

BABU RAM LAMICHHANE^{1,2,3*}, RABIN KADARIYA^{1,4}, NARESH SUBEDI¹, BED KUMAR DHAKAL⁵, MAHESHWAR DHAKAL⁶, KANCHAN THAPA⁷ AND KRISHNA PRASAD ACHARYA⁸

Rusty-spotted cat: 12th cat species discovered in Western Terai of Nepal.

Rusty-spotted cat *Prionailurus rubiginosus* is the smallest wild cat, believed to be distributed only in India and Sri Lanka. Recently it was discovered from wider areas than previously thought but never recorded from Nepal. During a camera trap survey primarily targeted for tigers *Panthera tigris*, rusty-spotted cat was photographed multiple times on a single camera trap station in Shuklaphanta Wildlife Reserve in January and February 2016. The camera trap location is in dry-deciduous *Sal Shorea robusta* forest in core area of the reserve at a distance of approximately 5 km from settlements. This is the first photographic evidence of rusty-spotted cat captured in camera traps in Nepal. Similarly, a photograph of a cat species taken by a park visitor in 2012 from Bardiya National Park was confirmed as rusty-spotted cat. With this record, Nepal has 12 felid species: tiger, common leopard *Panthera pardus*, snow leopard *Panthera uncia*, clouded leopard *Neofelis nebulosa*, Eurasian Lynx *Lynx lynx*, Asiatic golden cat *Catopuma temminckii*, fishing cat *Prionailurus viverrinus*, jungle cat *Felis chaus*, leopard cat *Prionailurus bengalensis*, marbled cat *Pardofelis marmorata*, Pallas's cat *Otocolobus manul* and rusty-spotted cat.

The miniature member of the feline family, the rusty-spotted cat is one of the lesser known small carnivore species (Sunquist & Sunquist 2014, Vyas & Upadhyay 2014). With an average adult weight of 1.1 kg for females and 1.6 kg for males (Phillips 1980), respectively, they are about half the weight of a typical house cat. Historically, it was believed to be confined to central and southern India and Sri Lanka (Pocock 1939, Phillips 1980, Khan & Mukherjee 2008). Nowell & Jackson (1996) reported an isolated record from Kashmir without evidence of continuous distribution

in between. But in recent years, it has been recorded frequently and found widely distributed in India (Anwar et al. 2010, Athreya, 2010) either due to its range expansion or more likely due to the high probability of detection in the extensive coverage of camera trap surveys across the region. The species has recently been recorded in the Indian part of the transboundary Terai Arc Landscape TAL from the Pilibhit forest division (now Tiger Reserve) and Katarniaghat Wildlife Sanctuary in 2010 and 2012, respectively (Anwar et al. 2010, 2012). Similar habitat exists along the

TAL-Nepal but rusty-spotted cat has never been recorded in Nepal before.

Rusty-spotted cat is believed to be primarily nocturnal (Nowell & Jackson 1996). Very little is known about their diet and habitat preference. They might be more common in grasslands, scrub, drier and open forests (Phillips 1980, Prater 1980) and apparently not found in closed forest types (Nowell & Jackson 1996). Multiple records in Sri Lanka and India show their tolerance to modified habitat such as denning and breeding in tea plantations in Sri Lanka (Phillips 1980). They were also found in attics of houses surrounded by paddy fields and coconut trees in southern India, old farm houses in mango plantations in Gujarat, or on farmlands on the outskirts of Bangalore (Nowell & Jackson 1996). The cat preys on small mammals and birds (Nowell & Jackson 1996) although we don't know details. They sometimes also take domestic chickens (Pocock 1939, Phillips 1980).

Rusty-spotted cat has never been described from Nepal but other eleven felid species have been previously recorded. Ten felid species (tiger, common leopard, snow leopard, clouded leopard, lynx, Asian golden cat, marbled cat, jungle cat, fishing cat, leopard cat) are well documented (Baral & Shah 2008, Jnawali et al. 2011, Thapa 2014) and a new species i.e. Pallas's cat was discovered in 2013 from the Nepalese Himalayas (Shrestha et al. 2014). Here we report the photographic evidence of the rusty-spotted cat, the 12th cat species of Nepal, from two protected areas of western Terai, Shuklaphanta Wildlife Reserve SWR and Bardiya National Park BNP in Nepal.

