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Yellow-throated marten *Martes flavigula* (Photo: PHAM Van Thong et al.)

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NEWS

Wild American mink found with Covid-19: first report of SARS-CoV-2 in a free-ranging wild animal

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A single free-ranging wild American mink *Neovison vison* testing positive for Covid-19 has been identified during US Department of Agriculture (USDA) epidemiological monitoring in the vicinity of an infected mink farm in Utah (Briggs 2020; Maron 2020; ProMED 2020). Other wild meso-carnivores and other species tested by the USDA were negative for the virus.

In spite of the general understanding that Covid-19 is a zoonotic disease (e.g. WHO 2020), the infected mink is the first "free-ranging, native wild animal confirmed with SARS-CoV-2", according to a statement issued by the USDA Animal and Plant Health Inspection Service (ProMED 2020). USDA spokespeople aver that "There is currently no evidence that SARS-CoV-2 is circulating or has been established in wild populations surrounding the infected mink farms" (ProMED 2020).

Covid-19 has run rampant in mink farms in the US and Europe, as has been widely reported in the media (see recent News items in this journal).

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NEWS

Thousands of farmed American Mink dead of Covid-19

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On 9 October 2020, CNN reported the death of thousands of American Mink *Neovison vison* of Covid-19 at fur farms in the U.S. states of Utah and Wisconsin (Rossburg & Ries 2020). According to the report, the virus was first observed in August, soon after farmworkers fell ill with the disease. Investigations revealed that the virus had been transmitted from humans to animals.

The illness manifests itself in American Mink with breathing difficulties and crusting around the eyes. Animals showing symptoms succumb rapidly and are usually dead by the following day. At least 8000 Mink have died of Covid-19 on nine fur farms in Utah. Two thousand Mink have died of Covid-19 on farms in Wisconsin (Rossburg & Ries 2020).

According to Reuters, Covid-19 outbreaks at dozens of fur farms in Denmark, the world's largest American Mink producer, have prompted the proposed culling of about one million animals (Barsoe 2020). There have been similar outbreaks among farmed American Mink in the Netherlands and Spain (Rossburg & Ries 2020).

SAR-CoV-2, the virus that causes Covid-19, has been detected in other carnivore species, including domestic dog and cat, Lion *Panthera leo* and Tiger *Panthera tigris* (Daly 2020). The animals in these cases are understood to have been infected by humans.

The zoonotic 2003 SARS outbreak is believed to have begun when bats and Common Palm Civets *Paradoxurus hermaphroditus* (also known as Asian Palm Civets and often referred to generically in the news media as "civets" or "civet cats") transmitted the virus to people (Gill 2020, Jarvis 2020, Wan *et al.* 2020). Although the Common Palm Civet was being looked at as a potential intermediary host species for SAR-CoV-2, further research indicates that several differences in the Common Palm Civet's ACE2 receptor make it less able to bind SARS-CoV-2, rendering this species a less than optimal intermediary (Jarvis 2020, Wan *et al.* 2020).

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NEWS

Covid-19 prophylactic tested on Ferrets; humans infected by mutated Covid-19 in Mink

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The New York Times and other news media have reported that a nasal spray applied to laboratory Ferrets *Mustela putorius furo*, the domesticated form of the Western (also known as European) Polecat, prevents transmission of Covid-19.

The spray contains a lipopeptide that precisely matches a stretch of amino acids in the spike protein of the SARS-CoV-2 virus. It works like this: “Before a virus can inject its RNA into a cell, the spike must effectively unzip, exposing two chains of amino acids, in order to fuse to the cell wall. As the spike zips back up to complete the process, the lipopeptide in the spray inserts itself, latching on to one of the spike’s amino acid chains and preventing the virus from attaching” (McNeil 2020).

In the study, Ferrets inoculated with the nasal spray were not infected by animals carrying the virus when they were housed together for 24 hours. All the untreated animals were infected when co-housed with infected Ferrets.

According to the researchers, the Ferret is an “ideal model” for assessing the transmission of respiratory viruses by aerosols of direct contact in part because Ferrets, like other mustelids, are highly susceptible to infection by SARS-CoV-2 (de Vries *et al.* unpublished, p. 6).

The researchers’ report of their study has not yet been peer-reviewed or formally published but is available online for preview (de Vries *et al.* unpublished).

There have been no human trials of the nasal spray yet.

In related news, the BBC reports that Denmark plans to cull as many 17 million American Mink *Neovison vison* after a mutated form of SARS-CoV-2 carried by some Mink on the country’s fur farms has been found to spread to humans (Anonymous 2020).

Covid-19 has been documented at fur-producing facilities in the Netherlands, Spain, Sweden and the US, in addition to Denmark, resulting in the extermination of millions of Mink (Briggs 2020). Farmed Mink catch the disease from humans. However, genetic analysis indicates that in the Netherlands and now Denmark, SARS-CoV-2 has been transmitted from Mink to people in a small number of instances (Briggs 2020). A mutated form of the virus passing from Mink to humans has public health implications as it may impede the effectiveness of human vaccines. Some experts are therefore calling for a ban on Mink

production (Briggs 2020), an industry that has for decades been the focus of criticism on animal welfare grounds.

Around the world, more than 50 million Mink are bred for their commercially valuable fur every year (Briggs 2020).

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ARTICLE

Recent records of the Honey Badger *Mellivora capensis* (Schreber, 1776) in Algeria

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Abstract

The Honey Badger *Mellivora capensis* is rare in Algeria. Its presence was last detected in 1980 in the southern part of the country, near the Moroccan border. In 2018 a live Honey Badger was filmed in Hammada Tanfouchai, near Tindouf, south-west Algeria, and followed by car during a naturalist expedition. A dead individual was found south-east of Tindouf by forest rangers. We also received information about a Honey Badger found dead in a road in 2019. These new data confirm that this mustelid is still present in Algeria and that follow-up work should be undertaken to better devise protection measures

Keywords: Viverridae, Mustelidae, Herpestidae, Prionodontidae, tropical lowland forest, wildlife conservation, camera-trapping

Récente observation du Ratel *Mellivora capensis* (Schreiber, 1776) en Algérie

Le Ratel *Mellivora capensis* est un carnivore rare en Algérie. Sa présence a été signalée pour la dernière fois en 1980 dans le sud du pays, près de la frontière marocaine. En 2018, un individu vivant a été filmé poursuivi par une voiture lors d'une expédition naturaliste à Hammada Tanfouchai près de Tindouf (sud-ouest de l'Algérie). Un autre individu mort a été retrouvé dans le sud-est de Tindouf par des gardes forestiers. Nous avons également reçu des informations sur un autre spécimen tué sur la route près de Tinzaouatine en 2019. Ces nouvelles données confirment que ce Mustelidae est toujours présent sur le territoire algérien et qu'un travail de suivi devrait être entrepris pour mieux concevoir des mesures de protection.

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Introduction

The Honey Badger has an extensive range, which extends through most of sub-Saharan Africa from the Western Cape, South Africa, to southern Morocco and south-western Algeria, and outside Africa through Arabia, Iran and western Asia to Central Asia (Turkmenistan, Uzbekistan) and the Indian subcontinent (Do Linh San *et al.* 2016). It is considered rare or to exist at low densities across most of its range (Begg *et al*. 2013).

Older mentions of this species in Algeria were reported by Joleaud (1922), who wrote that M. Augieras recorded its presence near the pools of water between Tabalbala (29°24′22″N–3°15′33″W), Igli (30°27′11.5″N–2°17′29.1″W) and Adrar (27°52′00″N–0°17′00″W) in south-west Algeria, and in Taoudenni (22°40′28″N–3°58′43″W) in Mali. In 1948, Panouse observed a Honey Badger in Hammada Draa, a few kilometres from Merkala (Panouse 1954). C. Petter, cited by Dupuy (1966), noted its presence at Zeghamra (29°59′N–02°29′W), near Beni Abbès. In 1980, Comminardi & Kowalski collected a skeleton and a

skin between El-Kebch and Djorf El-Aydada, near Oued Sougueur, south of Labiod Sidi-Cheikh. In 1986, K. De Smet (pers. comm.) noticed a stuffed individual exhibited at the headquarters of the Algerian Federation of Hunting Weapons, in Algiers.

Recent observations and reports in Algeria

On 25 January 2018, amateur naturalists N.H. and F.S. carried out an excursion in the region of Tindouf (27°40′00″N–8°09′00″W), south-west of Algeria, to observe wild fauna.

During the day, N.H. and F.S. observed a Honey Badger, which was on the move. Following in their all-terrain vehicle, they filmed the Honey Badger (Fig. 1). The observation took place in Hammada Tanfouchai, near Tabalbala (29°24′22″N–3°15′33″ W), in the Tindouf region.

