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Cover: Nilgiri Large Burrowing Spider *Haploclastus nilgirinus*. Acrylic on canvas. © Aakanksha Komanduri.

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COMMUNICATION

First photographic record of ferret badger *Melogale* sp. (Mammalia: Carnivora: Mustelidae) from the state of Tripura, India

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Abstract: Photographic records of the elusive ferret badger *Melogale* sp. were documented from the tropical evergreen forest interspersed with patches of jhum (shifting) cultivation in the state of Tripura, India. Numerous photos on multiple occasions were documented using camera traps set up in the Gumti Wildlife Sanctuary during a mammalian survey; a total of 40 pictures were captured in a semi-dry seasonal stream which was located in between two active patches of jhum. The pictures documented the nocturnal foraging behavior of this lesser known species. This study provides the inaugural documented evidence of the ferret badger's presence in the state of Tripura. Previous camera-trap records come from neighboring states such as Arunachal Pradesh, Meghalaya, Mizoram, and Assam, emphasizing the importance of continued research to comprehensively map species distributions. Records like these, although seem anecdotal, bear invaluable significance in unraveling ecology and habitat use of these lesser studied species.

Keywords: Distribution, disturbed forest, ecology, evergreen forest, Gumti Wildlife Sanctuary, jhum cultivation, mammal, north-east, occurrence, threats.

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Author contributions: All authors contributed to data collection. Study conception, study design, preparation, data collection & analysis were performed by Omkar Patil & Ashutosh Joshi. The first draft of the manuscript was written by Omkar Patil & all authors contributed to refining & revising the manuscript.

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INTRODUCTION

Small carnivores, including the members of the family Mustelidae, are among the least studied mammals across India. Ferret badgers are a cluster of five mustelid species indigenous to eastern and southeastern Asia. They are relatively smaller compared to those occurring sympatrically (badgers) and feature elongated bodies, prominently pointed snouts, and tails distinguished by their length and bushiness. The ferret badgers belong to the genus *Melogale,* which is the only genus of the monotypic mustelid, subfamily Helictidinae. They hail from the family Mustelidae, which includes various species of Badgers, Hog Badgers, Martens, Polecats, Weasels, Otters, Ferrets and many more across the world. In India, two species of ferret badgers (FB) have been observed, with their ranges majorly overlapping across the Asian mainland from northeastern Bangladesh (Islam et al. 2008; Akhtar et al. 2024), extending up to Nepal (Bhatta et al. 2021; Koju et al. 2021; Baral et al. 2022, 2024; Pathak et al. 2022; Thapa et al. 2024), Bhutan, northeastern India, China, and in some southeastern Asian countries such as Laos (Robichaud 2010; Coudrat & Nanthavong 2013), Cambodia (Schank et al. 2009), and Vietnam (Bahuguna & Mallick 2010; Nadler et al. 2011; Thapa et al. 2024). Like all of the FB species, the morphological attributes of Large-toothed or Burmese Ferret Badger *Melogale personata* and Small-toothed or Chinese Ferret Badger *Melogale moschata* bear a striking resemblance, leading to confusion regarding their identification and sympatric nature in the Asian mainland. The exact identification of a FB species typically necessitates examination of their dentition (Schank et al. 2009).

Ferret badgers have been relatively overlooked in scientific research for years, likely due to their elusive behavior and less attractive appearance compared to many other flagship mammals (Duckworth et al. 2016b). This lack of attention has resulted in an incomplete understanding of FB ecology, biology, life history traits, and conservation needs. Of the six species, the Small-toothed Ferret Badger *Melogale moschata* is the only FB species that has been extensively studied; it is listed as 'Least Concern' with a stable population trend on the IUCN Red List of Threatened Species (Duckworth et al. 2016a). Moreover, our knowledge about this species is primarily due to its involvement as an intermediate host for the acute respiratory syndrome coronavirus (SARS-CoV) (Guan et al. 2003). Conservation interest in other FB species, as well as most small carnivores, remains low, resulting in persistent knowledge gaps (Shepherd 2012). Records of FB have been documented from nearby states using various methods, a few of which have been a result of opportunistic sightings. Our study presents the first confirmed and scientific record of FB (*Melogale* sp.) from the Indian northeastern state of Tripura, along with some additional notes.

Significance of the study

The current record of the FB is a result of an assessment carried out in one of the most understudied parts of India. This emphasizes the importance of conducting studies in parts of India which are rich in biodiversity. Adding to this, the confirmed records of a rare species (the FB) shall bring it in limelight as they often linger in the shadows of megafauna such as the Clouded Leopard. Therefore, studies like this shall aid in promoting an in-depth research on such lesser-known species.

