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COMMUNICATION

THE FISHING CAT *PRIONAILURUS VIVERRINUS* (BENNETT, 1833) (MAMMALIA: CARNIVORA: FELIDAE) IN SHUKLAPHANTA NATIONAL PARK, NEPAL

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The Fishing Cat *Prionailurus viverrinus* (Bennett, 1833) (Mammalia: Carnivora: Felidae) in Shuklaphanta National Park, Nepal

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Abstract: The Fishing Cat *Prionailurus viverrinus* is known to occur in the Terai region since at least the late 1920s. Contemporary locality records of the Fishing Cat in this region are widely spaced, and the knowledge about the connectivity between these localities is still deficient. We present the first photographic evidence for the presence of the Fishing Cat in far western Nepal. In spring and winter 2016, we obtained 30 notionally independent events of the Fishing Cat in the floodplain of Shuklaphanta National Park at elevations of 181–221 m. This population unit may be connected to units in Indian protected areas. Further targeted surveys in adjacent wetlands and wildlife corridors are warranted to clarify its range in the Indian and Nepal Terai.

Keywords: Camera trapping, small wild cat, Terai, wetland, wildlife corridor.

सारांश: सन् १९२० दशक पछि मलाह बिरालो *Prionailurus viverrinus* तराई क्षेत्रमा देखा परेको हो। हाल यस क्षेत्रमा मलाह बिरालोको रेकर्ड व्यापक रूपमा राखिएको छ र पनि यी स्थानहरू बीचको कनेक्टिभिटीको बारेमा ज्ञानको अझै कमी छ। सुदूर पश्चिम नेपालमा मलाह बिरालोको उपस्थितिको रूपमा यो पहिलो फोटोग्राफिक प्रमाणको रूपमा प्रस्तुत गरिएको हो। सन् २०१६ को बसन्त र जाडो याममा शुक्लाफाँटा राष्ट्रिय निकुञ्जको बाढीग्रसित मैदानमा १८०–२२१ मीटर को उचाइमा मलाह बिरालोको स्वतन्त्र क्रियाकलापहरू गरेको देखियो। यो मलाह बिरालोको संख्या भारतीय संरक्षित क्षेत्रहरूमा भएको संख्या संग पनि जोडिएको हुन सक्छ। यो पाइने क्षेत्रहरूको बारेमा थप जात्रको लागि नेपाल र भारतको तराई क्षेत्रमा बन्धनन्तु प्रयोग गर्ने बाटो तथा सिमसार क्षेत्रहरूलाई लक्षित गरी थप अध्ययन गर्नु आवश्यक देखिन्छ।

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INTRODUCTION

The Fishing Cat *Prionailurus viverrinus* has an extensive but discontinuous geographic range in subtropical and tropical Asia, as it is strongly associated with inland and coastal wetlands (Mukherjee et al. 2016). These ecosystems have been imperilled since the early 20th Century due to large-scale conversions for agriculture, aquaculture, industry, hydropower plants (Gopal 2013; Davidson 2014; Dixon et al. 2016) and construction of brick kilns (Chakraborty et al. 2020a). The Fishing Cat is negatively impacted by this loss of natural wetlands and is consequently listed as Vulnerable on the IUCN Red List of Threatened Species, since populations are thought to have declined in all range countries (Mukherjee et al. 2016). Outside protected areas, Fishing Cats have been killed for consumption, in retaliation for preying on livestock and for damaging fishing nets (Miththapala 2006; Mukherjee et al. 2012; Chowdhury et al. 2015; Cutter 2015). At several sites, Fishing Cats have been victims of road collisions (Miththapala 2006; Thudugala 2016; Prerna et al. 2016; Palei et al. 2018). Fishing Cat populations are detrimentally affected by increased anthropogenic disturbances and destruction of mudflats and crop fields (Chakraborty et al. 2020a).