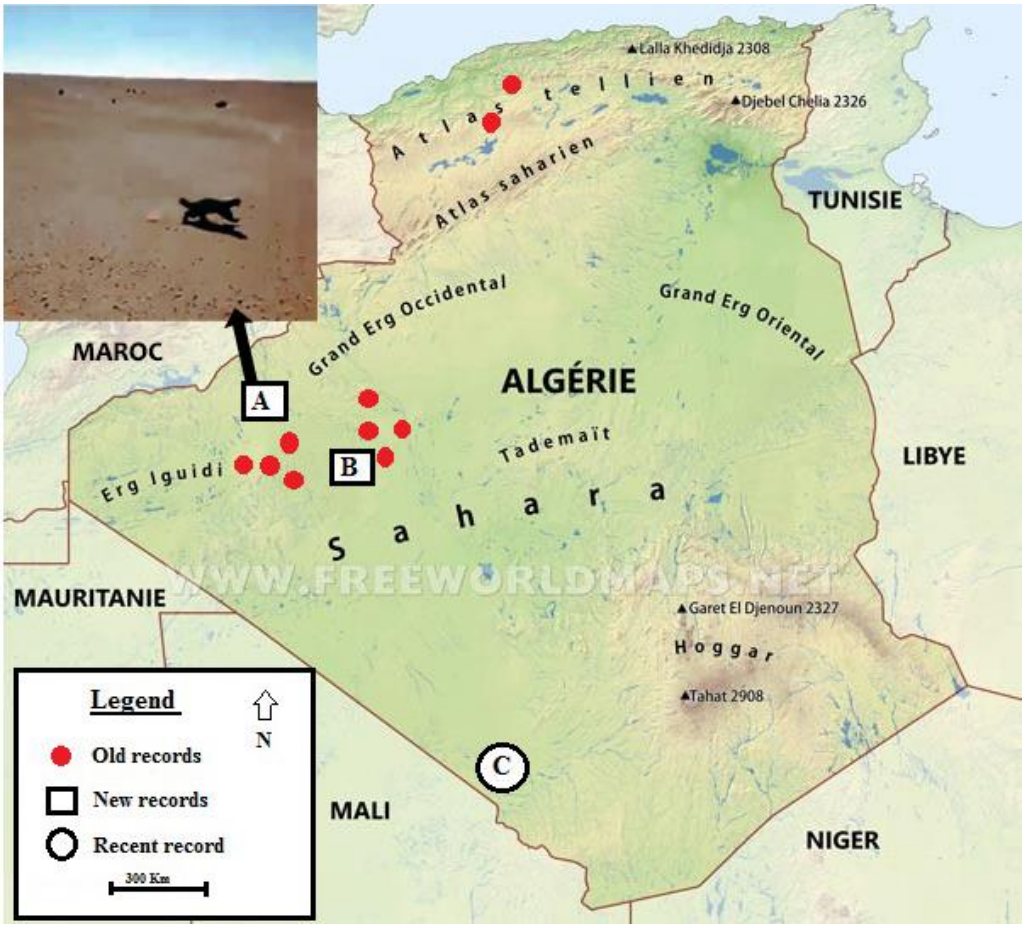

Fig. 1. The distribution of old, recent and new records of the Honey Badger *Mellivora capensis* in Algeria. A: Hammada Tanfouchai, near Tabalbala, near Tindouf, where a Honey Badger was videoed in 2018 (photo: Nadjem Haissoun and Fayca Seddiki); B: Touiref Bouam, south-east of Tindouf; C: Tinzaouatine road to Bordj Badji Mokhtar.

Local residents who were shown the video reported that a dead specimen had been recently found by foresters in Touiref Bouam, 60 km from the Moroccan border.

Ahmim (2019) received information about an individual found dead in 2019 on the road from Tin Zaouatine to Bordj Badji Mokhtar.

Discussion

Although considered of Least Concern on the IUCN Red List, the Honey Badger's global population is in decline (Do Linh San *et al.* 2016). In Algeria, its presence has not been reported since 1980, until the reports mentioned above. In Morocco, the species is considered a rare and threatened mammal (Cuzin 2003) that exists mainly in the Central and Eastern High Atlas, along the Dra'a river and in Tafilat, as well as in the Moroccan Atlantic Sahara (Aulagnier & Thévenot 1986, Cuzin 2003).

In 2015, Cherkaoui & Bouajaja (2017) carried out a seasonal survey that included 10 transects with a total length of 122 km and interviews with local residents in the region of Aferkat, in Guelmim Province, Morocco. These authors mentioned that according to eight interviewed beekeepers, Honey Badger is a fairly common animal in Aferkat. Indeed, two to five attacks per year were reported during the preceding decade and five individuals were killed. In October 2015, a male adult Honey Badger was trapped and killed by local beekeepers. There are therefore indications that the Honey Badger is more common in Morocco than has been heretofore known, suggesting that the species may also be more common in Algeria – vast areas of which are only very thinly populated with potential human observers – than has been believed.

Honey Badgers, which consume honey and prey on some domestic animals, are said to be regularly persecuted by beekeepers and farmers throughout their distribution range (Do Linh San *et al.* 2016). They are also hunted for bushmeat in some sub-Saharan African countries (Do Linh San *et al.* 2016).

Although protected by Algerian law, the rare Honey Badger requires more attention, including studies of its behaviour and ecology, especially its trophic niche, since it raids beehives and inconveniences beekeepers. Because it may come into conflict with humans, raising awareness about the Honey Badger's key role in ecosystems appears to be essential to ensuring the effective protection of this species.

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ARTICLE

Small carnivore records from Meru Betiri National Park, East Java

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Abstract

A camera-trap survey was conducted from August to November 2017 in Meru Betiri National Park, East Java. Photographs of Binturong *Arctictis binturong* represent the most southern global record and extend the known range about 500 km farther east in Java than is currently portrayed. Photographs of Yellow-throated Marten *Martes flavigula* are the most eastern record of the endemic Javan subspecies *M. f. robinsoni*. Other small carnivore species recorded were the Javan Ferret Badger *Melogale orientalis*, Javan Mongoose *Herpestes javanicus*, Leopard Cat *Prionailurus bengalensis* and Common Palm Civet *Paradoxurus hermaphroditus*.

Keywords: Viverridae, Mustelidae, Herpestidae, Prionodontidae, tropical lowland forest, wildlife conservation, camera-trapping

Introduction

The Binturong *Arctictis binturong* reportedly has a distribution that extends from eastern Nepal and southern China, southwards to Sumatra, Borneo and western Java (Willcox *et al.* 2015). The Binturong is listed as Vulnerable in The IUCN Red List of Threatened Species because of population declines through hunting and habitat loss, and this species is now uncommon or rare throughout much of its distribution (Willcox *et al.* 2015). Records of Binturong in Java are rare; transect surveys recorded this species from only two localities in western Java, whereas four sites in East Java, including Meru Betiri National Park, failed to detect this species (Rode-Margono et al. 2014). Consequently, the distribution of Binturong on Java was considered to be restricted to western Java (Fig. 1; Willcox *et al.* 2015).

The Yellow-throated Marten *Martes flavigula* has a wide distribution that extends from Afghanistan to the Russian Far East, south to Sumatra, Borneo and parts of Java (Chutipong *et al.* 2016a). This species is listed as Least Concern, reflecting its evidently large population and its tolerance for a wide range of habitats, including degraded forests (Chutipong *et al.* 2016a). The Javan endemic subspecies *M. f. robinsoni* is clearly distinct from martens on Peninsular Malaysia, Borneo and Sumatra, and might even warrant classification as a distinct species (Schreiber *et al.* 1989). The status and distribution of the Javan endemic subspecies is poorly known, and Chutipong et al. (2016a) suggested that it might be threatened. Published records of the Yellow-throated Marten in Java are rare (e.g. Rode-Margono *et al.* 2014), but various unpublished records (e.g. J. A. Eaton in Chutipong *et al.* 2016a) suggest

it might be more common than previously thought. Regardless, given the past suggestions of rarity, it is important to document records of this subspecies. Although transect surveys failed to detect this subspecies at several sites throughout Java (Rode-Margono et al. 2014), its distribution reportedly includes most of western Java, with a single small isolated population in East Java around Bromo Tengger Semeru National Park (Fig. 1; Chutipong *et al.* 2016a).

Fig. 1. Meru Betiri National Park, Java, Indonesia (solid red square), shown with the current known range in the Sundaland of the Binturong *Arctictis binturong* (taken from Willcox *et al.* 2015) and Yellow-throated Marten *Martes flavigula* (taken from Chutipong *et al.* 2016a).

Camera-trap survey in Meru Betiri National Park: results and discussion

We conducted a camera-trap survey that recorded Binturong, Yellow-throated Marten and other small carnivores in Meru Betiri National Park (580 km^2; 8°21' – 8°34'S, 113°37' – 113°58'E), East Java, from August to November 2017. A grid of 34 camera-trap stations spaced 2-3 km apart, in the eastern part of the park, covered about 100 km^2. All stations comprised two cameras (Panthera V6IR) attached to trees on opposite sides of the path (animal trails and ridgelines), approximately 40 cm above the ground and 2-5 m from the middle of the path. Cameras were stolen from eight stations; the remaining 26 stations all yielded photographs of wildlife.

Binturong was recorded at five out of 26 stations (19.2%; Fig. 2). These photographs represent the first of this species in Meru Betiri and the most southern record of Binturong within its global distribution, extending its known range about 500 km further east in Java than previously reported by Willcox *et al.* (2016; Fig. 1). Seidensticker & Suyono (1980) did not observe Binturong in Meru Betiri during a wildlife survey in 1976, although they reportedly found Binturong hair (identified by comparisons to a museum specimen) in scats of Leopard *Panthera pardus*. Nevertheless, our study provides the first verifiable records of Binturong from Meru Betiri. In 2018, a Binturong was reportedly photographed at another locality in East Java, the Kondang Merak forest near Balekambang Beach (Pryono 2018), about 150 km west of Meru Betiri, indicating this species may be more widespread in the forests of eastern Java than is currently recognised.

Photographs of the Yellow-throated Marten at four stations (15.4%; Fig. 2) are the first records from Meru Betiri; this species was not recorded during previous surveys in the park (Seidensticker & Suyono 1980, Rode-Margono *et al.* 2014). These photographs extend the known range of this species about 80 km farther east than previously reported (Fig. 1).

Fig. 2. Photographs of the Binturong *Arctictis binturong* (left; Meru Betiri, Java, 4 October 2017) and Yellow-throated Marten *Martes flavigula* (right; Meru Betiri, Java, 8 September 2017) obtained during a camera-trap survey of Meru Betiri National Park, Java, Indonesia, August to November 2017.

Javan Ferret Badger *Melogale orientalis* was recorded at one station. This species is endemic to Java and Bali and is listed as Least Concern, reflecting a presumably large population and its use of a wide variety of habitats, including agricultural landscapes (Duckworth *et al.* 2016, Wilianto & Wibisono 2017). This species has been recorded at sites throughout Java (Riffel 1991, Wilianto & Wibisono 2017), including Meru Betiri (Seidensticker & Suyono 1980), and its distribution is considered to include the entire island (Duckworth *et al.* 2016). Two photographs of Javan Mongoose *Herpestes javanicus* were obtained, and one individual was observed attacking a cobra *Naja* on a plantation near the boundary of Meru Betiri. The Javan Mongoose is widespread in Java (Chutipong *et al.* 2016b) and has been previously reported in Meru Betiri (Seidensticker & Suyono 1980). The Javan Mongoose and Javan Ferret Badger might have been more widespread in Meru Betiri than indicated by our camera-trap survey because the camera model we used (Panthera V6IR) was developed specifically to detect medium and large cats (Felidae); rat-sized carnivores might not always trigger the sensor on these cameras.