Materials and methods

Study area

This study was conducted in an area of 305 km² of SWR in a single dry season (January-March 2016) and in BNP. SWR & BNP are located in the western region of the Terai Arc Landscape TAL, Nepal, which stretches over nearly 23,000 km² of alluvial floodplains and Churia hills (Wikramanayake et al. 2004). SWR lies in the south-western corner of Nepal. The reserve is bordered by Mahakali river in the west, settlements in the north, India in the south and Syali river in the east. It is connected to Pilibhit and Dudhwa Tiger Reserve in India through the Laggabagga corridor in the south (India) and the Laljhadi corridor in the east (Nepal), respectively. An opportunistic sighting of a rusty-spotted cat was reported from BNP

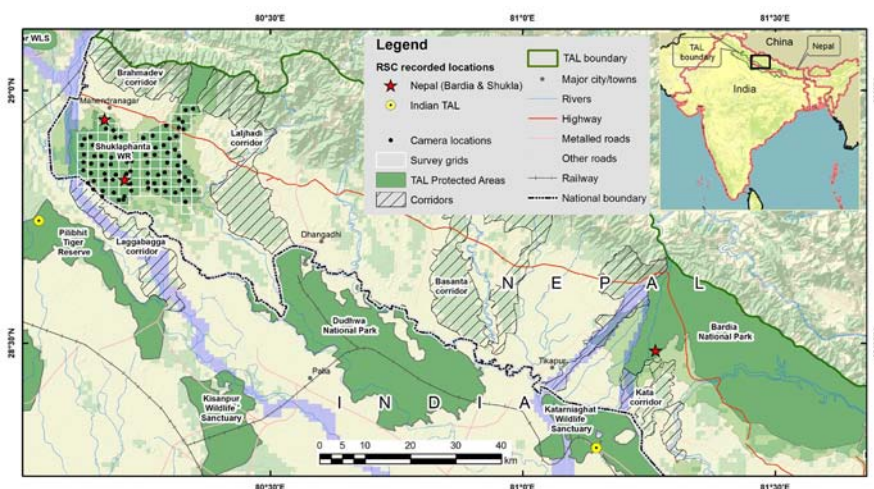


Fig. 1. Western Terai Arc Landscape showing rusty-spotted cat captured locations in Bardiya National Park (Nepal), Shuklaphanta Wildlife Reserve (Nepal), Katarniaghat Wildlife Sanctuary (India) and Pilibhit Tiger Reserve (India) along with other protected areas and forest corridors.

(968 km²), from the Karnali River floodplain, stretching ca. 100 km² in the south-western part of BNP (Wegge et al. 2009). BNP is connected to Katarniaghat Wildlife Sanctuary in India through the 'Khata' corridor (Wikramanayake et al. 2004). Both BNP & SWR have sub-tropical monsoonal climate with three distinct seasons: monsoon (July-October), cool-dry (November-February) and hot-dry (March-June).

Camera trap survey

As a part of tiger monitoring programme in the Western Terai Landscape, a camera trapping survey was carried out covering the entire SWR in two blocks between 27 January and 2 March 2016. Camera traps were placed systematically by super-imposing a grid of 2 x 2 km² (Fig. 1) and deploying a pair of camera traps (Reconyx 550 & Bushnell trophy cam) in each grid cell over a standard sampling duration of 15 days. Habitat type and site parameters were collected at each camera location. Camera trap locations within each grid cell were selected following intensive sign surveys for tigers to maximise the chance of photo-captures (Dhakal et al. 2014). Camera trap pairs were placed 8-10 m apart facing each other at 45-60 cm above the ground. As the primary target species of the study was tiger, site selection, distance between paired cameras and camera height might have affected the optimum capture of rusty-spotted cat. All the photographic data were downloaded, photos were sorted per species and individuals were identified whenever possible. Photo capture of a species within a 30 minute interval was termed as 'independent event'. Capture rate (number of independent events per 100 trap nights) was calculated as an abundance index of rusty-spotted cat (Thapa et al. 2013). Spatial calculations were done using ArcGIS 10.0.