Little is known about the contemporary status of the Fishing Cat in Pakistan, where it was photographed in just one locality in the Indus River basin (Islam et al. 2015). In India, the Fishing Cat is present in and around several albeit widely scattered protected areas (Singh 1982; Mukherjee et al. 2012; Nair 2012; Sadhu & Reddy 2013; Naidu et al. 2015; Malla 2016; Prerna et al. 2016; Talegaonkar et al. 2018). The Ganges-Brahmaputra River delta and Sri Lanka are presently considered Fishing Cat strongholds because of multiple locality records both inside and outside protected areas (Miththapala 2006; Mukherjee et al. 2012; Chowdhury et al. 2015; Das et al. 2017; Mukherjee et al. 2016; Kolipaka et al. 2019; Chakraborty et al. 2020a, b). Records of the Fishing Cat in Thailand, Myanmar, and Cambodia are, however, highly localised (Cutter & Cutter 2009; Rainey & Kong 2010; Thaug et al. 2018; Chutipong et al. 2019; Naing Lin & Platt 2019).

In Nepal, the Fishing Cat was listed as nationally Endangered in 2011, as the population was thought to comprise no more than 200 mature individuals (Jnawali et al. 2011). Since then, the Fishing Cat was recorded at several sites in the lowland Terai region (Fig. 1): in the Babai River valley in Bardia National Park (Yadav et al. 2018), in the surroundings of Jagdishpur Reservoir (Dahal 2016), in Chitwan and Parsa National Parks (Karki

2011; Mishra et al. 2018; Poudel et al. 2019) and in and around Koshi Tappu Wildlife Reserve (Pandey & Kaspal 2011; Taylor et al. 2016).

Here we report the first photographic evidence for the presence of a Fishing Cat population in Shuklaphanta National Park obtained during two monitoring surveys targeting the Tiger *Panthera tigris*.

STUDY AREA

Shuklaphanta National Park (ShNP) is a 305km² large protected area in the Terai of southwestern Nepal (Fig. 2), ranging in elevation from 174m in the south to 1,386m in the north-east (Bhujaraj et al. 2007). ShNP is bordered by farmland and settlements in the north, the Syali River in the east, and the Mahakali River in the south and west (Bharal & Inskipp 2009). In the south, ShNP is connected to Pilibhit Tiger Reserve in India through the Laggabagga corridor (Talukdar & Sinha 2013). The Kilpura–Khatima–Surai corridor to the west of the Mahakali River also connects ShNP to Pilibhit Tiger Reserve (Anwar & Borah 2020). The climate in this area is tropical savannah (Karki et al. 2016a) with temperatures ranging from 7–21 °C in January to a maximum of 37°C in May and 25°C in July (Timilsina & Heinen 2008). The area receives an annual rainfall of 1,055–2,843 mm, with more than 90% falling during the monsoon season between July and August (Pokheral & Wegge 2019).

The protected area consists of about 35% mixed deciduous forest, 30% Sal *Shorea robusta* forest and 35% open grasslands interspersed with wetlands (Pokheral & Wegge 2019). Grasslands called *phantas* occur mainly in the south-central part and are dominated by tall grasses such as *Imperata cylindrica* and *Heteropogon contortus*; *Phragmites karka* and *Saccharum spontaneum* grow around marshes and seven small lakes (Bharal & Inskipp 2009; Image 1). The national park hosts a diverse fauna including 28 fish species (Bhujaraj et al. 2007), 423 bird species (Bharal & Inskipp 2009), and Mugger *Crocodylus palustris* (Bhatt et al. 2012; Image 1). Nine turtle, 15 amphibian, 16 lizard, and 30 snake species have been documented to date (Rawat et al. 2020). Mammals are represented by Asiatic Elephant *Elephas maximus*, Greater One-horned Rhinoceros *Rhinoceros unicornis* (Talukdar & Sinha 2013), Hispid Hare *Caprolagus hispidus* (Yadav et al. 2008), Rhesus Macaque *Macaca mulatta*, Terai Gray Langur *Semnopithecus hector*, Chital *Axis axis*, Hog Deer *A. porcinus*, Indian Muntjac *Muntiacus muntjak*, Nilgai *Boselaphus tragocamelus*, and Wild Boar *Sus scrofa* (Pokheral & Wegge 2019). The *phantas*

