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RESEARCH ARTICLE

First Camera Trap Record of Fishing Cat *Prionailurus viverrinus* Bennett, 1833 (Carnivora: Felidae) from a Rural Wetland of Mid-West Bengal, India

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Abstract *Prionailurus viverrinus*, a wetland-dependent lesser cat with globally declining population, is suffering from increasing destruction/conversion of wetlands for various anthropogenic use, poaching, retaliatory killing etc. In India, they prefer to thrive in dense emergent vegetation adjoining different wetlands along the east coast and Gangetic plains. However, surveys determining their distribution range were carried out long ago and, due to various threats they have been decimated from many areas where they used to thrive earlier. This demands for a reassessment of their present status across its reported distribution range. Here we report the presence of fishing cats (through camera trap evidence) for the first time from a human-dominated wetland habitat of Murshidabad district, West Bengal, India. Out of all camera-trap images in the present study (N = 39), majority are of fishing cats *Prionailurus viverrinus* (25 pictures, 64.10%) followed by golden jackal *Canis aureus* (12 pictures, 30.76%), and jungle cat *Felis chaus* (two pictures, 5.12%). None of these wild fauna were recorded during day time. Fishing cats and golden jackals were mostly recorded between 21:01–3:00 h and 18:00–21:00 h respectively. Two images of jungle cats were also captured, one each during 21:01–00:00 h and 00:01–3:00 h. Similar studies in other wetlands within the distributional range of fishing cats will collectively validate their present distribution, which might be useful for in-situ conservation of this elusive vulnerable species.

Keywords Fishing cat · Camera traps · First report · Murshidabad · Human-dominated area · Conservation

Introduction

Among the lesser cats, the fishing cat *Prionailurus viverrinus* is known to have the second smallest distribution range with a declining global population (Cutter and Cutter 2009; Mukherjee et al. 2016). In India, they are distributed over a wide range of wetland habitats, particularly in the flood pains and mangrove areas of the east coast and the entire southern West Bengal falls under their broad geographical range. Various marshes, swamps, ponds, canals, rivers, tidal creeks, mangroves, etc. are considered as critical habitats for this wetland-dependent lesser cat (Marschke and Nong 2003; Cutter 2015) and the individuals have been reported to be highly localized near the dense emergent vegetation adjoining rivers and streams (Nowell and Jackson 1996). It has already been reported that wetlands are very fragile ecosystems around the globe (Davidson 2014). Alarmingly, more than 50% wetlands around the globe were destroyed during last century and the remaining ones are also suffering from various degrees of degradation due to several anthropogenic activities

Samrat Chakraborty and Souvik Barik these authors have contributed Equally to this work.

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(Fraser and Keddy 2005). Likewise, many wetlands in this country have also degraded and/or destroyed due to various anthropocentric developmental activities such as, unplanned expansion of urban areas, croplands, industrial areas, as well as, overexploitation of resources (Prasad et al. 2002). Such large scale destruction and degradation of wetlands, along with retaliatory killings by the fisherman communities out of perceived loss of fish stock is threatening their survival in many areas within its erstwhile distribution range (Sanyal 1999; Mukherjee et al. 2012, 2016; Cutter 2015; Thaung et al. 2018; Kolipaka et al. 2019). Mukherjee et al. (2016) reported that the global population of fishing cat has already declined by 30% during the last 15 years and is at the grave risk of further 30% decline in the coming years if the threats persist. Considering the existing threats, this species is now declared as 'vulnerable' by IUCN (Mukherjee et al. 2016) and included in Schedule-I of Indian Wildlife (Protection) Act to provide them with the highest level of protection (Anonymous 1972; Mukherjee et al. 2012). Government of West Bengal has also taken very good pro-conservation initiative by declaring fishing cat as the State animal (Mallick 2017).