Opportunistic sighting of rusty-spotted cat

A local nature guide (Mr. Ramjan Chaudhary) provided a photo of a cat species to one of the authors (Rabin Kadariya) to check if it was a fishing cat. The photo was taken by a park visitor on 28 March 2012 during a jeep safari in Karnali floodplain of BNP. In consultation with small carnivore experts it was identified as rusty-spotted cat. Later, the location of sighting and other details were also recorded. Similarly, a rusty spotted cat was sighted by the first author during a jeep safari in SWR on 20 April 2016.



Fig. 2. (a) Photograph of rusty-spotted cat taken by a tourist (Ms. A. Clifford) in Bardiya NP during a jeep safari, (b) first camera trap picture of rusty-spotted cat captured in Nepal from Shuklaphanta Wildlife Reserve, (c) two different individuals of rusty-spotted cat identified from their stripe pattern (inner side of left hind limb) and tail.

Results and discussion

We recorded 22 photographs of rusty spotted with total search effort of 1,317 trap nights from 85 camera trap grids in SWR. The species was identified based on body structure, pattern on the body (black spots on pale grey background), white belly with black lines and dark unmarked bushy tail. Photographs were obtained from six independent events on five different dates. The rusty-spotted cat was captured only in a single location with multiple recaptures ($n = 6$). The encounter rate of rusty-spotted cat within the core area of SWR was 0.46/100 trap nights. All the captures were made between 20:29 h in the evening and 04:54 h in the morning. Photographs from two events (28 January and 3 February 20:29 h) with similar position of the animal allowed us to confirm at least two individual males (Fig. 2). For the rest of the events, we were not able to confirm their individual identity. The location of the rusty-spotted cat records was in relatively open and dry Sal forest (Supporting Online Material SOM Figure F1) in the core area of the reserve with minimal human disturbance, about 4.6 km from the nearest forest edge. We also recorded additional eight mammal species, including six carnivores, in the same location where the rusty-spotted cat was captured (Table 1). Both tiger and rusty-spotted cat were also captured in a single trap night on 28 January 2016 (Fig. 3).

In addition to the camera trap, opportunistic sighting of a rusty-spotted cat was also recorded by the first author in SWR at 20:05 h of April 20, 2016 during ca. 50 km long jeep drive. The cat was found walking on the forest road, at the edge of the relatively open dry deciduous sal forest. The location (28°56'35.34" N / 80°10'20.7588" E, elevation 216 m) is very close (< 100 m) to the settlements and 13.8 km north-west of the camera trapped location.

In Bardiya, a rusty-spotted cat was recorded in the evening (ca. 18:00 h) of 28 March 2012 during a ca.15 km long opportunistic jungle safari in the Karnali floodplain. The cat was sitting on a log lying on the ground in a Sal forest and was photographed by a park visitor (Fig. 2a). Looking at its position, the cat was probably ambushing prey. Conspicuous small head structure, forehead stripes and pale grey coat with rusty spots enabled a confident identification as rusty-spotted cat. The sighting location lies within a dry deciduous Sal forest ca. 700 m from the nearest forest edge. All the records of rusty-spotted cat were from a forested area. But it was recorded from fringe (<1 km) to deep inside the core areas. Similar observations were done along the TAL-India (Anwar et al. 2010, 2012). In TAL-India, all records were recent and the species was not recorded earlier in regular camera trapping surveys (Anwar et al. 2012, Jhala et al. 2008). Comparable to our camera trap sur-

Table 1. Details of camera trap location where rusty-spotted cat was captured in Shuklaphanta Wildlife Reserve, Nepal.

Location ID	SWR 42
GPS	28.82346° N / 80.21171° E
Elevation	192 m
No. of independent events	6
No. of photos	22
Duration of Camera Trap	Jan 28 to Feb 12, 2016
Photo Captured dates	Time (in 24 hrs)
28 Jan 2016	22:42 h
31 Jan 2016	20:31 h
02 Feb 2016	19:54 h
03 Feb 2016	04:54 h
03 Feb 2016	20:29 h
08 Feb 2016	22:31 h
Terrain	flat
Camera location	forest road
Habitat type	sal forest
Nearest distance to village (km)	4.6
Other mammal species captured in the same camera trap station	tiger, common palm civet, small Indian civet, honey badger, bengal fox, Himalayan crestless porcupine, chital, muntjac, Indian hare

vey findings, captures of the rusty-spotted cat were made during the night (20:29 h-04:54 h) across TAL. However, the direct sighting records were made during the evening 18:00 h, 19:35 h and 20:05 h (Anwar et al. 2012 and present study).