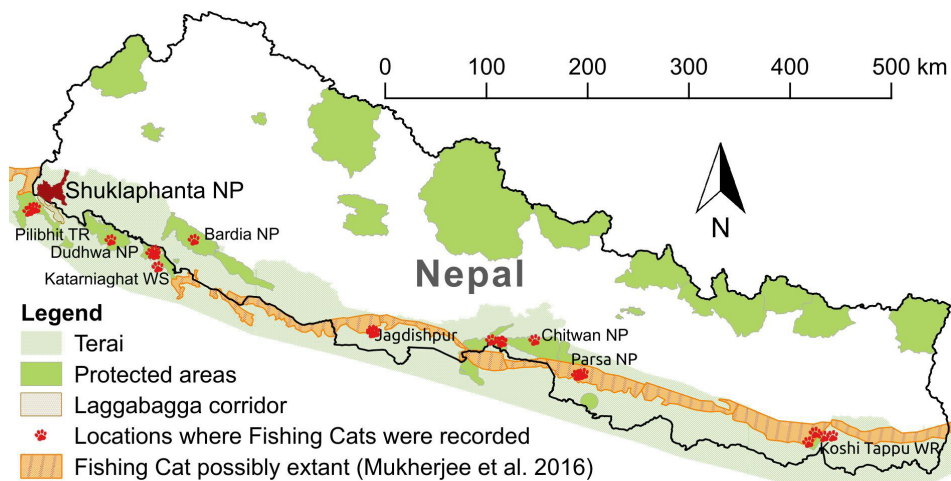


Figure 1. Terai with localities where the Fishing Cat has been recorded since 2010