MATERIAL & METHODS

Study area

The current finding emerged from a rapid assessment survey to understand the status and distribution of mammals in Tripura's protected areas using camera traps and other conventional methods (Patil & Joshi 2024). The Gumti Wildlife Sanctuary (GWS) is the largest protected area in Tripura, covering 389.5 km² across the Dhalai, Khowai, and Gomati districts (coordinates: 23.834–23.389 ^{0}N & 91.707–91.920 ^{0}E) (Figure 1). Declared a sanctuary in 1989 to enhance wildlife management efforts (Deb et al. 2013), its headquarters are in Gandacherra, Dhalai. Located at the foothills of the Atharamura-Kalajhari range, GWS serves as a watershed for major regional rivers and tributaries (Deb et al. 2013). Dumboor Lake, approximately 41 km² in size, is a critical water source, receiving flow from the Gumti River and other rivulets, and maintaining the forest's biodiversity.

The sanctuary's varied terrain, from 31 m to 419 m, includes ridges, narrow valleys, and both seasonal and perennial streams, providing habitats for diverse biota. The undulating terrain is mainly in the western edge of GWS, with the lowest elevation at the western ridge's furthest corner (Deb et al. 2013). Gupta (1992) documented natural heterogeneous forests, including tropical evergreen, moist deciduous, and low alluvial woodlands, with scattered tropical evergreen forests and sporadic inner grasslands. The eastern side of the sanctuary features mixed deciduous forests. The low alluvial woodlands result largely from jhum (slash-

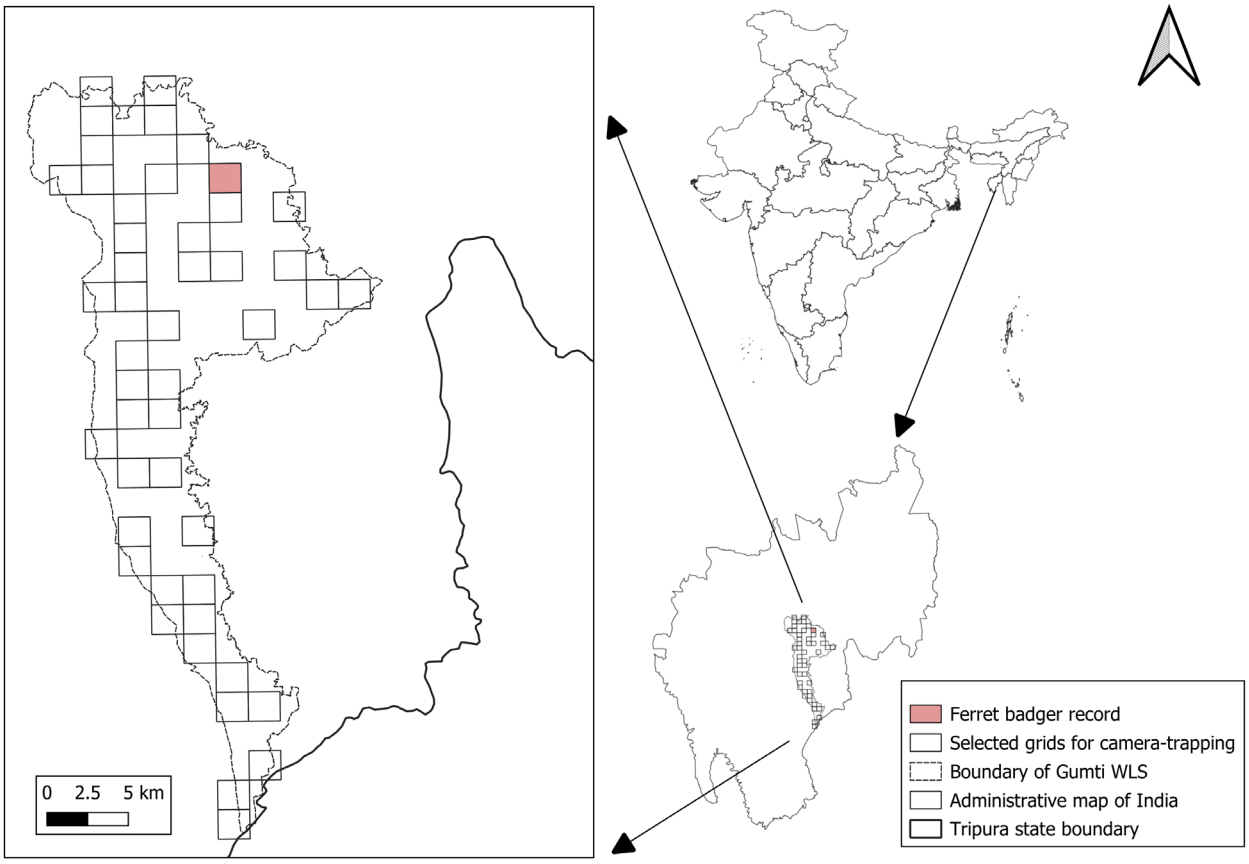

Figure 1. Location of Gumti Wildlife Sanctuary in the map of Tripura along with the sampled grids each measuring 4 km² along with the shaded grid where the ferret badger was recorded.

and-burn) cultivation and continuous grazing by local communities.