It is pertinent to note that some surveys on fishing cats were carried out long ago (Inglis et al. 1919; O'Malley 1914; Pocock 1939; Sanyal 1999), few others are based on sign surveys (Lynam et al. 2013; Taylor et al. 2016) and many wetlands with potential habitat for fishing cats have never been surveyed at all. This makes the management and conservation of these elusive nocturnal cat more challenging. Therefore, it is very much essential to reassess the present status across its reported distribution range. In India, presence of fishing cat was documented from protected areas (Haque and Vijayan 1993; Sadhu and Reddy 2013; Prerna et al. 2016; Sathiyaselvam and Satyanarayana 2016; Talegaonkar et al. 2018). Recently few scientific studies in this country have also reported the presence of fishing cats from coastal areas and mangroves situated outside protected areas (Kolipaka 2006; Janardhanan et al. 2014; Malla and Sivakumar 2014; Naidu et al. 2015; Paleiet al. 2018; Malla et al. 2018). However, in West Bengal, presence of fishing cats are only reported from some protected areas (Das et al. 2017; Mallick 2019) and also from a few locations of Howrah, Hooghly and East Medinipur districts (Adhya 2011; Mukherjee et al. 2012, 2016; Kolipaka et al. 2019; Chakraborty et al. 2020) as shown in Fig. 1. This indicate that recent reports on fishing cats from many wetlands situated outside the protected areas in human-dominated landscapes are still at the rudimentary stage.

Over the years, camera traps have emerged as an effective tool in many wildlife surveys (O'Connell et al. 2010; Sollmann 2018), including the surveys of felids (Wegge et al. 2004). Camera traps are also widely being used in the surveys of fishing cats (e.g. Lynam et al. 2013; Sadhu and Reddy 2013; Islam et al. 2015; Thaung et al. 2018; Kolipaka et al. 2019; Poudel et al. 2019; Chakraborty et al. 2020). Keeping these in view, surveys are being carried out across the state of West Bengal, India in the wetland habitats situated outside protected areas. In this paper, we report the presence of fishing cats through camera trap evidence for the first time from a wetland habitat amidst human-dominated rural area of Murshidabad district of West Bengal, where presence of fishing cat was never reported till date.

Method

Study Area

The present study was carried out in Sadikpur village (Fig. 2, Latitude 24°32′56.04″N, Longitude 88° 1′52.47″E, West Bengal, India), which is an agriculture dominated rural area situated in *rarh* region between the Farakka feeder canal and Padma River and six km away from Indo-Bangladesh border (Directorate of Census Operations 2011).

Data Collection

Questionnaire surveys are practised in many wildlife studies to obtain ancillary data on sighting of wild mammals (Wolf et al. 1996; Sekhar 1998; Reza et al. 2002; López et al. 2003). Therefore, we initially carried out extensive questionnaire surveys in the wetlands areas of Murshidabad district. The wetlands were identified through preparation of Landsat 8 satellite image (https://earthexplorer.usgs.gov/) derived Normalized Difference Water Index (McFeeters 1996; Sahu 2014) map of Murshidabad district and by comparing high quality Google Earth ($\sim$ 1 m spatial resolution) satellite imagery. We showed a photographic plate with pictures of all wetland-associated mammals reported from Murshidabad district (Agrawal et al. 1992), and only selected the respondents for questionnaire surveys who had correctly identified the photograph of fishing cat. Among the respondents, some fishermen claimed that they have seen fishing cats during the night hours while patrolling fish ponds. Risk of vandalism is a constraint to carry out continuous camera trapping for wildlife studies in human dominated landscapes across the world (Meek et al. 2019; Green et al. 2020). Therefore, we explored all possibilities for installing and protection of camera traps from being stolen in the areas where the respondents had given an affirmative answer during the questionnaire survey. However, we