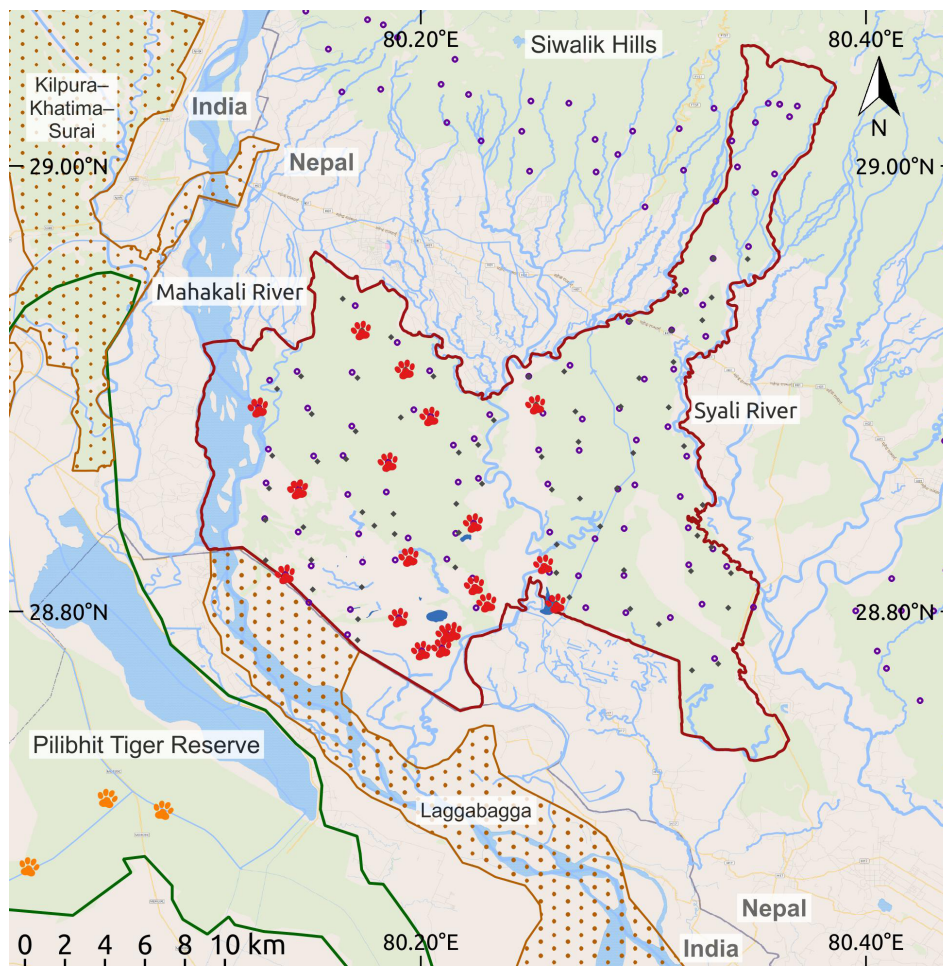


Figure 2. Shuklaphanta National Park and surroundings in the southwestern Terai



Image 1. Rani Tal, one of the shallow lakes in Shuklaphanta National Park. © Angie Appel

provide prime habitat for Nepal's last remaining Swamp Deer *Rucervus duvaucelii* herds (Pokheral & Wegge 2019). Since December 2008, cats recorded during camera trap surveys include Tiger, Leopard *Panthera pardus* (Pokheral & Wegge 2019), and Rusty-spotted Cat *Prionailurus rubiginosus* (Lamichhane et al. 2016).

MATERIALS AND METHODS

Three camera trap models were used during surveys: Reconyx 550, Bushnell Trophy Cam and Panthera V4. Each camera trap had a unique identification number for data recording and maintenance purposes. ShNP and adjacent forest corridors were superimposed with a grid of 2x2 km² cells that were searched for Tiger signs to determine suitable camera trap locations. Two camera traps were deployed as pairs facing each other at a distance of 6–12 m, henceforth termed station. The camera traps were mounted 45–60 cm above ground without any attractant. They were active for 24 hours and set to take between three and 12 photographs within an interval of one second followed by a video. Stations were placed between 1.5km and 2.9km apart from each other. The coordinates of locations were determined using a Garmin eTrex 64s device set to WGS

84 datum, and their elevations using the digital elevation model generated by the Space Shuttle Radar Topography Mission version 3 dataset that provides a 90-meter resolution (NASA JPL 2013). Inside ShNP, the stations were kept at locations for at least 15 days and were then moved to new locations. In the forest corridors outside of ShNP, they were kept at locations for six to seven days as local people collected firewood during the survey period. Habitat type and site parameters were collected at each location. Records of the Fishing Cat within an interval of 30 minutes between consecutive photographs are considered a notionally independent event.

RESULTS

The first survey session was carried out from 27 January to 26 April 2016 in 95 cells within the national park and in 67 cells in two forest corridors located to the northwest and east of the national park. The second survey session covered 85 cells from 23 November 2016 to 11 December 2016 inside the national park. The total survey effort during both sessions amounted to 3,404 camera trap days (Table 1).

The Fishing Cat was recorded at nine locations in 12 notionally independent events (NIE) during the first survey session (5.55% of locations), and at 15 locations in 18 NIE during the second survey session (17.65% of locations) (Table 2). These 24 locations range in elevation from 181m to 211m and encompass an area of about 144km² in the southwestern part of Shuklaphanta National Park. Seven locations were in proximity of less than 10m to a waterbody; 10 were between ~40m and 250m away from a waterbody; and the distance of seven locations to a waterbody was between ~500m and 2km. All photographs show solitary individuals that were recorded between early evening at 18.44h and early morning at 06.30h in 28 NIE. Two NIE were recorded in mid-morning, both at the same location in a grassland.

Table 1. Survey sessions and survey blocks in Shuklaphanta National Park and adjacent forest corridors, Nepal. The term 'camera trap day' refers to a 24-hour period.