The other small carnivore species photographed in our survey were the Leopard Cat *Prionailurus bengalensis* and Common Palm Civet *Paradoxurus hermaphroditus*, which were recorded in 50.0% and 57.7% of the stations, respectively. Both species are classified as Least Concern in The IUCN Red List of Threatened Species, and both were previously recorded in Meru Betiri (Seidensticker & Suyono 1980). The only ground-dwelling small carnivore that was recorded in Meru Betiri by Seidensticker & Suyono (1980) that we did not record was the Small Indian Civet *Viverricula indica*. In fact, Seidensticker & Suyono

(1980) described this species as locally abundant in Meru Betiri, especially by water. Recent surveys across Java only detected the Small Indian Civet in an agricultural landscape in West Java (Rode-Margono *et al.* 2014), but not in forests, indicating this species is now rare in or absent from Javan forests. However, this species might be more abundant in agricultural and other open habitats in Java, similar to what has been found in Thailand (Chutipong *et al.* 2014).

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First record of a melanistic Common Genet *Genetta genetta* in southern Portugal extends the geographic range of this variant in Europe

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Abstract

We report the first record of a melanistic Common Genet *Genetta genetta* in southern Portugal, obtained with a camera-trap set near a seasonal stream in May 2019. This record extends the distribution of this genetic variant towards the south-western tip of the introduced area of this species. Melanism cases can contribute to the analysis of patterns of introduction and spread of the only viverrid in Europe. They can also shed light on possible mechanisms of natural or artificial selection behind melanism in the genet's introduced range.

Keywords: Iberian Peninsula, introduced species, mammals, melanism, pigmentation

Introduction

The Common Genet *Genetta genetta* is a wild mammal (Carnivora: Viverridae) native to Africa and the Arabian Peninsula. It has been introduced and is considered naturalized in Europe (Gaubert *et al.* 2015). It is currently widespread in Portugal (Álvares *et al.* 2019), Spain (Calzada 2007), Andorra and France (Gaubert *et al.* 2008), and it occurs less extensively in other European countries (Delibes 1999, Gaubert *et al.* 2008, 2015).

Common Genets normally display a pale yellow-grey coat with distinctive black spots in the back and flanks, a black stripe along the spine, and black rings along the tail. Cases of melanism are infrequently reported, geographically localized, and dispersed within this species's Iberian introduced range (Duarte & Rubio 1999, Gaubert & Mézan-Muxart 2010). In Portugal, the country covering the south-western limits of the introduced range, few cases of melanism have been previously described, all of which in the central and northern regions (Barros *et al.* 2014).

A camera-trapped melanistic individual

A remote camera-trap placed in a private nature reserve near Ourique, southern Portugal (Fig. 1a), photographed a new instance of a melanistic Common Genet at 01h35 on 19 May 2019 (Fig. 2). The pictures clearly show the characteristic spotted pattern against a markedly darkened coat (Fig. 1b). The camera is a Reconyx HP2W Professional White Flash Camera, which can take night-time photographs in colour. This does not appear to disturb most

wildlife. Some animals may stop in front of the camera, so multiple photographs are taken. This is what apparently happened with this genet, as the camera was set to take a series of three photographs when triggered but it took eight photographs of this individual, indicating that it stopped walking for a few moments (Fig. 2).

Fig. 1. Location (black dot), in south-western Europe, of the melanistic Common Genet *Genetta genetta* depicted in Fig. 2. The map is in Lambert equal-area projection and was made with QGIS 3.6.3.

The camera was pointed along a vehicle track (dirt road) close to where the track is crossed by a winterbourne, i.e. a temporary stream which is normally dry through the summer months and wet when there has been sufficient rainfall, usually in winter. This track is also used by other small and medium-sized mammal species, such as Wood Mouse *Apodemus sylvaticus*, European Rabbit *Oryctolagus cuniculus*, Iberian Hare *Lepus granatensis*, Beech Marten *Martes foina*, Wild Cat *Felis sylvestris*, Red Fox *Vulpes vulpes*, European Badger *Meles meles* and Eurasian Wild Pig *Sus scrofa*.

Fig. 2. (a) Melanistic Common Genet *Genetta genetta* photographed with a camera-trap in southern Portugal in May 2019; (b) close-up of the genet.

Discussion

Our record extends the geographic spread of documented melanistic genets across the Iberian Peninsula (cf. Barros *et al.* 2014, Alguazas-Martínez *et al.* 2017). This supports the idea that melanism in the Common Genet is disseminated in this species's introduced area, hence unlikely driven by environmental conditions (Gaubert & Mézan-Muxart 2010, Barrull & Mate 2012, Barros *et al.* 2014), although this has not been formally tested. Given their genetic foundation, the documentation and mapping of cases of melanism may contribute to the elucidation of introduction patterns of the Common Genet into Europe (Gaubert & Mézan-Muxart 2010, Barros *et al.* 2014), as well as the possible mechanisms of natural and/or artificial selection that may explain the spread of this pigmentation variant in this introduced species's range (Delibes *et al.* 2013).

Author contributions

AMB conceived the article, built the map and led the writing. PP provided the genet photographs and contributed to the writing. Both authors reviewed and improved the final version. We thank Will Duckworth for his helpful comments on this manuscript.

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ARTICLE

Two sighting records of Stripe-backed Weasel *Mustela strigidorsa* in Yunnan Province, China

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Abstract

The Stripe-backed Weasel *Mustela strigidorsa* is listed as Endangered on the China Species Red List. We document two sighting records from Yunnan province in southern China. The first record was of one animal observed on a paved road in the township of Tongbiguan, Yingjiang County, western Yunnan, at 15h20 on 9 February 2018. The second observation was of three animals travelling together in Mengla County, Xishuangbanna Prefecture, southern Yunnan, on 27 July 2018 at 15h09. Photographs were obtained at both events. The Yingjiang record is from a village and the Xishuangbanna record is from a forest park with hundreds of visitors on busy days. In view of the species's tolerance of heavily degraded landscapes and human disturbance, the Stripe-backed Weasel is likely to have been overlooked in China. Its national conservation status warrants a reassessment.

Keywords: Dehong Prefecture, Yingjiang County, Tongbiguan Township, Xishuangbanna Prefecture, Mengla County

云南省两个纹鼬记录

摘要

纹鼬(*Mustela strigidorsa*)被2016年出版的《中国脊椎动物红色名录》列为濒危物种，对其在中国的分布现状和生态习性所知甚少。我们收集了云南省热带地区的两个近年确切记录，现把相关信息简单报道：2018年2月9日15h20，在德宏自治州盈江县铜壁关乡三合村的乡道上拍摄到一只纹鼬；该地点以农田村寨为主，夹杂有斑块状的次生林-竹林。2018年7月27日15h09，在西双版纳自治州勐腊县望天树景区内观察到3只纹鼬，并拍摄到亚成体。根据纹鼬对破碎化生境和人为干扰的适应能力，我们相信其在中国尚有一定数量，实际保育状况有待进一步摸清。

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The Stripe-backed Weasel *Mustela strigidorsa* is an Indomalayan mustelid occurring in the foothills of the eastern Himalayas in north-east India, across much of Myanmar and south-western China, as well as Vietnam, Lao PDR, Thailand (Abramov *et al*. 2008) and, as recently documented, far-northern Cambodia (McCann & Pawlowski 2018). It was thought to be rare until increased survey effort of the region greatly improved our knowledge of the distribution of this and other tropical Asian mustelid species (Duckworth & Robichaud 2005, Abramov *et al*. 2008, Streicher *et al*. 2010). In China, however, there have been few recent publications documenting its occurrence, except for an observation record in some old-growth moist broadleaf evergreen forest in Gaoligongshan National Nature Reserve, Tengchong County, western Yunnan (Chan & Zhao 2014). Perhaps because of the lack of recent records, it is listed as Endangered in the latest China Species Red List (Jiang *et al*. 2016).

In an attempt to clarify the species's status in China, we collected two verifiable recent records of Stripe-backed Weasel from the tropical regions in Yunnan Province. On 9 February 2018 at 15h20, a weasel was observed on a paved road in the village of Sanhe in Tongbiguan Township, Yingjiang County, Dehong Prefecture, Yunnan province (24°36'56"N, 97°39'19"E, 1355 m asl). It ran into the courtyard of a house when the observer approached to 20 m and later came out and disappeared into roadside bamboo clumps (Figs. 1, 2). The surrounding landscape is a mosaic of villages and farmland, with patches of secondary broadleaf–bamboo forest (Fig. 3). Local villagers reported that the species is common in the area and that it preys on domestic chickens, as has been reported by villagers in Lao PDR (Streicher *et al*. 2010).

Fig. 1. Stripe-backed Weasel *Mustela strigidorsa* on a road in the village of Sanhe, Tongbiguan Township, Yingjiang County, Dehong Prefecture, Yunnan Province, China, 9 February 2018.

Fig. 2. The same Stripe-backed Weasel *Mustela strigidorsa* as in Fig. 1, its whitish back stripe clearly visible, village of Sanhe, Tongbiguan Township, Yingjiang County, Dehong Prefecture, Yunnan Province, China, 9 February 2018.

Fig. 3. Satellite image of the village of Sanhe, Tongbiguan Township, Yingjiang County, Dehong Prefecture, Yunnan Province, China. The red square indicates the site of the Stripe-backed Weasel *Mustela strigidorsa* observation.

