locations during camera trap survey (2016/2017) in Bardia National Park Nepal. Red squares are camera-trapped locations of Dhole, black square is the location where a dead Dhole was found. Tigers were captured in locations shown as a circle with dot inside. Political boundaries may not be accurate.

four shifts (blocks) successively. Twelve grid cells were not surveyed due to the inaccessibility of the terrain or difficulty to find suitable location for camera traps. The camera trap location within each grid cell was selected following an extensive survey of tiger signs. In each sampling point a pair of motion sensor camera traps (Cuddeback Color Model C1, Cuddeback Attack, Reconyx 500, and Reconyx 550) was installed at 45–60 cm above ground on either side of the game trail, forest road or stream bed, maximizing the possibility of tiger capture.

Camera traps were checked every alternate day to observe the photographs of tiger and other species captured on the previous nights. Cameras were active for a minimum of 15 days in each sampling location. Camera trap photos were given unique identification names and sorted species-wise in separate folders. We compared the photos obtained in camera traps with Dhole photos of IUCN Red List of Threatened Species (Kamler et al. 2015) and the National Red List of Mammals of Nepal (Jnawali et al. 2011) to confirm the identification. Photos obtained at one-hour intervals at the same camera location was considered as independent detections.

Results

A total of 4,035 trap-nights of camera-trap effort from 257 sampling locations resulted in 47,871 photographs of 34 mammal species. We found 29 photographs and a video of Dholes from four locations in four independent detections between 10 December 2016 and 04 January 2017 (Table 1; Image 1; Video 1). All the photos were captured during the daytime between 10.22h and 17.39h. All the Dholes' captured locations were within 27.45km^2 area (12km periphery) in the central part of Bardia National Park.

Solitary dholes were captured in all locations but we could not confirm whether they were multiple individuals or repeated capture of a single individual due to the lack of any identification features. Other sympatric carnivores such as Tiger *Panthera tigris* and Striped Hyena *Hyaena hyaena* were also recorded in some of the locations. We found evidence (photograph) of one dead Dhole probably killed by villagers in retaliation in 2012, within 1.7km to the nearest camera trapped location (Image 2). Scat and footprint of possibly a single Dhole was also recorded in multiple locations in the periphery of camera-trapped location during the survey.

Discussion

Our study confirmed the presence of Dhole in the western Terai of Nepal. Other sympatric carnivores in Bardia include Tiger, Leopard, Jackal, and Hyaena. Unlike the solitary Tigers and Leopards, Dholes are known as social hunters with usually 5–10 (up to 25 adults) in a pack (Karanth & Nicholas 1995). In tropical evergreen

Table 1. Details of the camera trap locations where dholes were photo captured in Bardia National Park.

Particulars	Camera trap grid ID			
	97	99	143	155
GPS	28.478^{0}N 87.369^{0}E	28.449^{0}N 87.360^{0}E	28.482^{0}N 87.441^{0}E	28.461^{0}N 87.472^{0}E
Elevation (in m)	228	193	270	293
No. of photo (Video)	5	9	5 (1)	10
No. of individuals	1	1	1	1
Duration of camera trap	09–24 Dec 2016	09–24 Dec 2016	09–24 Dec 2016	28 Dec 2016–12 Jan 2017
Photo captured date and time	22.xii.2016 14.54h	16.xii.2016 10.56h	10.xii.2016 10.22h	04.i.2017 17.39h
Terrain	Flat	Flat	Riverbed	Undulating
Habitat type	Mixed forest	Mixed forest	Mixed forest	Mixed forest
Nearest distance to village (in km)	2.3	0	0.66	0
Distance to nearest tiger captured locations (in km)	3.2	0	10.3	0
Other mammal species captured in the same station	Red Muntjac *Muntiacus muntjac*, Sambar *Rusa unicolor*, Rhesus Macaque *Macaca mulatta*, Large Indian Civet *Viverra zibetha*, Crab-eating Mongoose *Herpestes urva*	Tiger *Panthera tigris*, Striped Hyena *Hyaena hyaena*, Red Muntjac, Terai Grey Langur *Semnopithecus hector*, Indian Crested Porcupine *Hystrix indica*	Indian Crested Porcupine, Sambar, Chital *Axis axis*	Tiger, Indian Crested Porcupine, Sambar, Asian Elephant *Elephas maximus*, Malayan Porcupine *Hystrix brachyura*, Rhesus Macaque