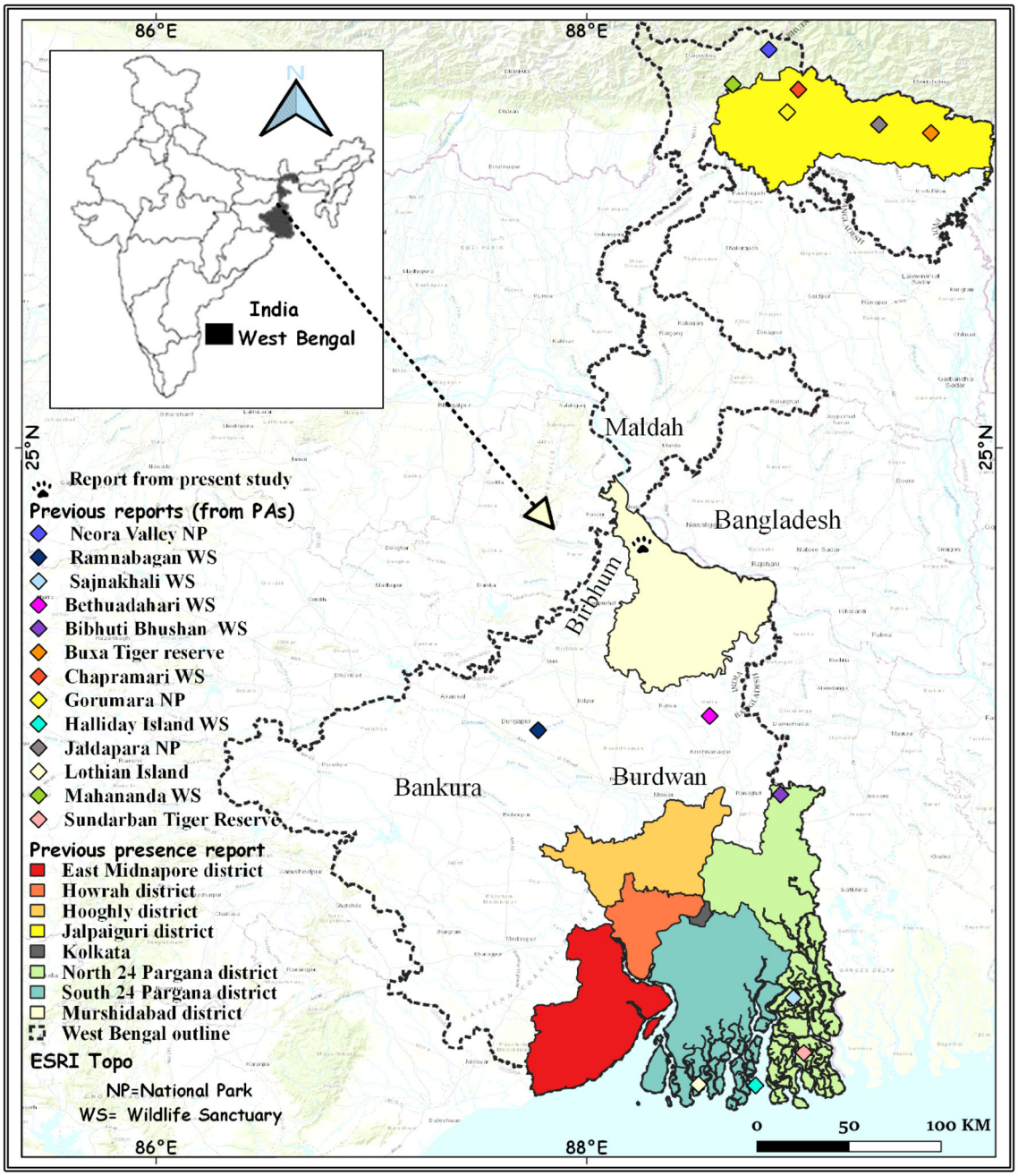


Fig. 1 Location of Fishing cat *Prionailurus viverrinus* records (including present study and previous records) from West Bengal, India

received local support for installation of camera traps only in Sadikpur (present study area). There we visited the places mentioned by those respondents during questionnaire surveys and carried out signage surveys (i.e. searched for presence of pugmarks, scats, remains of fish carcass etc.) to assess the potential trails of these elusive cats. We found pugmarks on the elevated dikes and muddy bank surrounding a waterbody. Thereafter, camera traps (Cuddeback Long Range IR Model-1224 and Spy-point IR-5) were set up in four locations where the pugmarks were noticed. A minimum gap of 200 m was maintained between two adjacent camera trap stations (Fig. 2). In each camera trap station, two infrared camera traps were attached to the same tree trunks (15–30 cm above the ground) in a way that one was facing towards the bank and another towards the dike to ensure capturing images irrespective of the animal moving through the dike or bank of the water body. Here, instead of the conventional way of camera traps pairs facing each other, we had put the camera traps on the same tree trunk facing in the opposite direction