On 27 July 2018 at 15h09, a bird photographer saw three weasels travelling together in a forest park in Mengla County, Xishuangbanna Prefecture, Yunnan Province (21°37'23"N, 101°35'13"E, 716 m asl). The animals apparently comprised a family group and included an obviously smaller individual. The two fully grown individuals crossed the concrete footpath by the ticketing office a group of visitors approached. The subadult was startled and backtracked into roadside bushes before eventually joining the two leading animals across the path (Figs. 4, 5). The forest park is famous for its mature stand of *Parashorea chinensis* trees, and although the forest is criss-crossed by numerous concrete roads and footpaths, the original primary vegetation is largely retained.

Fig. 4. Stripe-backed Weasel *Mustela strigidorsa* showing its whitish back stripe, Mengla County, Xishuangbanna Prefecture, Yunnan Province, China, 27 July 2018.

The weasels photographed during both observations had inconspicuous ears positioned to the side of the head, black eyes, a chestnut brown dorsum, buff chin down to upper breast and a narrow whitish dorsal stripe; these are diagnostic characteristics of the Stripe-backed Weasel (Streicher *et al*. 2010).

Fig. 5. The same Stripe-backed Weasel *Mustela strigidorsa* as in Fig. 4, by the ticketing office of the forest park, Mengla County, Xishuangbanna Prefecture, Yunnan Province, China, 27 July 2018.

Yingjiang Tongbiguan Township is about 9 km from the international border with the state of Kachin in Myanmar; Kachin State has "one of the most impressive series of records" for Stripe-backed Weasel (Abramov *et al*. 2008: 253). Mengla County, Xishuangbanna, is within 20 km of the international border with the province of Phongsaly in Laos; the species is known from Phongsaly Province and specimens have also been collected in Mengla County itself (Abramov *et al*. 2008).

Some species previously considered rare are now found to be widespread, ecologically tolerant, and much overlooked by usual survey techniques (e.g. Willcox *et al*. 2012). The Striped-backed Weasel appears to be an example of this: the Yingjiang record is from the environs of a village and the Xishuangbanna record is from a forest park with over 300,000 visitors annually. In view of the species's tolerance of heavily degraded landscapes and human disturbance, it is likely to have been overlooked in China. A re-assessment of its conservation status in China is warranted.

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ARTICLE

New Record of the Libyan Striped Weasel *Ictonyx libycus* from the Atlantic Moroccan Sahara

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Abstract

Updated information on a recent record of the Libyan Striped Weasel *Ictonyx libycus* occurring in a new area in the Moroccan Atlantic Sahara region is provided. Most of the recent records for this species come from the Aousserd (22°33'25N, 14°19'44W) region at the extreme south of the country.

Keywords: Libyan Striped Weasel, skull, Morocco

Nouveau signalement du Zorille *Ictonyx libycus* dans le Sahara atlantique marocain

Résumé
Des informations actualisées concernant un signalement récent du Zorille *Ictonyx libycus* dans une nouvelle zone de la région du Sahara atlantique marocain sont fournies. La plupart des observations récentes de cette espèce proviennent de la région d'Aousserd (22°33'25N, 14°19'44W) à l'extrême sud du pays.

Introduction

The Libyan Striped Weasel (or Saharan Striped Polecat) *Ictonyx libyca* is a small-sized and compact terrestrial mustelid ranging in total length from 30 to 380 cm and in weight from 200 to 600 g (Larivière & Jennings 2009). General morphological characteristics include black face, limbs and underparts. The body is covered by white stripes interleaved with variable black inter-stripes and the fur is longish with a silky appearance. The tail is long and white and sprinkled with black hairs. An unbroken white band encircles the face, running from the forehead behind the eyes to the base of the throat (Fig. 1). As with most mustelids, it has well developed anal glands and secretes a pungent fluid when threatened (Franca 2012).

The Libyan Striped Weasel ranges from the Sahel to Sudan throughout North Africa on the edges of the Atlantic Sahara as well as the coastal band of south Mediterranean (Ahmim & Do Lihn San 2015; Fig. 2). It occupies mainly sub-desert habitats such as stony desert, massifs, steppes, oases, sparsely vegetated dunes and cultivated areas in arid and sub-arid zones (Ahmim & Do Lihn San 2015).

Fig. 1. A Libyan Striped Weasel *Ictonyx libycus* at Aousserd, southern Morocco. © Javi Elorriaga.

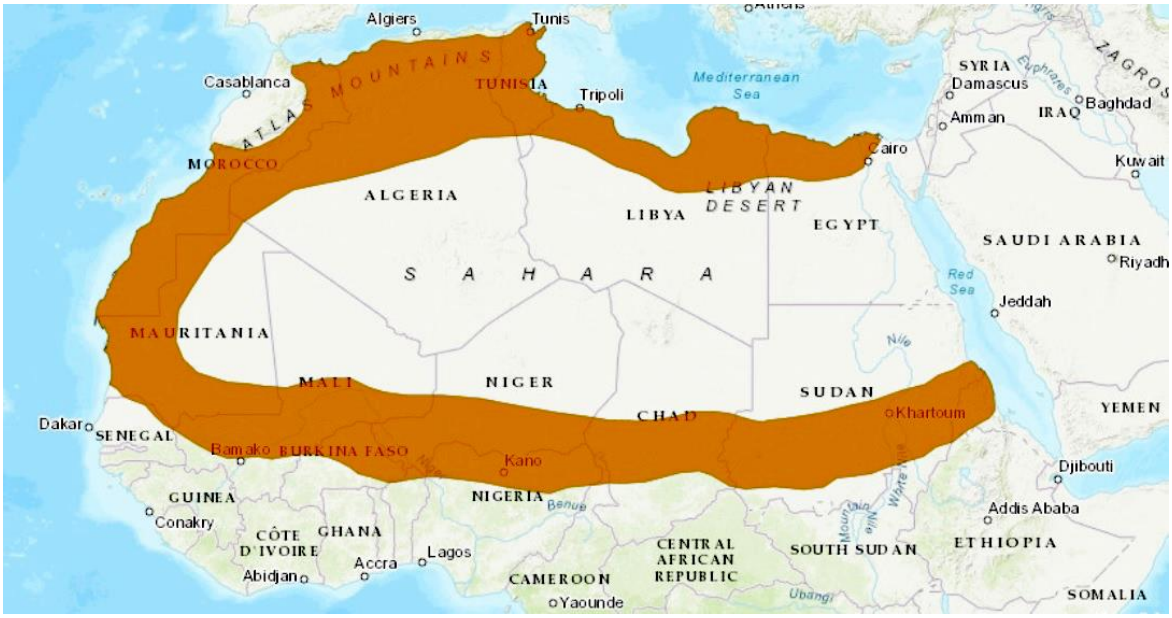

Fig. 2. Distribution map of the Libyan Striped Weasel *Ictonyx libycus* (IUCN 2015).

According to the IUCN Red List this species is globally classified as Least Concern because it has a wide distribution range. The species is uncommon throughout Morocco and information is scarce and patchy (Aulagnier *et al*. 2017; Fig. 3). In Morocco, the Libyan Striped Weasel, which is nocturnal, co-exists in places with other parapatric small-sized mustelids with which the weasel may compete, such as the mainly diurnal Least Weasel *Mustela nivalis*, near Berkane and Taourirt, in the north-east of the country (Imad Cherkaoui, pers. obs. 2006).

To our knowledge no research has assessed the ecology or population dynamics of this species in North Africa, which makes this small carnivore one of the least studied in this region. Although the Libyan Striped Weasel is not included in the IUCN Red Lists of Threatened Species, the lack of studies of its ecology, distribution and current conservation status in Morocco and elsewhere is noteworthy. Given the ecological importance of this species, there is a need for a better understanding of microhabitat factors that are associated with its occurrence and field research is needed to quantify its conservation status and distribution.

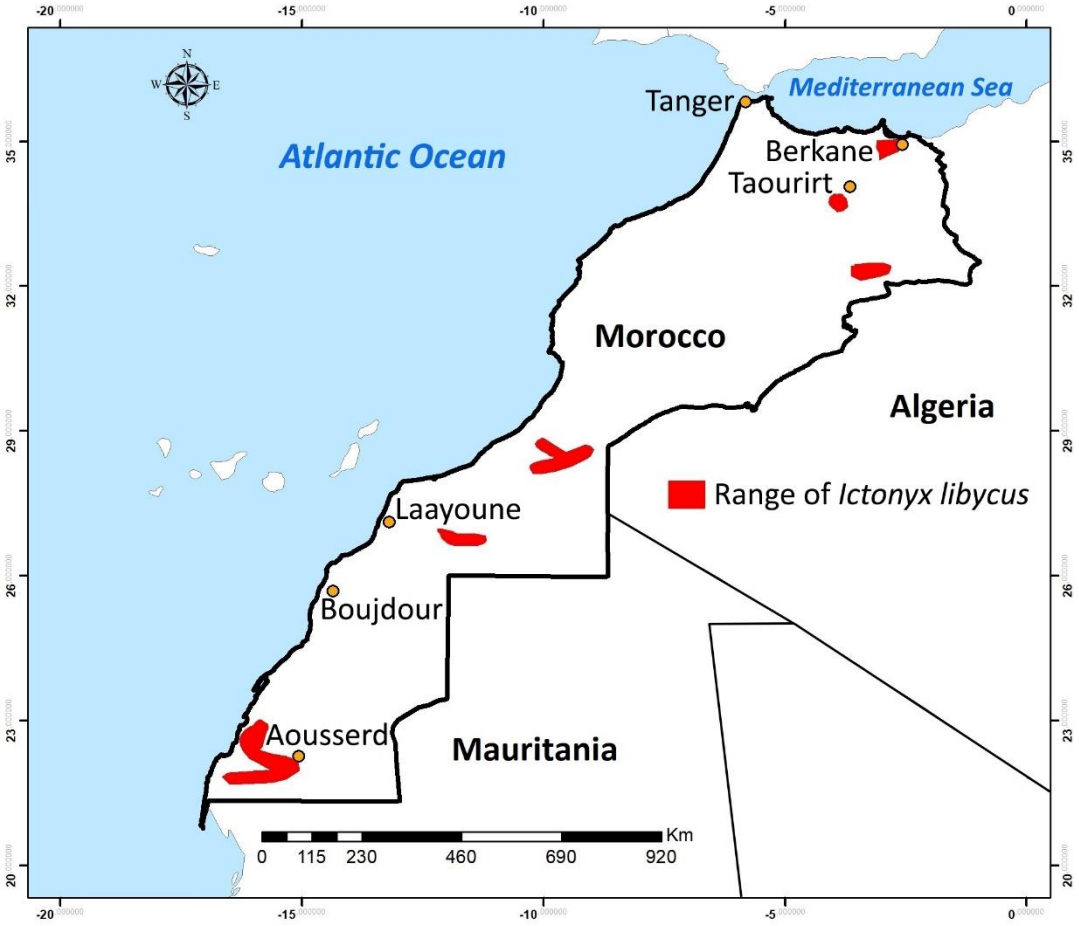

Fig. 3. Known range of the Libyan Striped Weasel *Ictonyx libycus* in Morocco prior to the observation reported here (map modified from Ahmim & Do Linh San 2015).