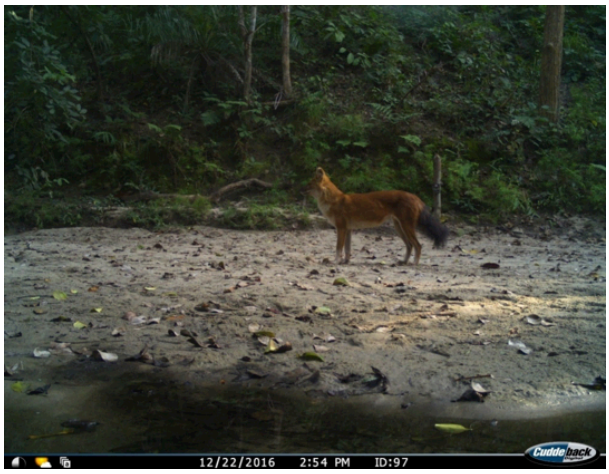

Image 1. Camera trap photograph of a Dhole (2016) (© DNPWC/ NTNC/ZSL Nepal).

Image 2. Dhole found dead in Bardia National Park (2012) (© NTNC/ BNP).

forests of southeastern Asia, Dholes appear to persist in smaller packs, probably due to the low prey biomass and small size of ungulate prey in these habitats (Kawanishi & Sunquist 2008). In our study, however, we photographed only solitary Dholes. We assume that these Dholes are sub-adult individuals looking for locations to establish territory and form a pack.

Dhole populations are scattered across Nepal but connectivity between them is not understood well (Khatiwada et al. 2011). Dholes occur historically in Terai and Churia (Himalayan foothills) but their exact distribution at present is unknown. It is believed that their population is declining due to various threats (Kamler et al. 2015). Decline in prey species has been identified as a major threat for Dhole (Aantheria et al. 2007; Thapa et al. 2013). In Bardia, widespread prey hunting was reported during the early 2000s at the peak of insurgency between maoist rebels and government (Malla 2009; Bhattarai et al. 2016). This could have caused a decline of the Dhole population in Bardia. With restoration of security and control of hunting, in recent years, the prey density in Bardia has recovered (92 prey species/km^2, Dhakal et al. 2014), which could support a larger carnivore density. On the camera stations of Dhole capture, prey species like Chital *Axis axis*, Red Muntjac *Muntiacus muntjac*, Sambar *Rusa unicolor*, Rhesus Macaque *Macaca mulata*, Terai Grey Langur *Semnopithecus hector*, Indian Crested Porcupine *Hystrix indica*, and Malayan Porcupine *Hystrix brachyura* were also photographed. In addition, Hog Deer *Axis porcinus*, Swamp Deer *Rucervus duvaucelii*, and Four-horned Antelope *Tetracerus quadricornis* occur in Bardia that may serve as prey species of Dhole.

Unlike Chitwan where Thapa et al. (2013) reported no negative interactions with humans, we recorded attacks on livestock by a Dhole and retaliatory killing. Although dholes are pack hunters, our record included a solitary dhole which came into fringe area (close to village). Khatiwada et al. (2011) also reported retaliatory killing of dhole in Kanchanjungha Conservation Area. This emphasizes the threat to the species.

The habitat in Bardia (including grassland and Sal forest) is very similar to other Terai protected areas where Dholes are recorded in higher numbers (Thapa et al. 2013). Dhole camera trapped locations lie in Sal forest of Churia Hills or river floodplain. They were captured in a periphery of ~27km^2 which is about the home range size of a Dhole pack (Karanth & Sunquist 2000). Based on the location of the camera trapped Dhole, we assume that it came through the foothills all the way from Karnali River floodplain of Bardia. In the 1990s, a pack of Dhole was recorded from the Karnali floodplain (Binti Ram Chaudhary, NTNC pers. obs. during 1990s). This reappearance of Dhole in BNP opens up a new possibility to establish a Dhole population in Bardia. An intensive and close monitoring of the Dhole is required to understand their status. An awareness program targeted at local communities about the Dhole is necessary to prevent retaliatory killings. Supplementation of the Dhole in Bardia could be an option to re-establish a population and ensure their survival.

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