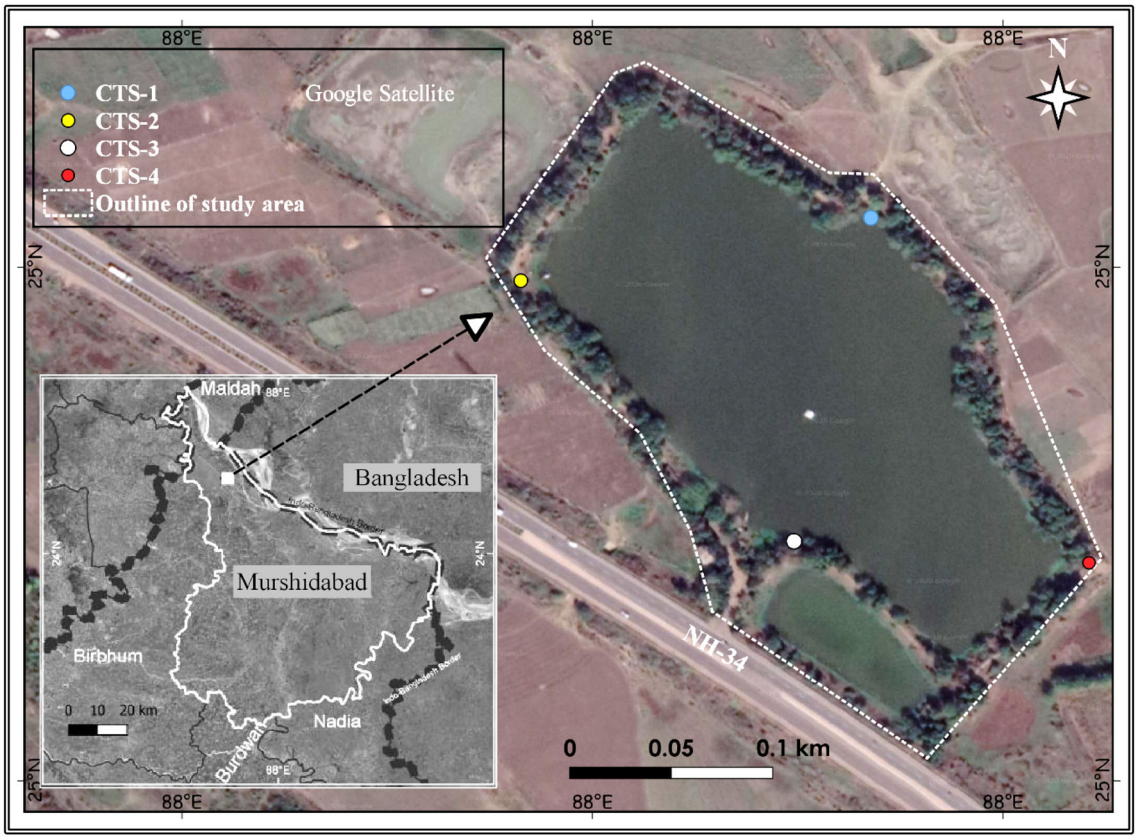


Fig. 2 Location of the Camera trap stations (CTS) in the study area

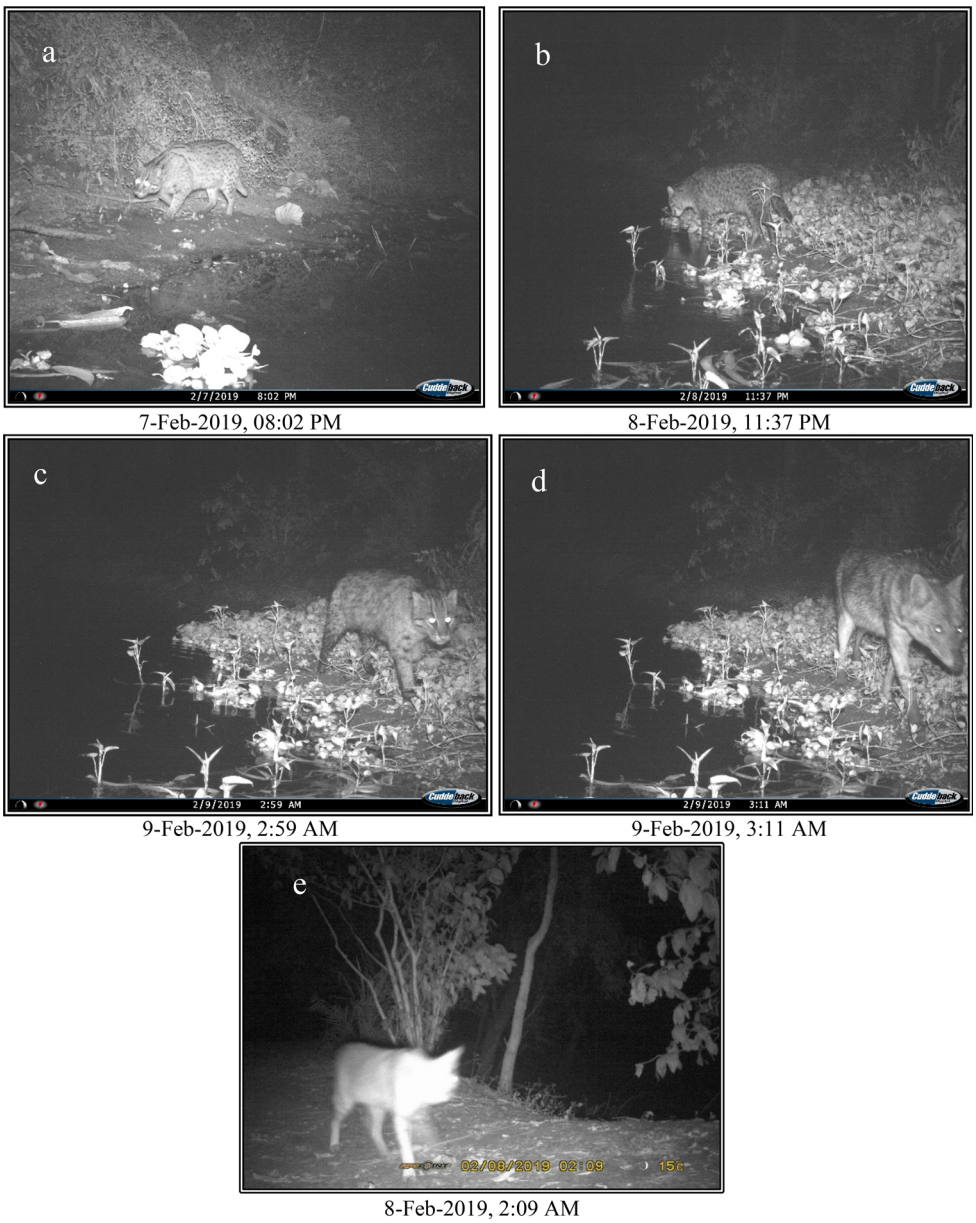
in order to optimize the area covered with limited number of camera traps. Camera trap efforts in carnivore surveys carried out inside protected areas ranged from 16 to 1000 trap nights (see, Karanth and Nicholas 2002; Wang and MacDonald 2009; Thapa et al. 2014; Lannichhanne et al. 2014). However, in contrast to locations inside protected areas, the risk of camera trap stealth out of vandalism was fairly high, especially in areas adjoining human habitation. Hence, with best of our efforts and after convincing the local residents we could only keep the camera traps operational for two trap nights (7–9 Feb 2019). Nevertheless, the objectives of present study was to explore and record the presence/absence status of fishing cat in study area and it was successfully accomplished with our relatively lesser trap night efforts. Thus, our total sampling effort was of 192 camera trap-hours (each camera trap was operational for 48 h * 4 camera-traps) in total.

Result

Out of 39 images of wild mammals obtained from four camera trap stations, 25 pictures (64.10%) were of fishing cats (*Prionailurus viverrinus*). Two associated wild species sharing the same habitat such as jungle cat (*Felis chaus*; two pictures, 5.12%) and golden jackal (*Canis aureus*; 12 pictures, 30.76%) were also recorded in the camera traps (Fig. 3a–e). Images of fishing cat and golden jackal were recorded in all camera trap stations (CTS 1-4), jungle cats were photographed in only one camera trap station (i.e. CTS 1). Assessment of the time of the recorded images (Table 1) revealed that all wild mammals were recorded in night hours; particularly fishing cats and golden jackals were mostly recorded during 21:01–3:00 h and 18:00–21:00 h respectively. Besides, two images of jungle cats were captured, one each during 21:01–00:00 h and 00:01–3:00 h.