This study presents the conclusive record for the presence of the rusty-spotted cat in Nepal and brings the total number of cats in the country to 12 (SOM T1). According to the National Red List of Nepal (Jnawali et al. 2011), two felid species i.e. marbled cat (whose photographic evidence has not been found in recent years) and Asiatic golden cat are listed in Data Deficient DD category. Two new species (Pallas's cat and rusty-spotted cat) discovered after 2013 have not been assessed in the National Red List. The discovery of two new cat species in Nepal also highlights the importance of research on sta-

tus, distribution and ecology for their conservation in the country.

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Supporting Online Material SOM Figure F1 and Table T1 are available at www.catsg.org.

¹ National Trust for Nature Conservation, Khumaltar, POB 3712, Lalitpur, Nepal

² Institute of Cultural Anthropology and Development Sociology, Faculty of Social and Behavioral Sciences, Leiden University, Leiden, The Netherlands

³ Evolutionary Ecology Group, Faculty of Sciences, University of Antwerp, Antwerp, Belgium

⁴ Laboratory of Wildlife Biology and Medicine, Graduate School of Veterinary Medicine, Hokkaido University, Sapporo, Japan

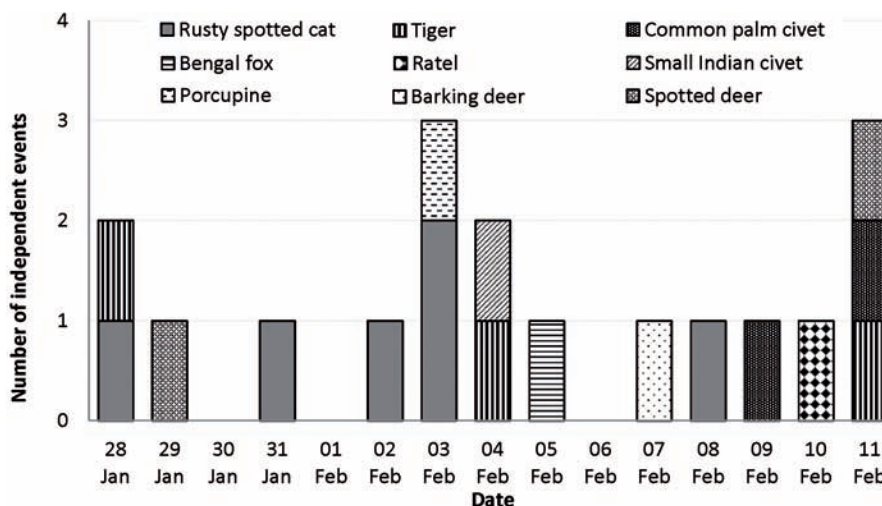


Fig. 3. Temporal pattern of mammal species capture in camera trap station (CT 042) where rusty-spotted cat was captured in Shuklaphant Wildlife Reserve, Nepal.

⁵ Shuklaphanta Wildlife Reserve Office, Majhgaon, Kanchanpur, Nepal

⁶ Department of National Parks and Wildlife Conservation, Babarmahal, Kathmandu, Nepal

⁷ WWF Nepal, Baluwatar, Kathmandu, Nepal

⁸ Ministry of Forests and Soil Conservation, Singhadurbar, Kathmandu, Nepal

*<baburam1@gmail.com>, <baburam@ntnc.org.np>

CHARLES McDOUGAL¹, BHIM GURUNG^{1*}, DHAN BAHADUR TAMANG³, BABURAM MAHATO¹, RAJU KUMAL¹ AND PRAKASH M. SHRESTHA¹

Stability of tigers in Chitwan National Park, Nepal

Tiger *Panthera tigris* monitoring using radio-telemetry, pugmark tracking and camera trapping was conducted for four decades in an area of approximately 100 km² in the western part of Chitwan National Park, Nepal. The aim was to record the life history, longevity and reproductive status of the resident breeding tigers. From 1985 to 2015, the data shows a density of six breeding females / 100 km² and considerable disparity in reproductive success for male and female tigers. Seven long-lived females (12-17 years) produced a mean of 5.14 litters, yielding an average litter size of 2.89. Nearly 60 percent of the cubs survived up to the age of dispersal. Such high reproductive success and constant number of breeding females are the contributing factors in the stability of the Chitwan tiger population.