Survey session	Survey block	Elevation range	Camera trap days
27 January–26 April 2016	Inside ShNP	174–917 m	1,503
	Brahmadev forest corridor	245–809 m	465
	Laljhadi forest corridor	179–361 m	465
23 November–11 December 2016	Inside ShNP	174–244 m	1,436

Table 2. Details of notionally independent events of Fishing Cat obtained in Shuklaphanta National Park between January and December 2016.

Date and time	Coordinates	Elevation and habitat
30.i.2016, 02.57h; 8.ii.2016, 06.19h	28.790°N & 80.211°E	182m; open riverine forest, resting on a wooden bridge over a creek (Image 2)
31.i.2016, 21.20h; 9.ii.2016, 19.33h	28.817°N & 80.139°E	185m; open grassland, <140m to a marsh
2.ii.2016, 19.03h	28.867°N & 80.185°E	202m; Sal forest, <140m to a creek
2.ii.2016, 21.09h	28.797°N & 80.190°E	189m; open riverine forest, <200m to a marsh
4.ii.2016, 05.37h	28.892°N & 80.127°E	198m; riverine forest, <4m to bank of Mahakali River
4.ii.2016, 10.02h; 7.ii.2016, 09.22h	28.784°N & 80.209°E	182m; open grassland, on a stream bank (Image 3)
5.ii.2016, 06.30h	28.840°N & 80.224°E	192m; dense Sal forest, <50m to a stream bank (Image 4)
6.ii.2016, 03.12h	28.855°N & 80.145°E	188m; forest road passing through a grassland interspersed with forest patches, <2km to Mahakali River
9.ii.2016, 18.44h	28.782°N & 80.200°E	181m; riverine forest interspersed with grasses, ~185m to a creek
25.xi.2016, 05.33h	28.891°N & 80.126°E	198m; mixed deciduous forest on bank of Mahakali River
26.xi.2016, 18.58h	28.812°N & 80.224°E	184m; forest patch in grassland, <1.5km to a marsh
26.xi.2016, 19.21h	28.909°N & 80.193°E	213m; Sal forest, <1km to a creek
26.xi.2016, 21.16h	28.804°N & 80.229°E	191m; riverine forest, <1.2km to a marsh
28.xi.2016, 06.17h; 29.xi.2016, 05.25h; 6.xii.2016, 23.13h	28.824°N & 80.195°E	186m; mixed deciduous forest patch, <500m to a marsh (Image 5)
29.xi.2016, 05.25h; 9.xii.2016, 23.19h	28.855°N & 80.145°E	189m; Sal forest patch in grassland, ~250m to a creek
30.xi.2016, 02.50h	28.784°N & 80.209°E	182m; riverine forest on bank of Mahakali River
1.xii.2016, 20.49h	28.893°N & 80.252°E	210m; Sal forest, ~250m to a creek
2.xii.2016, 20.10h	28.812°N & 80.224°E	184m; riverine forest on bank of Mahakali River
5.xii.2016, 02.40h	28.821°N & 80.255°E	190m; Sal forest, <40m to Syali River
6.xii.2016, 02.59h	28.909°N & 80.193°E	213m; Sal forest, ~40m to a stream
6.xii.2016, 04.07h	28.888°N & 80.204°E	206m; Sal forest, ~890m to a marsh
7.xii.2016, 03.19h	28.926°N & 80.173°E	221m; Sal forest, ~800m to a marsh
10.xii.2016, 21.29h	28.804°N & 80.261°E	193m; Sal forest on bank of lake
11.xii.2016, 04.47h	28.791°N & 80.214°E	185m; riverine forest, ~80m to a marsh (Image 6)

DISCUSSION

The survey sessions in 2016 yielded the first photographic evidence for the presence of a Fishing Cat population in ShNP. Solitary Fishing Cats were recorded at 24 locations in the south of the national park. These records contribute to reducing the information gap about the cat's distribution in the Terai.