Because of its secretive nature, almost nothing is known of the Libyan Striped Weasel's reproductive biology (Rosevear 1974, Walker 1975) and it has probably been overlooked and under-recorded in many areas. Recent records of the weasel at sites that were previously considered unsuitable underscore this.

These small, solitary carnivores are specialist predators of small mammals and have a high metabolic rate, which means they can only exist in habitats containing adequate numbers

of prey (Kingdon 1997). Such habitats are being lost or drastically transformed to agriculture and agroforestry, especially in the Mediterranean part of the range of this weasel (Benabid 2000). This is compounded by overgrazing, which reduces the cover on which the Libyan Striped Weasel's prey species rely. Human population expansion has increased the number of dogs that often kill Libyan Striped Weasels or compete with them for food. The density of stray dogs has increased markedly in and around human settlements, which is likely having a significant impact on the weasels.

New record of a Libyan Striped Weasel

The record documented here confirms the presence of the Libyan Striped Weasel in an area where the species had not previously been recorded. On 22 July 2018, a decomposed body of the animal was found 14 km north of the city of Boujdour and 4 km from the coast (26°13'58"N; 14°17'45"W; Fig. 3). This area is characterized by stony desert with occasional sparse vegetation, concentrated in contrasted green patches known locally as "grara" (Fig. 4). Available records indicate that this is the first known sighting of the weasel in this location of the Moroccan Atlantic Sahara. In recent years, most of the records have come from the Aousserd area (22°33'25"N, 14°19'44"W), a few kilometres north of the Mauritanian border.

Fig. 4. Habitat in the area of southern Morocco where the remains of a Libyan Striped Weasel *Ictonyx libycus* were recovered on 22 July 2018.

Fig. 5. Dorsal view of the Libyan Striped Weasel *Ictonyx libycus* skull recovered in the Moroccan Atlantic Sahara on 22 July 2018.

Fig. 6. Ventral view of the Libyan Striped Weasel *Ictonyx libycus* skull recovered in the Moroccan Atlantic Sahara on 22 July 2018.

Skull identification

The Libyan Striped Weasel specimen (Figs. 5, 6) was identified by its cranial characters, following Osborn & Helmy (1980) and Panouse (1957). The outline of the skull is a triangular shape in the dorsal view. It differs from all other small Moroccan carnivores by one particular characteristic: the para-pterygoid bones in the Libyan Striped Weasel are fused with the tympanic bulla. Also, the coronoid process of the mandible is rounded. In the specimen recovered, the sutures in the cranial bones are not visible, indicating that it is an

adult. Skull measurements fall into the range given by Osborn & Helmy (1980) which, for condyloincisive lengths (CIL) are 49.9 mm in males (range 48.2 – 54.9 mm) and 49.8 mm in females (range 46.8 – 52.8). In this specimen, the CIL is 48.9 mm, the zygomatic width (ZW) is 29.4 mm and the postorbital width (POW) is 10.4 mm, and the para-pterygoid bones are fused with the tympanic bullae. This cranial character is not present in any other Moroccan carnivore. The skull is now registered in the Mammal Collection of the National Museum of Natural History, Grigore Antipa, Bucharest, Romania, with collection number MAM12912.

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ARTICLE

Observations of Striped Hog-nosed Skunk *Conepatus semistriatus* on the eastern flank of the Eastern Cordillera of Colombia

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Abstract

The Striped Hog-nosed Skunk *Conepatus semistriatus* is the only member of the family Mephitidae in Colombia and has a limited number of records in the country. In this paper, we present new records of Striped Hog-nosed Skunk from the eastern flank of the Eastern Cordillera of Colombia, Orinoco River Basin. Striped Hog-nosed Skunk was recorded by camera-traps during research on the ecology of the Andean White-eared Opossum *Didelphis pernigra* between December 2018 and January 2019. The camera-traps were placed between two farms. We showed photographs of the Skunk to local farmers and obtained additional records. Striped Hog-nosed Skunk has been previously reported in rural environments, which suggests that the species is relatively tolerant of human activities.

Keywords: Andes, geographical distribution, Orinoco River Basin, skunks

Observaciones del mapurito *Conepatus semistriatus* en el flanco oriental de la Cordillera Oriental de Colombia

El mapurito *Conepatus semistriatus* es el único miembro de la familia Mephitidae en Colombia y tiene un número limitado de registros en el país. En este trabajo, presentamos nuevos registros de *C. semistriatus* en Colombia, en el flanco oriental de la Cordillera Oriental, cuenca del río Orinoco, Departamento del Meta; aproximadamente 2100 m snm. Se grabó un mapurito con una cámara trampa como parte de un estudio sobre la ecología de la chucha de oreja blanca *Didelphis pernigra* desarrollado entre diciembre de 2018 y enero de 2019. Las trampas se colocaron entre dos fincas. Mostramos fotografías del mapurito a campesinos locales y obtuvimos registros adicionales. El mapurito ha sido reportado previamente en ambientes rurales, lo que sugiere que esta especie es relativamente tolerante con las actividades humanas.

Palabras clave: Andes, distribución geográfica, mapurito, región orinoquense

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Introduction

The Striped Hog-nosed Skunk *Conepatus semistriatus* (Boddaert 1785) is distributed in Belize, Brazil, Colombia, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru and Venezuela (Emmons & Feer 1997, Wozencraft 2005, Esser *et al.* 2012). The only member of the family Mephitidae in Colombia, it has been recorded between 0 and 3100 m asl. There are a limited number of records in the Andean and Caribbean regions of Colombia,

as well as the Sierra Nevada de Santa Marta and the Serranía de la Macarena (Solari *et al.* 2013, Andrade-Ponce *et al.* 2016, Diaz-Pulido *et al.* 2017). It has been recorded in the following departments in Colombia: Antioquia, Cesar, Cundinamarca, La Guajira, Magdalena, Meta, Nariño, Norte de Santander and Santander (Meza-Joya *et al.* 2018). Here we present new records for the species from the eastern flank of the Eastern Cordillera of Colombia from the Department of Meta in the Orinoco River Basin.

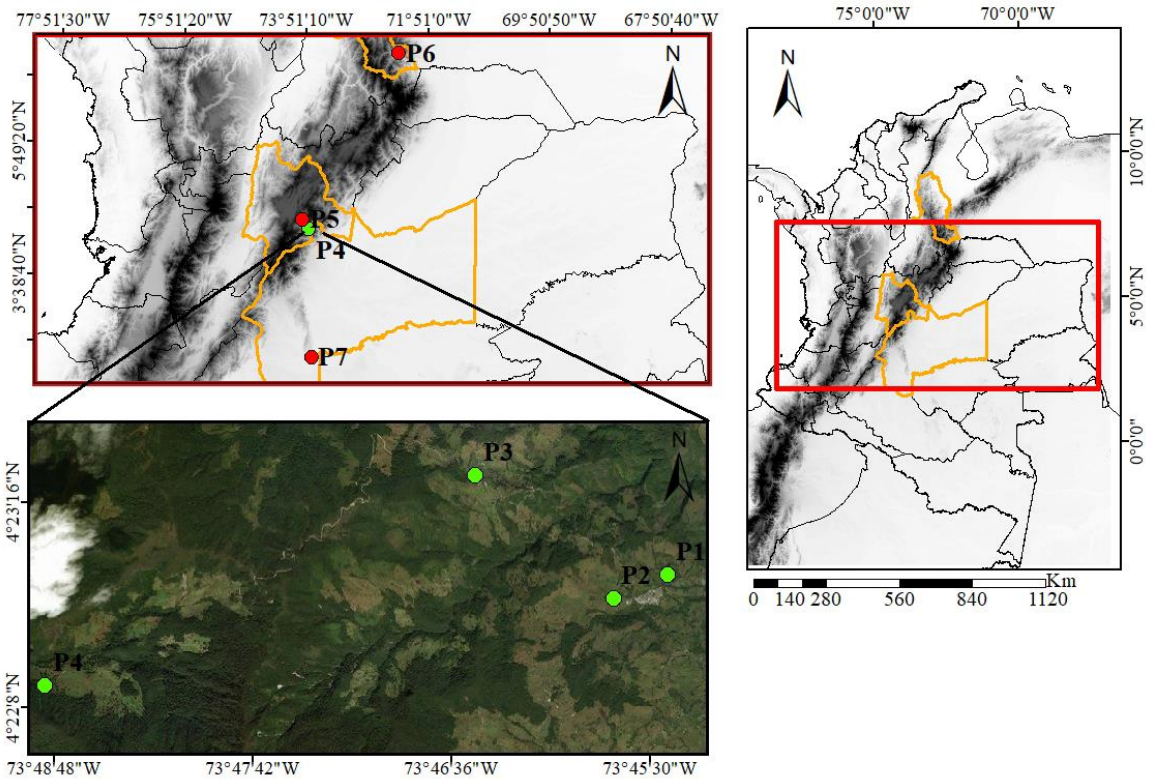

Fig. 1. Locations of Striped Hog-nosed Skunk *Conepatus semistriatus* observations on the eastern slope of the Eastern Cordillera of Colombia. The maps on the left side show details of the location of El Calvario, Department of Meta, Colombia. The green dots (P1-P4) are those reported here; the red dots (P5-P6) are from previous studies. P5 corresponds to Choachí, Cundinamarca (Meza-Joya *et al.* 2018); P6 corresponds to Tamá National Park north of Santander (Cáceres-Martínez *et al.* 2016, Meza-Joya *et al.* 2018). P7 is in Sierra de la Macarena (Díaz-Pulido *et al.* 2017). P1 was recorded using a camera-trap; P2-P4 were obtained from interviews with local farmers. P2 was recorded on a livestock farm; P3 and P4 were recorded on the Quetame–El Calvario route. The aerial image at the bottom is from Google Earth, 9 January 2019.