Methods

Camera trapping surveys were conducted in the GWS located in the Dhalai, Khowai and Gomati districts of Tripura between 10 March 2024 and 5 April 2024. The survey area was divided into 47 grids, each covering an area of 4 km². These grids were chosen based on their forest cover and limited to minimal anthropogenic pressure as identified through satellite imagery using Google Earth Pro and QGIS (V.3.30.2). The camera traps utilized in this exercise were the Spartan Lumen camera traps with white flashes & Cuddeback Xchange C1 with infrared flashes. Each grid was studied further to determine a camera trap location and was marked on the map. The feasibility of the trap locations was ascertained with the help from local forest staff such as Forest Guards, Rangers, Banmitra (friends-of-forests) and field facilitators. Special attention was provided to ensure safety from theft and to avoid human interference from Jhum cultivation activities while deploying camera traps at the predetermined location as animals generally avoid human-infested areas. Consequently, some camera traps were positioned in dry rivulets, ditches, and stream beds to achieve these objectives. Presence of secondary signs of mammalian fauna such as pugmarks, rake-marks, and droppings in an area were also considered while deciding the camera trap location. The camera traps were deployed on each trap location for a maximum of 10 days. Out of the 47 selected grids, camera traps were placed in 29 grids in a singular and paired manner. A total of 46 camera traps were deployed in the sanctuary, accounting to 280 trap nights between 10 March and 5 April 2024.

Based on the study model, we placed a pair of camera-traps in a semi-dry seasonal stream located in the Ganganagar forest range (23.750 ^{0}N & 91.816 ^{0}E) (Image 1). Since the location was right next to active jhum cultivation sites, finding a relatively less disturbed spot was difficult. The area had multiple hillocks juxtaposed to each other, forming a highly undulating terrain; while their slopes merged into one another, forming a network of small seasonal streams. We selected this spot for

Image 1. Habitat (dominated by jhum cultivation) near a camera-trap location where a ferret badger *Melogale* sp. was camera-trapped in Gumti Wildlife Sanctuary, Tripura, India. Photographed in March 2024. © Vivek PARC Foundation.

two major reasons: 1. It was a relatively undisturbed spot, according to the forest staff and 2. The location was riddled with numerous secondary signs such as pugmarks & droppings or scats indicating active usage by various mammalian species, possibly felids (cats), mustelids (badgers), viverrids (civets), and herpestids (mongoose). The cameras were monitored by the local Banmitras on a daily basis, however, the data were shifted from the memory cards to external hard drives upon their retrieval after 10 days.

RESULTS

The camera was deployed in the location during the second week of March 2024 between 12 March 2024 to 22 March 2024. During the course of 10 days, a ferret badger (*Melogale* sp.) was recorded on numerous occasions in that particular location (Image 2). The camera-trap data exclusively captured instances during the nighttime, aligning with findings from Wang & Fuller (2003) which studied the nocturnal activity patterns of *Melogale moschata*, in southeastern China.

From 10 trap nights at this location, 40 images of FB were produced on four separate occasions. Details of the photo captures are mentioned in Table 1.

Along with its nocturnal nature, the repeated appearance of the FB in the same locations could imply that the camera-trap station encompasses within the territory of that particular individual. It also provides us more insight about its habitat preference as it was documented in a matrix comprising of forests as well as jhum cultivation which corroborates with the findings of Kakati et al. (2014) in Arunachal Pradesh and Meghalaya.

DISCUSSION

Ferret badgers represent a group of carnivores that remain relatively understudied (Duckworth et al. 2016b). A study in the Hubei Houhe National Natural Reserve in Central China revealed that the Chinese Ferret Badger *Melogale moschata* is a legitimate disperser of seeds (Zhou et al. 2008). About eight species of plant seeds were discovered using fecal analysis. Similar to other Mustelids, the Chinese Ferret Badger exhibits a digging behavior to forage food, and the relatively smaller pits they dig may enhance the seedling survival. The authors emphasize on protection of the species as they are a fragmentation tolerant species and may aid in regeneration of degraded forests (Zhou et al. 2008). The Indian species of FB are included

Image 2. A camera-trap record of ferret badger *Melogale* sp. obtained during the survey in Gumti Wildlife Sanctuary, Tripura, India. © Vivek PARC Foundation; The Habitats Trust; Tripura Forest Department.

Table 1. Details of ferret badger *Melogale* sp. recorded during the camera trapping survey of mammals in March 2024 in Gumti Wildlife Sanctuary, Tripura, India.