In 2011, the Fishing Cat was not yet suspected to inhabit this protected area (Jnawali et al. 2011). As documented by the opportunistic records obtained in spring and winter 2016, the floodplain below the elevation of 250m provides suitable habitat for the cat. It was photographed foraging in the vicinity of stream banks, but also while wandering between shallow

waterbodies in grassland and forest patches. These records are consistent in the Fishing Cat's habitat use with those in the similarly water-rich Dudhwa and Chitwan National Parks (Nair 2012; Mishra et al. 2018). Elsewhere in its range, it was also observed in a matrix of grass cover and shallow edges of waterbodies (Mukherjee 1989; Cutter 2015; Islam et al. 2015; Taylor et al. 2016; Angie Appel pers. obs. 04 February 2016; Malla et al. 2018; Naing Lin & Platt 2019).

The survey effort inside ShNP was concentrated on the floodplain in the south. We, therefore, emphasize that the absence of records of the Fishing Cat in the hilly landscape in the north does not indicate its absence there. For comparison, Bardia National Park extends over an area of 968km² in the Nepal Terai; since 2008,



Image 2. Fishing Cat resting on a wooden bridge over a creek in Shuklaphanta National Park on 30 January 2016. © Department of National Parks and Wildlife Conservation (DNPWC), National Trust for Nature Conservation (NTNC) and Zoological Society of London, Nepal (ZSL)



Image 3. Fishing Cat in a grassland in Shuklaphanta National Park on 4 February 2016. © DNPWC, NTNC and ZSL

camera trapping surveys have been conducted annually to bi-yearly for a duration of 2–3 months in 197–295 locations spread across the entire national park (Thapa & Khanal 2014; Thapa et al. 2015; Thapa & Sherchan 2016; Karki et al. 2016b; Bajracharya et al. 2017). Despite these extensive surveys, the Fishing Cat was recorded only in late 2016 in just one location in the vicinity of a riverbank (Yadav et al. 2018). The survey effort in the two forest corridors adjacent to ShNP was very likely too short to record the Fishing Cat. Furthermore, local

people collected firewood in both corridors, which is why camera trapping was discontinued after a few days.

A Fishing Cat targeted survey in Koshi Tappu Wildlife Reserve yielded 5.94 notionally independent events per 100 camera trap nights with cameras set up only at night (Taylor et al. 2016). The rather low encounter rate of 0.88 notionally independent events per 100 camera trap days in ShNP during the two survey sessions is possibly due to the camera trapping design that was employed. A spacing between camera traps of 1.5–2 km placed

Table 3. Notable records of the Fishing Cat obtained during surveys targeting the Tiger in national parks (NP), wildlife sanctuaries (WS), and tiger reserves (TR) in the Indian and Nepal Terai.

Site and date of record	Source	Distance to next closest site where the Fishing Cat was recorded
Lansdowne Forest Division, Uttarakhand, India; 14.iii.2012	Abishek Harihar in litt. 25.x.2012	~175km north-west of Shuklaphanta–Pilibhit protected area complex
Dudhwa NP, Uttar Pradesh, India; 21.ii.–4. iv.2012	Nair (2012)	~60km south-east of Shuklaphanta–Pilibhit protected area complex
Katarniaghat WS, Uttar Pradesh, India; 8–27.iii.2011	Meraj Anwar in litt. 27.v.2011	~40km east of Dudhwa NP
Bardia NP, Nepal; 31.xii.2016 and 5.i.2017	Yadav et al. (2018)	~35km north-east of Katarniaghat WS
Parsa NP, Nepal; 8.iii.2016	Poudel et al. (2019)	~50km south-east of Chitwan NP



Image 4. Fishing Cat in a Sal forest patch in Shuklaphanta National Park on 5 February 2016. © DNPWC, NTNC and ZSL

along roads and wildlife trails is the usual design for documenting large carnivores (Pokheral & Wegge 2019). Apparently, the Fishing Cat does not frequent these beaten tracks and is therefore less readily recorded at such locations. The encounter rate of the Fishing Cat will probably increase by adjusting the survey design to focus on waterbodies, an experience also shared by Chakraborty et al. (2020b). Nair (2012) recommended a spacing of less than 1km between camera traps with increased emphasis near water for a Fishing Cat targeted survey. Mohd-Azlan & Thaqifah (2020) also advised to place camera traps closer to potential hunting grounds of a cat that exhibits a preference for waterbodies as well, the Flat-headed Cat *Prionailurus planiceps*. On the other hand, we recognise that such a survey design is more

challenging to implement, especially in tall grasslands and marshy grounds. Placing camera traps in the many pools, puddles and lakes in ShNP is a rather adventurous endeavour due to Muggers and Greater One-horned Rhinoceroses hiding in these habitats.