Discussion

Fishing cats are reported to be present in the wetlands situated in Ganga-Yamuna-Bramhaputra river systems (Mallick 2017). However, apart from a few localities (Inglis et al. 1919; O'Malley 1914; Sanyal 1999; Adhya 2011), scientific information about the presence of fishing cats in most of the entire distribution range is lacking. Majority of the large wetlands thriving within the distribution range (like the wetland where this study was done) have never been surveyed to find out the existence of



7-Feb-2019, 08:02 PM

8-Feb-2019, 11:37 PM

9-Feb-2019, 2:59 AM

9-Feb-2019, 3:11 AM

8-Feb-2019, 2:09 AM

Fig. 3 Camera trap photographs of (**a**, **b**, **c**) fishing cat *Prionailurus viverrinus*, (**d**) golden jackal *Canis aureus* (**e**) and jungle cat *Felis chaus* recorded during present study

fishing cat. Even secondary information (such as roadkill, retaliatory killing or rescue reports) are also very sparse and non-existent from the present study area. In this context, this is the first camera trapped photographic evidence of the presence of this elusive nocturnal species from study area, as well as, from entire Murshidabad district, West Bengal, India.

Fishing cats, along with two other species during the present study were recorded in the night, particularly between 21:00 and 3:00 h. This is in agreement to Taylor et al. (2016) who reported that fishing cats are active throughout night and their activities decline immediately before sunrise. Although, a few respondents in our questionnaire survey, mentioned that they had seen golden jackal and jungle cat during day time, yet no photographs of fishing cat, jungle cat, golden jackal was captured during daytime (i.e. between 6 am and 6 pm). Due to possible risk of vandalism, we could deploy the camera traps for only two days, and therefore refrain from any conclusive remark on the complete absence of wild fauna around these wetlands during daytime. However, it would be plausible to mention here that the present wetland is an aquaculture pond where fisherman start aquaculture activities during dawn and these anthropogenic activities continue till dusk. Possibly for this reason all wild mammalian fauna recorded during this study avoid venturing around the wetland during daytime and start visiting during night hours.

Interestingly, fishing cats and golden jackals were recorded from all four camera traps present on different sides of the waterbody, which indicate that they visit the

Table 1 Species captured by camera traps (CTS 1-4) from the study area during two trap nights

Captured species	Events	CTS 1		CTS 2		CTS 3		CTS 4	
		Trap night 1	Trap night 2	Trap night 1	Trap night 2	Trap night 1	Trap night 2	Trap night 1	Trap night 2
Fishing cat	06:01–18:00	0	0	0	0	0	0	0	0
	18:01–21:00	1	0	0	0	1	0	2	0
	21:01–00:00	1	0	1	0	1	2	2	2
	00:01–03:00	2	0	1	1	0	0	1	4
	03:01–06:00	0	0	1	0	1	0	1	0
Jungle cat	06:01–18:00	0	0	0	0	0	0	0	0
	18:01–21:00	0	0	0	0	0	0	0	0
	21:01–00:00	1	0	0	0	0	0	0	0
	00:01–03:00	1	0	0	0	0	0	0	0
	03:01–06:00	0	0	0	0	0	0	0	0
Golden Jackal	06:01–18:00	0	0	0	0	0	0	0	0
	18:01–21:00	0	0	0	0	0	0	0	0
	21:01–00:00	0	0	0	1	0	0	0	0
	00:01–03:00	3	1	0	1	0	1	0	1
	03:01–06:00	0	1	0	1	0	2	0	0