Date (dd-mm-yy)	Time (from) (hh:mm:ss)	Time (to) (hh:mm:ss)	Total number of camera trap images	Remarks
12-03-24	19:06:52	19:07:59	13	- In a seasonal semi-dry stream surrounded by Jhum cultivation. - Three out of four times the FB was seen to use the same approach route towards the camera trap. - The time spent by the FB differs considerably in their capture duration.
13-03-24	18:58:20	19:00:14	18	
17-03-24	18:51:12	18:51:26	6	
20-03-24	10:23:36	10:23:41	3	

in the Schedule II of the Indian Wildlife Protection Act, 1972. It is important to highlight that although the genus *Melogale* is not included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2023), they are known to be victimized through substantial trade, particularly in Indo-Chinese markets which are increasingly shifting towards online platforms, posing challenges for tracing, as emphasized by Thomas et al. (2021). Small carnivores, including FB, are predominantly traded within Indonesia, either for consumption as meat or as live pets. However, the trade in such mammals often escapes attention and lacks monitoring (Shepherd 2012).

Despite the widespread perception of their distribution in northeastern India, empirical evidence from the wild is scarce. While both *Melogale personata* and *Melogale moschata* are categorized as 'Least Concern' in the IUCN Red List, it is essential to recognize that these assessments were likely the best possible outcomes given the available resources & constraints

and were primarily based on infrequent observations or anecdotal records (Duckworth et al. 2016a,b). Consequently, the precise extent, distribution patterns, and population status of both the species within and outside India, remain unclear and warrant further investigation for clarification. In India, the geographical range of both FB species is primarily confined to the eight northeastern states, specifically Arunachal Pradesh, Assam, Meghalaya, Mizoram, Manipur, Nagaland, Tripura, and Sikkim along with sparse occurrences have also been documented in India, particularly in the state of West Bengal (Chakraborty & Bhattacharya 1999; Choudhury 2013). Notable proximity records stem from investigations conducted by Kakati et al. (2014), particularly in the Garo Hills region of Meghalaya. These studies employed camera traps, and one instance involved the identification of *Melogale personata* based on a recovered skull specimen. Most recent camera trap records of FB come from Manas National Park, Assam (Bhatt & Lyngdoh 2024). Furthermore, there have been four documented occurrences in close proximity to Balpakram National Park within the South Garo Hills District, and a fifth observation near the town of Tura situated in the western region of West Garo Hills District. The sixth sighting was reported from Chayang Tajo in the East Kameng district of Arunachal Pradesh (Kakati et al. 2014).

Both *Melogale personata* & *Melogale moschata* have been reported to be sympatric with each other. As documented in our research, the presence of FB has been noted in Jhum cultivations, as well as in both disturbed and undisturbed moist deciduous forests, and moist evergreen forests. Consistent with the findings of Kakati et al. (2014) from Arunachal Pradesh & Meghalaya, four of the observations in their study were situated in the vicinity of villages, disturbed forests, and jhum cultivations. Although previously available literature (Gupta 1999) mentions the presence of *Melogale personata* (and other related species from Mustelideae, Viverideae, & Herpestideae) from Tripura, the observations were predominantly based on examination of working plans, management plans, primate surveys where the data were solely based on reports from locals, forest staff and records from naturalists. In this light, our findings are the first conclusive evidence of the species, based on systematic scientific surveys. Our study corroborates the observation by Kakati et al. (2014), as images of FB were captured in the vicinity of Jhum cultivation site. This gives us an unprecedented opportunity to understand the natural history of these lesser studied species, particularly in such an anthropomorphized and dynamic landscape.

The Small-toothed Ferret Badger can be regarded as a seldom-captured mammal in camera trap surveys conducted across northeastern India, as evidenced by the limited photographic documentation of the genus (Datta et al. 2008; Kakati 2010). The low encounter rate with camera traps may arise from factors such as natural fluctuations in local population densities, inherent rarity of the species, the presence of anthropogenic threats, and/or limitations inherent to the camera-trapping methodology itself (Schank et al. 2009).

Based on the images produced in the camera trap, the FB was seen to be engaged in foraging behavior. Previous studies based on scat analysis of multiple species of small mammals in Taiwan reported omnivorous dietary habits of Small-toothed Ferret Badgers. A diverse array of food items including amphibians, carcasses of smaller birds & mammals, earthworms, eggs, fruits and snails have been documented from their scats (Chuang & Lee 1997).

Our photographic evidence of the FB marks a first scientifically confirmed record to the current checklist of mammals of Tripura. Furthermore, it underscores the imperative to investigate the natural history of small carnivores, particularly lesser known species, considering the looming threats to the habitat and dynamic ecological landscape of the state, to ensure their continued sustenance.

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