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CAT

N° 61 | AUTUMN 2014

news





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CATnews is produced with financial assistance from the Friends of the Cat Group.

Design: barbara surber, werk'sdesign gmbh
Layout: Christine Breitenmoser
Print: Stämpfli Publikationen AG, Bern, Switzerland

ISSN 1027-2992 © IUCN/SSC Cat Specialist Group

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Cover Photo: Leopard cat in Rajaji National Park, India (Photo Akanksha Saxena), see article on p. 21 of this issue.

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Clouded leopard co-exist with other five felids in Chitwan National Park, Nepal

Once believed to be regionally extinct in Nepal, the clouded leopard *Neofelis nebulosa*, was recorded in 1989 and again in recent years with two new photographic evidence from Annapurna Conservation Area and Shivapuri Nagarjun National Park in 2011 and 2012. This year we recorded photographs of three individual clouded leopards from two locations in Chitwan National Park using camera traps. With this record, Chitwan National Park is one of the few parks in the world with six felid species i.e. tiger *Panthera tigris*, common leopard *Panthera pardus*, clouded leopard, fishing cat *Prionailurus viverrinus*, leopard cat *Prionailurus bengalensis* and jungle cat *Felis chaus*.

The clouded leopard is a medium-sized (Sanderson et al. 2008) elusive forest dwelling cat (Rabinowitz et al. 1987) having patchy distribution with some new being published in recent years across its range (e.g. Borah et al. 2012, Pandey 2012, Appel et al. 2012, Ghose 2002). Clouded leopards, once thought to be regionally extinct in Nepal, were recorded from different parts of Nepal over the last 25 years including Dhanusa, Nawalparasi, Kaski (Dinerstein & Mehta 1989), Annapurna Conservation Area (Appel et al. 2012) and Shivapur Nagarjun National Park (Pandey 2012). Surprisingly they were recorded in different habitats including sub-tropical deciduous forests of Terai and Siwaliks (Dinerstein & Mehta 1989), coniferous forest of Mid hills (Pandey 2012) and mixed broadleaf forests

of High hills (Appel et al. 2012). Their distribution and status in Nepal is still poorly known.

The clouded leopard had never been recorded in Chitwan National Park (CNP) before. An individual rescued in Nawalparasi about 100 km west of CNP was radio collared and released in the park in 1988 (Dinerstein & Mehta 1989). After two weeks of tracking, the animal headed west (towards the direction it was translocated from) and went out of tracking range of CNP. Recently Ghimirey et al. (2014) reported a case of clouded leopard rescued from the settlement outside of CNP and released into the park in 2007, but its status after release was unknown. The recent camera trap record of clouded leopard is the first evidence of the existence of clouded leopard in CNP. With

this record, CNP is one of few parks of the world with six species of felids.

Study Area

CNP (27°16.56' - 27°42.14'N and 83°50.23' - 84°46.25'E), is a world heritage site and the first National Park (1973) of Nepal. It is priority tiger conservation landscape (Wikramanayake et al. 1998). Situated in the south central lowlands in the inner Terai (Fig. 3), the park is dominated by forest (sal, riverine and mixed hardwood) 80 %, grassland 12%, exposed surface 5% and water bodies 3% (Thapa 2011). The park is drained by three major rivers systems i.e. Narayani, Rapti and Reu. Narayani River marks the western boundary, Rapti River marks the northern boundary, Parsa Wildlife Reserve is contiguous in eastern boundary whereas Reu River and the international border with India along the Valmiki Tiger Reserve mark the southern boundary for CNP.

Methods

The camera trapping survey was carried out throughout the Chitwan National Park, buffer zone, adjoining forest patches and corridors as a part of the National Tiger and Prey base Survey in Nepal 2013 (DNPWC & DOF 2013). For logistic reasons and camera traps availability, the area was divided into four blocks with area ranging from 288 to 528 km². Camera traps were placed systematically across the study area by super-imposing a grid of 2 km x 2 km (Fig. 3) and deploying a pair of camera traps in each cell over a standard sampling duration of 15 days. General habitat type and site parameters were collected at each camera location. Three models of camera traps were used: Reconyx 550, Moultrie 40D and Bushnell HD trophy cam. The ideal location for camera trap placement in each grid was found following intensive sign surveys to maximize the chances of photo-capture. As the primary target of the study was tigers, a site placement bias may have occurred, affecting the optimum capture of clouded leopards. Installation details, GPS location and habitat parameters of the camera stations were collected in a standard format while installing the camera traps in the field. Camera traps were checked every alternate day to ensure that the camera traps were functional and to replace batteries and SD cards as required. All the photographic data were downloaded, photos were sorted per species and individuals were identified whenever pos-



Fig. 1. Camera trap photograph of an adult clouded leopard at location A (camera station CNP-103) in Chitwan National Park, 2013.

sible. Spatial calculations of the distance to the nearest tiger/common leopard photographed as well as distance to the nearest settlements were calculated using ARCGIS 10.0.

Results and discussion

Camera traps were deployed in a total of 362 camera trapping stations with a total of 5,430 trap nights. Clouded leopards were captured in two camera trap stations in two independent events (one each). A total of 10 photographs of clouded leopard were obtained comprising of three individuals. At one location, two individuals were captured together, with one individual following another while in the other location only one individual was captured (Figs 1 & 2).

All three individual clouded leopards were adults but their sex could not be determined from the photo. The first photograph was taken on 18 March 2013, at 4:21 am at camera station CNP103 in the southwestern part of the park, very close (1.6 km) to the Valmiki Tiger Reserve, India. The second photograph of the two individuals was taken on 12 April 2013, at 9:37 am in the eastern side of the park which lies deep inside the park (12.1 km from the boundary; Fig. 3).