Chitwan National Park CNP, a UNESCO World Heritage Site, was established in 1973 largely to protect two iconic endangered species, the greater one horned rhinoceros *Rhinoceros unicornis* and the Bengal tiger *Panthera tigris tigris*. Prior to the park's establishment, most of the area was a Rhinoceros Sanctuary, which was created in 1962. A force of armed guards, called the Gaida Gusti (Rhino Patrol), manned a series of guard-posts throughout the area to prevent poaching. However, nothing was done to curtail the overgrazing by large numbers of domestic cattle and buffaloes. Large livestock numbers simply compensated for decline in

deer numbers. With less natural prey available, tiger numbers were also down.

When the park was created, one of the first priorities was the control of illegal domestic livestock grazing. This task was tackled energetically by Tirtha Man Maskey, the first Chief Warden of CNP. Additionally, in 1975, a contingent of the Nepal Army was stationed inside the Park to protect rhinoceros and tigers but also to deter illegal human activities within the park. Livestock were rounded up and kept in enclosures at the guard posts until the owners paid a fine for their release. It took almost three years, but eventually do-

mestic livestock grazing was controlled. The result was that deer numbers rose and the tiger numbers followed suit. However, very little was known about tiger biology, behaviour, reproduction, dispersal, movement/activity pattern, and habitat requirements that could assist the park management for better protection. To address this lack of knowledge, the Smithsonian Nepal Tiger Ecology Project began in 1973 and continued through 1980. For the first time, radio-telemetry was used on tigers to monitor the movement and activities of individual tigers. One of the major findings of the project was that breeding tigers maintain exclusive home ranges defined as territories (Sunquist 1981). Females compete for resources to establish exclusive territories to maintain themselves and to raise their offspring. Males compete for reproductive females, with successful ones establishing territories that monopolise several females (Sunquist 1981).

In 1980, McDougal was made a Smithsonian Research Associate to conduct a long term tiger monitoring LTTM project as a follow up to the earlier Smithsonian Studies in the 1970s. The objective was to gain a long-term perspective on the population dynamics, life histories, and reproduction, including cub survival to age of dispersal. In this paper, we analyse the data collected during this project to determine the life histories of the resident

Lamichhane B. R., Kadariya R., Subedi N., Dhakal B. K., Dhakal M., Thapa K. & Acharya K. P. 2016. Rusty-spotted cat: 12th cat species discovered in Western Terai of Nepal. *Cat News* 64, 30-33. Supporting Online Material

SOM F1. Camera trap location where rusty-spotted cat was captured in Shuklaphanta Wildlife Reserve. The location was at typical forest road in Sal forest (visible on the background of photo).



SOM T1. Natural history of felid species recorded in Nepal.

SN	Scientific name	Common name	IUCN Red List (Global)	IUCN Red List (National)	Nepal's Protected Animal List	Size category	Source
1	<i>Catopuma temminckii</i>	Asian Golden Cat	NT	DD	-	Medium	Ghimirey & Pal 2009
2	<i>Felis chaus</i>	Jungle Cat	LC	LC	-	Medium	Karki 2011
3	<i>Lynx lynx</i>	Eurasian lynx	LC	VU	Protected	Medium	Thapa 2014
4	<i>Neofelis nebulosa</i>	Clouded Leopard	VU	EN	Protected	Medium	Lamichhane et al. 2014
5	<i>Panthera pardus fusca</i>	Leopard	NT	VU	-	Large	Thapa et al. 2014
6	<i>Panthera tigris tigris</i>	Bengal Tiger	EN	EN	Protected	Large	Dhakal et al. 2014
7	<i>Panthera uncia</i>	Snow Leopard	EN	EN	Protected	Large	Jackson 1996
8	<i>Pardofelis marmorata</i>	Marbled Cat	NT	DD	-	Small	Jnawali et al. 2011
9	<i>Prionailurus bengalensis</i>	Leopard Cat	LC	VU	Protected	Small	Karki 2011
10	<i>Prionailurus rubiginosus</i>	Rusty-spotted cat	VU	N/A*	-	Small	This study
11	<i>Prionailurus viverrinus</i>	Fishing Cat	EN	EN	-	Medium	Mishra 2012
12	<i>Otocolobus manul</i>	Pallas's cat	NT	N/A*	-	Small	Shrestha et al. 2014