Camera-trap records

Striped Hog-nosed Skunk was recorded in the following locality: Colombia, Department of Meta, Municipality El Calvario, Corregimiento San Francisco; 4°22' 51.94" N –73°45' 24.48" W, approximately 2100 m asl. The species was recorded by a camera-trap during a survey targeting the Andean White-eared Opossum *Didelphis pernigra*. The camera-traps were set between December 2018 and January 2019 in a rural landscape (Fig. 1). Eight sampling

stations were used, each with one camera-trap for 17 nights. One camera-trap malfunctioned during the survey; the total survey effort was 120 effective camera-traps-nights. Distance between stations was between 45 m and 50 m. At each station, we used sardines and a sugar-water mixture as bait to attract Andean White-eared Opossums. The camera-traps were set near the boundaries between two farms; the first one had crops of beans *Phaseolus vulgaris*, whereas in the second there were domestic pigs and chickens, as well as crops of *P. vulgaris* and imperial grass *Axonopus scoparius*. According to local farmers, the vegetation on the farms was partly the result of government-led reforestation efforts in 2010. The reforested area had relatively tall trees, 20-30 m, and included two non-native species, Chinese ash *Fraxinus chinensis* and *Eucalyptus* spp., as well as *Ficus* sp.

On 17 January 2018, at 05h18, a skunk was camera-trapped once in an area with native and exotic vegetation between the two farms. It was not photographed interacting with the bait near the camera-trap. The skunk had the typical black body and two dorsal white lines joined at the neck (Emmons & Feer 1997). The individual lacked the terminal bushy white portion of the tail; this may have been lost to a predator (Fig. 2). During the camera-trapping, Andean White-eared Opossums were recorded by all the camera-traps. In addition, while walking the site to retrieve the data from the cameras, we frequently sighted Red-tailed Squirrel *Syntheosciurus granatensis*.

Fig. 2. Striped Hog-nosed Skunk *Conepatus semistriatus* camera-trapped at 05h18 on 17 January 2018 at San Francisco, El Calvario, Meta, Colombia; note the absence of a white, bushy portion at the end of the tail (P1 in Fig. 1). See the supplementary video file.

Interview records

After recording the skunk using camera-traps, we interviewed 15 local residents. Respondents were shown photographs of Striped Hog-nosed Skunk and asked questions about its status in the area. All of the interviewed residents mentioned that the species was present in the area and indicated that it is common to observe the Skunk early in the morning, at around 05h00 to 06h00. The interviews mentioned having observed a Skunk with a tail with a white and bushy part, suggesting that there was more than one individual at the study site. In agreement with these statements, we received additional reports by local farmers about three different sightings. One person indicated the presence of a Skunk on a cattle farm around October in 2017; approximate coordinates 4º22' 43.91" N – 73º45' 42.18" W (Fig. 1, P2).

Fig. 3. A couple of Striped Hog-nosed Skunks *Conepatus semistriatus* video-recorded at about 19h00 on 25 January 2020 on the Quetame–El Calvario road, El Calvario, Meta, Colombia (P3 in Fig. 3). See the supplementary video file.

Two additional sightings by local farmers from the San Francisco–Quetame road (4° 23'24.7" N – 73°46'27.5" W and 4°22'14.9" N – 73°48'51.0" W, respectively), in December 2019 and on 25 January 2020. The sighting made on January 2020 occurred at approximately 19h00, and the local farmers took a video of a couple of Skunks near the location of the camera-trap record (Fig. 3). There was no photographic record or video for the sighting in 2019.

Discussion

Several authors suggest that Striped Hog-nosed Skunk is mainly found in either open areas or ecotones between savanna and forest and that it regularly uses forests as refuges but avoids large forest patches (Linares 1998, Kasper *et al.* 2009, Esser *et al.* 2012). In addition, Striped Hog-nosed Skunk has been found in human-impacted environments such as the one presented here (Araúz 2005, Cavalcanti *et al.* 2014, González-Maya *et al.* 2017). In the Emas Natural Park in Brazil, Striped Hog-nosed Skunk has been recorded in the visitors and office

areas (Cavalcanti *et al.* 2014). The species has been found in six rural localities of Panama (Araúz 2005). Those localities included forests or forest edges surrounded by grasslands or areas opened for agriculture. Furthermore, this species has been previously recorded in rural areas in the Colombian Andes (Meza-Joya *et al.* 2018) and one specimen was found less than 100 m from a house and approximately 1.1 km from a main road in Bogotá, the capital of Colombia and its largest city (González-Maya *et al.* 2017). In addition, this Skunk appears to use roads (Fernandez-Rodriguez & Ramirez-Chaves 2015, Machado *et al.* 2015). Altogether, the evidence suggests that Striped Hog-nosed Skunk is tolerant of human-induced modifications to landscapes. The limited number of museum specimens of Striped Hog-nosed Skunk from Colombia may suggest that this species is not abundant in the country. However, in light of the species' tolerance of human-modified habitats and relatively large altitudinal range, several alternative reasons are plausible: the skunk has not been the target of collection efforts on account of the unpleasant odour emitted by this species; appropriate traps have not been used to obtain specimens; survey or trapping efforts in this type of unprotected, human-dominated habitat has been lower than in forest blocks of natural habitat that support species of higher conservation concern.

Our findings, and the other additional confirmed records of Striped Hog-nosed Skunk on the eastern slope of the Eastern Cordillera (Diaz-Pulido *et al.* 2017, Meza-Joya *et al.* 2018), suggest that this skunk occurs throughout the flank of the Cordillera facing the Colombian eastern llanos. This is in line with the predictions of a distribution model for Striped Hog-nosed Skunk, which predicts its presence along the Andean Eastern Cordillera of Colombia, as well as in most of the Caribbean region (Meza-Joya et al. 2018). However, the Andean region has suffered significant changes due to human activity, since it is the most populated region in Colombia (Etter & van Wyngaarden 2000, Etter *et al.* 2006). The situation is evident on the eastern slope of the Eastern Cordillera, where deforestation and habitat fragmentation due to rural activities such as agriculture, cattle ranching and the introduction of exotic vegetation has led to the native forests to be considered as endangered ecosystems (Ramírez *et al.* 2011, Etter *et al.* 2017). Additional studies should focus on assessing the Striped Hog-nosed Skunk's actual tolerance to human perturbations on landscapes and potential habitat limitations, so that distribution models can be corrected and refined.

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ARTICLE

Diurnal activity and diet of Small Indian Mongoose *Urva auropunctata* on the outskirts of Vadodara, Gujarat, India

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Abstract

The Small Indian Mongoose *Urva auropunctata* is a diurnal, omnivorous and opportunistic predator. Native to the Indian subcontinent, it has been introduced to many parts of the world, where it is considered a pest species. Although common, little is known about its ecology in its native range. During the winter months (December to February), in a village in western India, we used a handheld camera to record the activity of a single mongoose. We assessed mongoose diet by analysing faecal pellets in the vicinity of the 10 active burrows identified in the area. We found that the Small Indian Mongoose was active during the entire day, except when it avoided the hot midday temperatures by retreating to a burrow. Outside of the burrow, the targeted mongoose spent its time foraging (72%), basking (24%), grooming (1.8%) and socialising (1%). Faecal analysis revealed that in the early winter the diet was mainly insects (75.4%) but shifted to more plants (64.6%) as winter came to an end.

Keywords: Small Indian Mongoose, diet, diurnal activity, native range

Introduction

The distribution of the Small Indian Mongoose *Urva auropunctata* (see Patou et al. 2009) stretches from the Arabian Peninsula across the northern Indian subcontinent to South-east Asia. It has also been introduced to many other parts of the world, mainly islands (Gilchrist et al. 2009). It has been classified as of Least Concern by the IUCN (Jennings & Veron 2016). This survey contributes to closing the knowledge gap for small carnivores in Central Sumatra by presenting new records for species belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae, based on an extensive camera-trap survey conducted between March 2013 and March 2014 in the Bukit Tigapuluh Landscape, Jambi, Indonesia.

Urva auropunctata is a ground-foraging, burrowing species that lives in intricate burrows or in dense shrub cover (Gilchrist *et al.* 2009). The species is tolerant of high temperatures (Matsuura *et al.* 1977); temperatures below 0°C severely stress it (Nellis & McManus 1974, Nellis & Everard 1983). In the Caribbean, the Small Indian Mongoose is an entirely diurnal species (Nellis & Everard 1983).

The Small Indian Mongoose plays a vital role in agro-ecosystems as a predator of insects, snakes, rodents and some birds; it also consumes fruits, tubers and berries and may occasionally scavenge (Feldhamer *et al.* 1999, Gilchrist *et al.* 2009). It plays a significant

role controlling pest populations (Mahmood & Nadeem 2011). Studies in north-western Pakistan revealed that the Small Indian Mongoose is a highly opportunistic that feeds largely on mammals and prefers habitat close to human settlements (Mahmood *et al.* 2011). One study in Central Punjab, Pakistan, revealed that the Small Indian Mongoose preferred feeding in agricultural fields that had a low input of synthetic fertilizers and pesticides. This study also showed that the diet had a high biomass of plant material, followed closely by insects (Rana *et al.* 2005). Studies on Korčula Island, Croatia, revealed that Small Indian Mongooses there consumed more fruits in the winter than during the summer (Cavallini & Serafini 1995). The Small Indian Mongoose was introduced to the Fiji Islands in 1883 (Veron *et. al.* 2007, Simberloff & Rejmánek 2011) and has been implicated anecdotally in the decline of many of Fiji's birds (Morley & Winder 2013), such as the Barred-wing Rail *Nesoclopeus poecilopterus* (Gorman 1975), the Pacific Black Duck *Anas superciliosa* (Martin 1938), the Banded Rail *Gallirallus philippensis* (Mercer 1970), the Purple Swamphen *Porphyrio porphyrio* (Clunie & Morse 1984) and the Friendly Ground Dove *Gallicolumba stairi* (Watling 2001).