wetland from all sides. Fishing cats are reported to be wetland-specialists and are reported to frequent waterbodies to hunt on fishes (Mukherjee et al. 2012, 2016; Cutter 2015; Kolipaka et al. 2019). Golden jackals are scavengers (Majumder et al. 2011; Ćirović et al. 2016), and visit this wetland possibly in search of offal remains present there. Time of the camera trap images also revealed that both fishing cat and golden jackal were found to use the same localities (CTS 3 & 4), with a minimum gap of 10 min duration (see Fig. 3c, d) and we did not record any conflict between these two species during the present study. Feeding behaviour studies of fishing cats revealed that after catching a large fish, they forage only on the flesh and leave the vertebral columns and head of the fishes (pers. observation), which probably serve as food for the golden jackals (Ćirović et al. 2016; Kolipaka et al. 2019). This might be the possible reason for co-occurrence of fishing cats and golden jackals in our study area. However, this hypothesis on co-existence of fishing cat and jackal may be tested in future. On the other hand, jungle cats are more generalist among the lesser cats and their diet comprised of higher amount rodents (Majumder et al. 2011), which is possibly more abundant in the adjacent crop fields. Not being exclusively dependent on wetlands, jungle cats perhaps ventured less near the camera traps installed around the waterbody resulting in lesser number of images during present study.

Destruction of wetland habitats and or even small scale changes might lead to catastrophic impact on the occurrence and survival of fishing cats (Mukherjee et al. 2012, 2016). Prasad et al. (2002) reported 70% of the wetland habitats to be presently under paddy cultivation. Vast stretches of lands surrounding the present study area are agricultural lands. Visual interpretation of the high resolution Google Earth satellite images (see, Taylor and Lovel 2012; Hu et al. 2013) indicate that several water bodies and their adjacent vegetation has degraded and converted to crop fields (Fig. 4a, b). Agricultural field provides the habitat for large number of bird species (Muñoz-Sáez et al. 2017; Barik et al. 2019) and small rodents (Sridhara and Tripathi 2005a, b), which are reported to be the secondary food resource of fishing cat (Cutter 2015). Mukherjee et al. (2012) mentioned that agricultural landscapes bear great potential in maintaining continuity between the populations of fishing cats across their distribution range in India. This is only possible if the specific locations of the occurrence of fishing cats (like the present one) are known across its distribution range and conservation initiatives are taken accordingly. Interpretation of the satellite image of the present study area revealed an alarming rise in the number of brick-kilns in the adjoining area (Fig. 4c, d). Mushrooming of brick industries have already been reported as a major cause of the destruction of fishing cat habitat in West Bengal (Mukherjee et al. 2012; Chakraborty et al. 2020). Aquaculture is extensively practiced in such large rural ponds (Mukherjee et al. 2012) and these ponds are also frequented by the fishing cats for easy availability of large bodied fish therein, which often result in human-fishing cat conflicts and retaliatory killings of those threatened feline species. On the other hand, frequent mortality of fishing cats due to road accidents have been reported from different parts of West Bengal (Maity and Adhya 2018).