Both locations fall within the Siwalik hill range, the Himalayan foothills, with dense coverage of mixed hardwood forest. The details of the trap location, nearest distance to settlement and the nearest distance to the tiger and leopard captured location are presented in Table 1.

Unlike the clouded leopards reported by Dinerestein & Mehta (1989) which were found on degraded habitats with frequent interaction with humans, both the locations where clouded leopards were trapped during this study fall deep inside the core area of the park with minimum human disturbance. With the exception of location A, local people who illegally entered the park to collect resources like fodder, fuel wood and vegetable were photographed. In both locations, there is dense canopy cover of moist mixed hard wood forest and cameras were set on two sides of a stream with permanent water flow. This also shows the preference of clouded leopards to undisturbed dense forests as observed in other studies (Austin & Tewes 1999, Rabinowitz et al. 1988).

Chitwan National Park has a high density of tiger ($4.5 \pm SE 0.35/100 \text{ km}^2$) and common leopard ($3.45 \pm SE 0.49/100 \text{ km}^2$; Karki 2012, Thapa 2011) and there is evidence



Fig. 2. Two individuals of clouded leopard captured by camera trap from location B (camera station CNP-302) in Chitwan National Park, 2013.

of coexistence between these large carnivores (Seidensticker 1976). Clouded leopards were captured in areas used by tigers and common leopard suggesting a coexistence of these three species which may be attributed to a high prey biomass. In addition to these three medium to large sized felids, three small sized felids – fishing cats (Mishra 2013), leopard cats and jungle cats – are also found in CNP (Karki 2012).

Following the confirmation of the existence of the clouded leopard, CNP has six species of felids i.e. tiger, common leopard, clouded leopard, fishing cat, leopard cat and jungle cat of which two are listed as Endangered (tiger and fishing cat) and one Vulnerable (clouded leopard) in the IUCN Red List. During this study all six species of felids were captured with camera traps, Table 2 summarizes the capture records.

Table 1. Details of the camera trap locations where clouded leopards were photographed.

Parameter	Camera trap location A (CNP 103)	Camera trap location B (CNP 302)
long/lat	27.48255° N 84.21288 E	27.46041° N 84.63913 E
Elevation (m)	301	488
No. of photos	2	8
No. of individuals	1	2
Duration of camera trapping session	09 - 26 Mar 2013	29 Mar - 14 Apr 2013
Date and time of clouded leopard picture	18 Mar 2013, 4:21 h	12 Apr 2013, 9:37 h
Terrain	Flat	Undulating
Camera location	Streambed	Streambed
Habitat type	Mixed hardwood forest	Mixed hardwood forest
Distance to closest village (km)	4.6	12.1
Distance to closest tiger capture (km)	2.7	0.9
Distance to closest leopard capture (km)	2.9	0*
Other mammal species captured at the same station	Common palm civet, Indian grey mongoose, Wild boar	Common Leopard, Sloth bear, Large Indian civet, Indian grey mongoose, Sambar, Wild boar, Barking deer

*Clouded leopard and common leopard captured at the same station

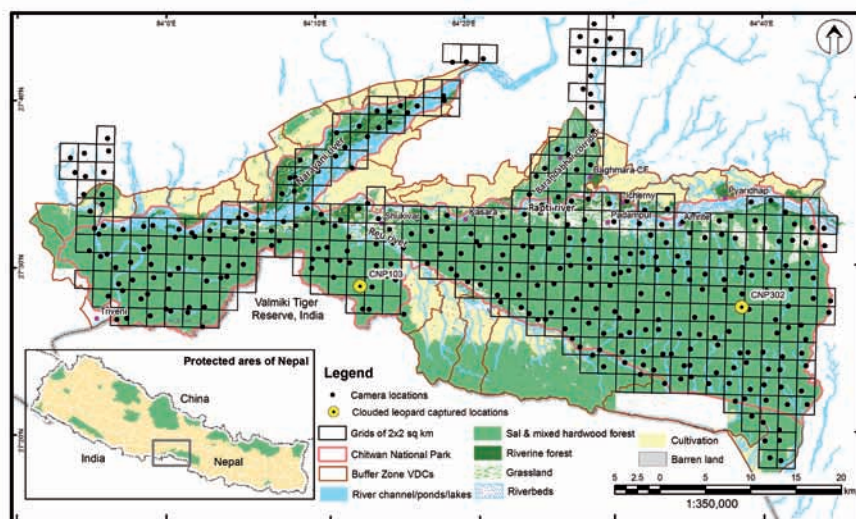


Fig. 3. Clouded leopard, capture location, camera trapping stations and camera trapping grids in Chitwan National Park.

Table 2. Summary of the camera trap capture records of six felid species in Chitwan National Park, Nepal, 2013.

Species	No of locations	No of independent events
Clouded leopard	2	2
Fishing cat	19	23
Leopard cat	21	27
Jungle cat	36	58
Leopard	112	198
Tiger	136	255

The largest number of capture locations as well as independent events were observed for tiger followed by leopard, jungle cat, leopard cat, fishing cat and clouded leopard. The high felid diversity of CNP is comparable with other records of six species in Royal Manas National Park, Bhutan (Tempa et al. 2013, Borah et al. 2012) and seven species in Jeypore-Dehing rainforest in Assam, India (Hance 2010). Some literature suggests the existence of marbled cat in Chitwan (CNP 2013), however there is no conclusive evidence for now.

Acknowledgements

This study was a part National Tiger and Prey base Survey in Nepal, 2013. Thus, we would like to thank the Government of Nepal, Ministry of Forest and Soil Conservation, Department of National Parks and Wildlife Conservation, Department of Forests, National Trust for Nature Conservation, WWF Nepal, USAID-Hariyo Ban Program and all the donors, field staff, Nepal army, student volunteers and local communities for their support.

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