Most field studies of this species have been conducted within the introduced parts of its range (Gilchrist *et al.* 2009) and generally indicate that the Small Indian Mongoose is a diurnal, opportunistic predator. We hypothesise that the Small Indian Mongoose has an opportunistic diet within its native region, and this study focussed on the diet and activity of the Small Indian Mongoose in an agro-pastoral landscape on the outskirts of the city of Vadodara, Gujarat, India.

Materials and methods

Study area

The study was conducted in the small rural settlement of Sripore Timbi (22°18′22.11″N, 73°17′05.64″E) adjoining Timbi Irrigation Reservoir, on the outskirts of Vadodara city, Gujarat, India, where multiple burrows were located close to each other along the edge of the pond. The village is set in an agro-pastoral landscape mixed with scrubland and reed cover. All observations were recorded during the winter months (December 2018 to February 2019).

Locating active burrows

During the pilot study, areas with high mongoose activity were noted through observations of pugmarks (Shrestha & Basnet 2005) and direct observations. The mongooses were seen the most near the pond edge. A strip 10 m in width alongside the pond was searched with the help of local residents and burrows were identified. Burrows had two or three openings, with the exception of one burrow, which had five openings. Dried reeds were placed at the burrow openings at dusk and checked the next day. Burrows with openings where reeds had been displaced were considered active. These active burrows were targeted for the diet study.

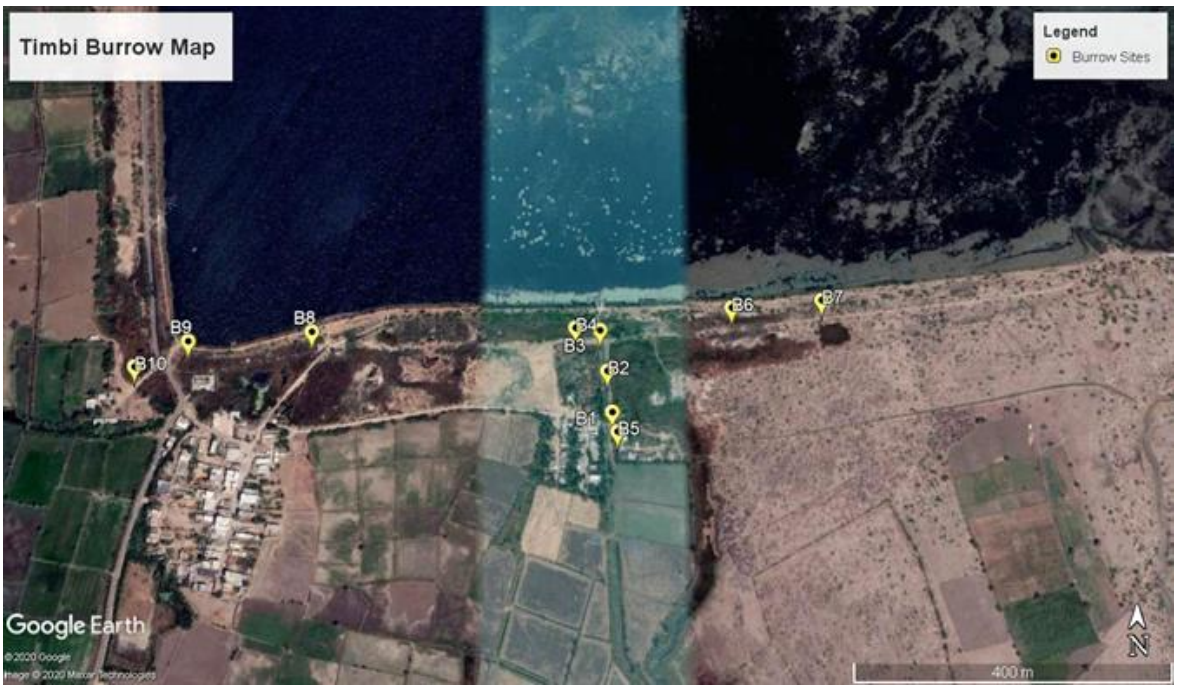

Fig. 1. Aerial image of the village of Sripore Timbi, on the outskirts of Vadodara, Gujarat, India. Active burrows of Small Indian Mongoose *Urva auropunctata* that were observed in the study are indicated.

Activity pattern and budgeting

To observe activity patterns, one large male Small Indian Mongoose – the only adult male in the area – was followed at a distance of about 10 m from sunrise to sunset on the last Sunday of December 2018, January 2019 and February 2019 (Kays *et al.* 2010). Mongooses in the vicinity of the village were already to some extent habituated to humans and this and the reed and shrub cover left between the observer and the mongoose ensured that the behaviour of the mongoose was not influenced. Small gaps in the vegetation made it possible to observe and record mongoose behaviour. Each field visit lasted 11 hours and 20±10 minutes. The timing of sunrise (08h12 to 07h44) and sunset (18h03 to 18h38) changed over the course of study (Table 1).

Photographs of the target mongoose were taken in bursts of 10 every 5 minutes, as with a camera-trap in time-lapse mode (Altmann 1974), using a handheld Canon 1200D DSLR camera. The photographs were tagged to reflect the activity seen in them in ExifPro® Image Analysis software and a .csv file was made after compiling the spreadsheets exported from ExifPro®. These files were run in the activity package of R® analysis software. Individual behavioural activities were analysed in a similar manner, by calculating the image captures in the study period. All the software used is open access software available online. For percentage calculations, this formula was followed:

$$\left(\frac{\text{No. of photographs of a given activity during one hour}}{120\ \text{(total number of photographs during one hour)}}\right) * 100$$

The mongoose was considered "active" whenever it was outside its burrow. Each burst of 10 images was categorised as falling within one of the following activities: basking, grooming, foraging and socialising. If the mongoose entered a burrow within the timeframe of a burst of 10 photographs, the mongoose was counted as inactive.

The mongoose was not observed within its burrow.

Diet analysis

To investigate the diet of the Small Indian Mongoose, faecal pellets were collected around the entrances of the 10 active burrows that had been identified (Fig. 1). The mongooses are known to defecate in early morning (Rasa 1983) so scats were collected in the afternoon during each field visit, when the mongooses had retreated in their burrows.

The collected scats were sun-dried and then placed in a warm-water bath of 40°C ± 5°C for 3-4 hours so that the scats loosened. The scats were then washed in a sieve and the components physically separated (Mahmood *et al.* 2017). The plant and insect matter was weighed and insects were identified to class whereas plant matter was largely left unidentified, although seeds were identified to genus level. Lightweight fish, bird and mammal components like scales, feathers and hair were counted instead of weighed.

Results

Activity pattern and activity budget

About nine burrow entrances were observed within a radius of 50 m. Burrows B1, B2 (two openings each) and B5 (five openings) were frequently used by the target mongoose (Fig. 1). The mongoose usually emerged from its burrows sometime after sunrise and retreated back to the burrow almost an hour before sunset (Table 1, Fig. 2). We incidentally observed that other individuals showed a similar activity pattern.

Table 1. Time of sunrise, sunset and first capture, as well as temperature, humidity, wind speed and cloud cover, for each of the three field visits.

Date	Sunrise	Sunset	Time of first capture	Temperature at first capture (°C)	Average temperature (°C)	Humidity (%)	Wind speed (km/h)	Cloud cover (%)
30-12-2018	07h16	18h03	08h12	14	26	47	9	40%
20-01-2019	07h19	18h17	08h25	16	27	55	5	20%
24-02-2019	07h03	18h38	07h44	17	28.2	75	0	51%

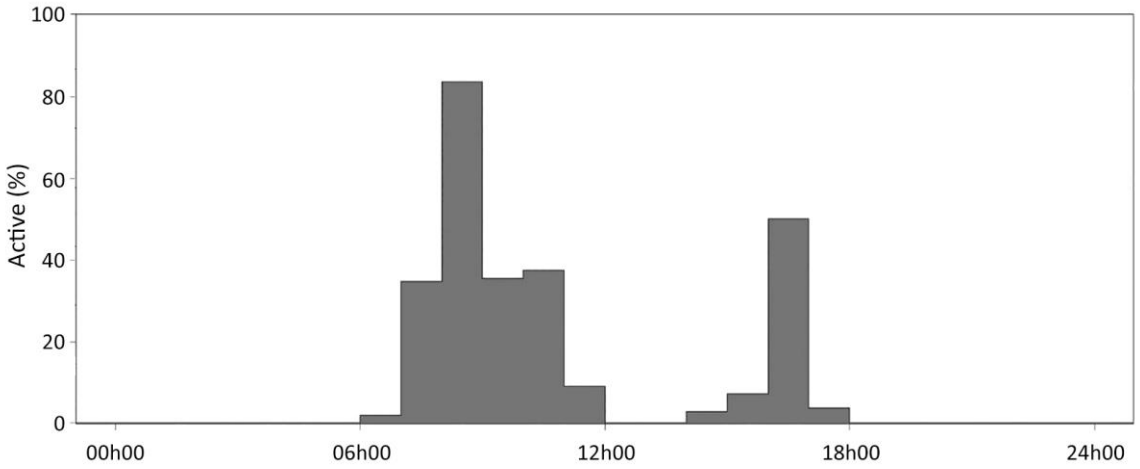

Fig. 2. The percent of each hour (averaged across all three observation days) the targeted Small Indian Mongoose *Urva auropunctata* was outside its burrow, hence "active", as defined for the purposes of this study in Sripore Timbi, Gujarat, India. As the graph shows, the mongoose was most active during the morning hours, peaking from about 09h00 to 10h00. There was a second bout of activity in the late afternoon, about an hour before sunset.