In June 2010, the Fishing Cat was recorded in three locations in the adjacent Pilibhit Tiger Reserve in India (🐾 in Fig. 1; Meraj Anwar in litt. 27 May 2011). We, therefore, consider it likely that the Laggabagga corridor provides connectivity for this population unit across the Mahakali River. Colour-marked Greater One-horned Rhinoceroses were repeatedly recorded in this corridor moving between ShNP, Pilibhit Tiger Reserve and up to Kishanpur Wildlife Sanctuary and Dudhwa National Park, latter two located about 60km farther southeast



Image 5. Fishing Cat in a mixed deciduous forest patch on 28 November 2016. © DNPWC, NTNC and ZSL



Image 6. Fishing Cat in riverine forest on 11 December 2016. © DNPWC, NTNC and ZSL

(Talukdar & Sinha 2013; Thapa et al. 2013). Two male Tigers were also identified in both ShNP and this corridor (Chanchani et al. 2014). To the west of ShNP, the Fishing Cat is potentially present in the Kilpura–Khatima–Surai corridor (Mukherjee et al. 2016). Both Rusty-spotted Cat and Jungle Cat *Felis chaus* were recorded in this corridor in the late autumn seasons of 2012 and 2014 (Anwar & Borah 2020). In light of these circumstances, we would like to encourage surveyors to watch out for the Fishing Cat when working in these corridors.

In the late 1920s, Champion (1933) obtained one of the earliest camera trap records of the Fishing Cat in the Indian Terai, specifically in the area where the Ganges River leaves the Siwalik Hills and meanders into the Gangetic plains. Since then, several contemporary camera trap records of the Fishing Cat were obtained as by-catch during surveys targeting the Tiger in the Indian and Nepal Terai (Table 3).

To date, camera trap surveys targeting the Fishing Cat in the Terai were carried out only in the vicinity of Jagdishpur Reservoir (Dahal 2016), in Chitwan National Park (Mishra 2016; Mishra et al. 2018) and in Koshi Tappu Wildlife Reserve (Taylor et al. 2016). All these records shed important light on the Fishing Cat's distribution and habitat use. Some of them (Talegaonkar et al. 2018; Yadav et al. 2018) indicate that its range is wider than estimated by Mukherjee et al. (2016). Yet, little is known about its ecology and conservation needs in these sites and beyond the borders of protected areas.

The Terai is a water-rich region with innumerable small seasonal streams and perennial rivers passing through; most of the streams originate in the Siwalik Hills north of the Terai (Champion 1933; Bhujii et al.

2007; Anwar & Borah 2020). The Nepal Terai alone harbours 163 wetlands (Bhujii et al. 2007). Mukherjee et al. (2016) collated unsurveyed areas across the Terai that are potentially suitable for the Fishing Cat (Fig. 1). In one of these areas, its presence was corroborated by Poudel et al. (2019) in the very south of Parsa National Park.

Still, large wetland areas and waterbodies remain to be surveyed in the region to determine the population size, survival rate and conservation needs of the Fishing Cat. As a large part of these areas is situated in human-influenced and -dominated landscapes, we strongly recommend to also assess the quality of wetland habitats and use by local people, especially in the vicinity of aquaculture sites. As documented by Haque & Vijayan (1993) inside a protected area, the Fishing Cat preys mainly on fish, but also on birds, small mammals, amphibians and reptiles. Fundamental aspects of the Fishing Cat's diet and trophic relations in human-dominated landscapes are still lacking and urgently need to be updated through in-depth investigations in future survey sites.

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