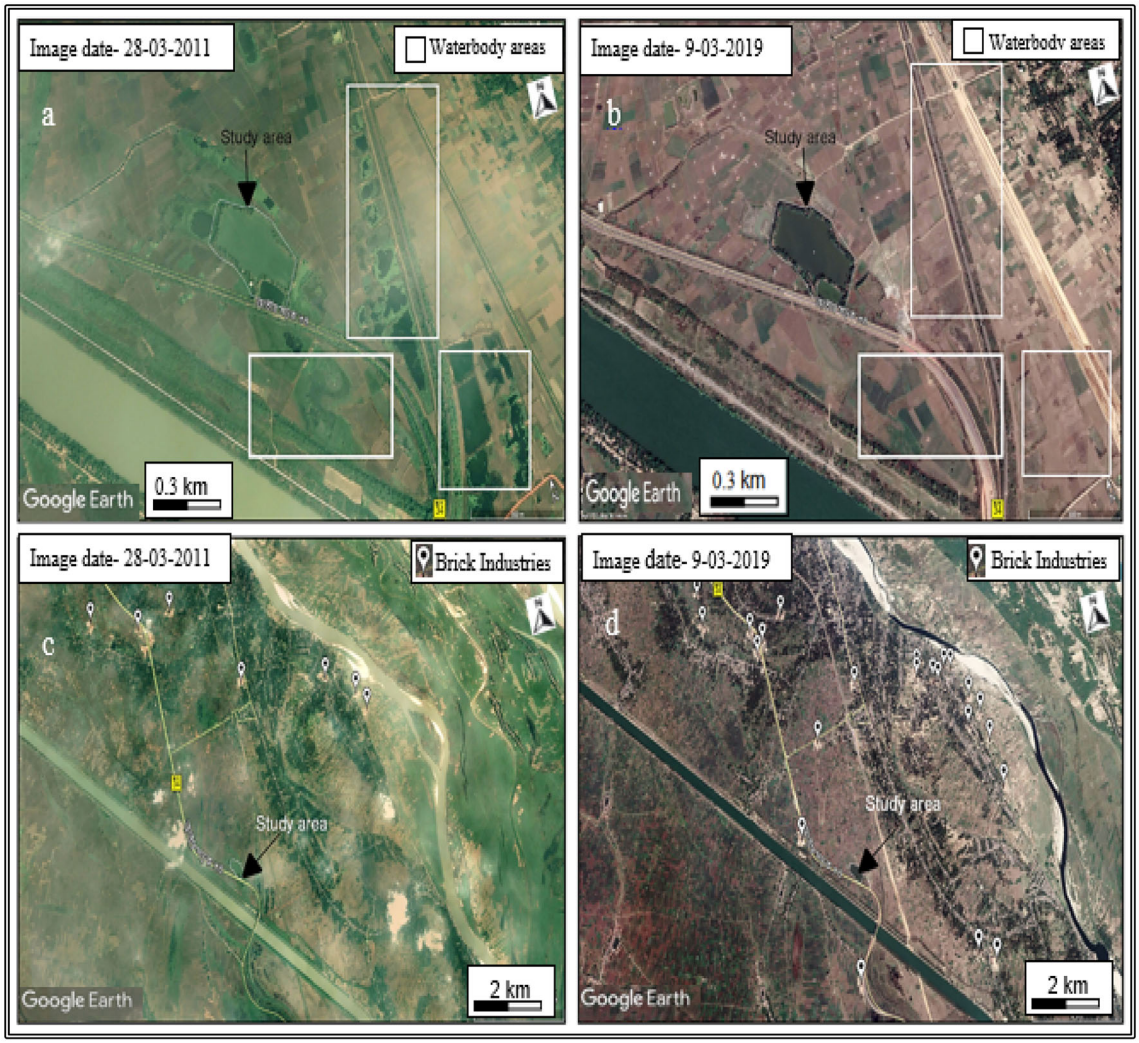


Fig. 4 Comparison of Google Earth Images to show the increase of agricultural land (**a**, **b**) and brick industries (**c**, **d**) over time. [White boxes show the waterbody areas and white balloons showing brick industries. Black arrows showing the study area. Image acquisition date-28 March 2011 (**a**, **c**) and 9 March 2019 (**b**, **d**)]

However, we recorded more photographs of fishing cats from the camera trap stations situated on bank of the water body away from the national highway NH 34 (i.e., from CTS-1 & 4), which possibly indicates towards their tendency to avoid roads with speeding vehicles. Therefore, we feel that the road kills possibly occur in highly fragmented habitats, where they are compelled to cross the road at night to move from one patch to another in search of suitable resources.

This is the first report along with photographic evidence of the existence of fishing cat in the study area. Further research is being carried out in the study area to get a deeper insight about the resource utilisation pattern and accordingly design suitable conservation plan to conserve the species and the wetland. It is also the onus of the conservationists to conduct similar studies in other wetlands situated in human dominated landscape within its distributional range, which collectively will validate their present distribution. Findings of the present study, along with similar other studies, will also be useful to prioritize areas for extensive awareness programmes amongst the stakeholders, to initiate compensation schemes and to adopt appropriate conservation strategies for fishing cats, along with other associated flora and fauna, where they are still thriving.

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Compliance with Ethical Standards

Conflict of interest There are no potential conflict of interest.

Ethical standards The data used in the present manuscript have been collected by us and the research is carried out in the state of West Bengal outside protected areas strictly maintaining the ethical standards and legal requirements of the host country. We obtained necessary permission from the office of the Principal Chief Conservator of Forests (Wildlife) and Chief Wildlife Warden, Directorate of Forests, Govt. of West Bengal, as well as, got approval from the Chairman, West Bengal Biodiversity Board, Department of Environment, Govt. of West Bengal. The present study was carried out maintaining respects for local beliefs, economic and cultural interests, and rights. All methods were non-intrusive and no animal was harmed during the study.

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