The mongoose was observed to bask in the sun (Figs. 3-5) between about 08h00 and 09h00 in two favoured spots nearby burrow openings, permitting a quick escape from potential predators, especially feral dogs.

Fig. 3. Small Indian Mongoose *Urva auropunctata* basking in the sun in one of its two preferred basking spots, in Sripore Timbi, Gujarat, India.

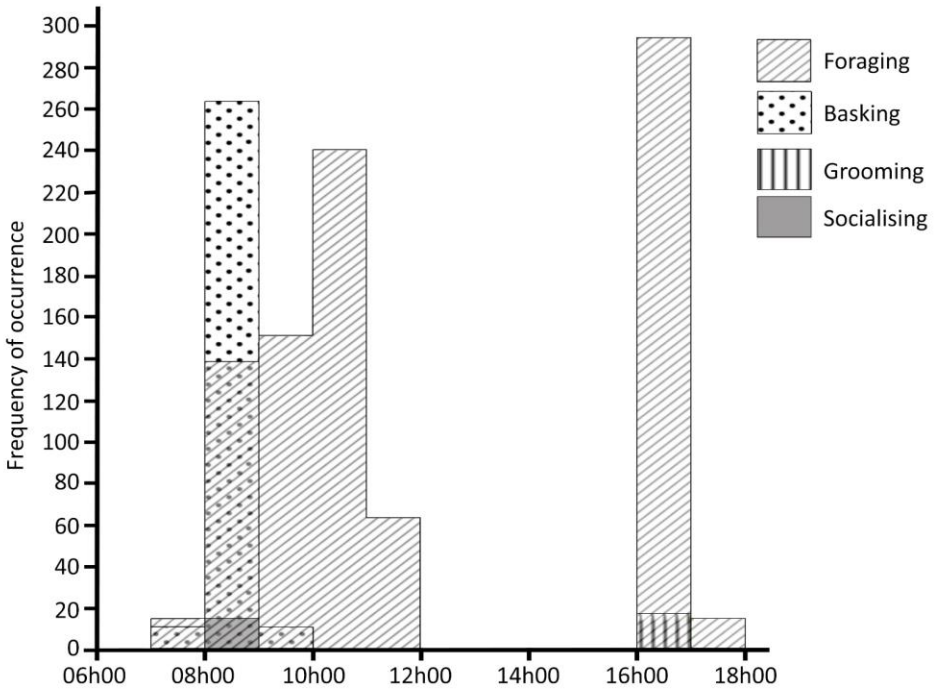

Fig. 4. The frequency of occurrence (the number of photographs showing a given activity within a given hour, totalled across all three observation days) of different activities exhibited by the target Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India.

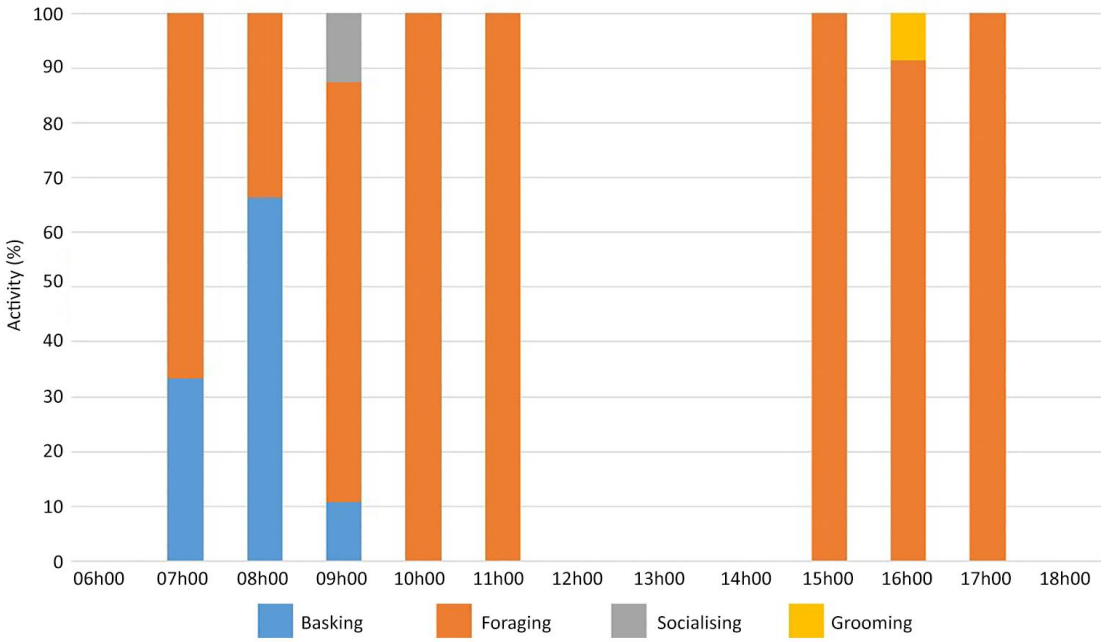

Fig. 5. Activities exhibited by the target Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India, displayed as a percentage of each hour.

After basking, the mongoose usually foraged until midday (Figs. 4, 5), with sparse socialising sessions comprising no more than two observed events per field visit. During the hottest hours, the mongoose retreated to its burrow, re-emerging in the afternoon, when the heat was less. Grooming behaviour was mainly observed in the late afternoon (Figs. 4, 5), after which the mongoose would retreat to its burrow for the final time before nightfall.

Diet analysis

Thirty scat pellets were collected every month from the mongoose burrows, amounting to a total of 90 scats. Plant and insect parts constituted a major portion of the scats, while bones, hair, seeds and fish scales were also recovered (Table 2). The mongoose diet consisted mainly of insects in the months of December and January, shifting to more plants in February (Fig. 6).

Table 2. Numbers of hairs, fish scales, feathers, bone fragments and seeds recovered from scats of Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India.

	No. of scats	**No. of hairs recovered**	**No. of fish scales**	**No. of feathers**	**No. of bone fragments**	**No. of seeds**
Dec.	30	15	12	27	9	14
Jan.	30	16	0	0	12	2
Feb.	30	35	0	0	10	2

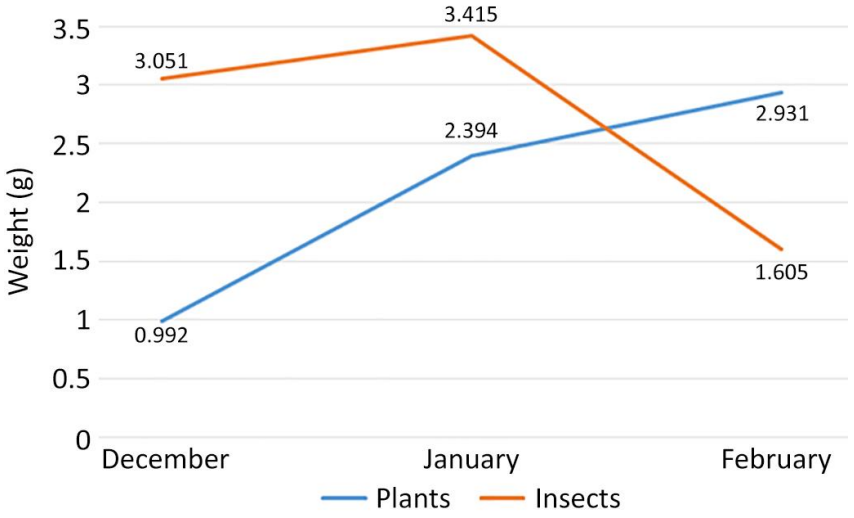

Fig. 6. Shift in the diet of the Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India, during the winter months.

The minor components included hair, bone fragments, fish scales (cycloids) and feathers (Table 2). These were low in weight and were therefore counted and the frequency of occurrence (no. of components / no. of scat pellets [30]) compared over the time (Fig. 7).

Fish scales and feathers were recovered only from scat pellets collected in December (Fig. 7). Seeds were also found regularly during the study (Table 2).

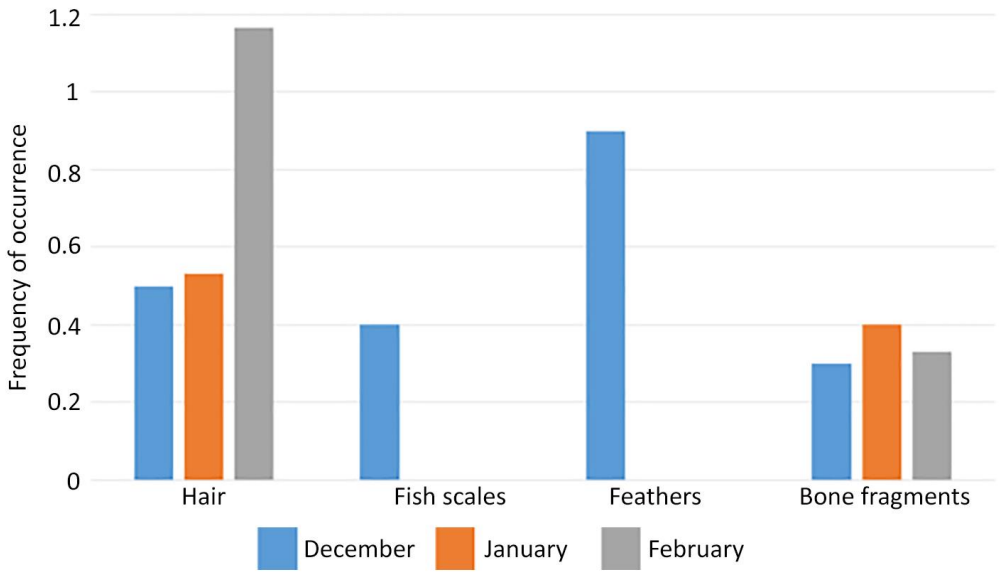

Fig. 7. Frequency of occurrence (number of items in a category divided by total number of scats [30]) of minor components in scat pellets of Small Indian Mongoose *Urva auropunctata* in Sripore Timbi, Gujarat, India.

Discussion

In our study area, the targeted *U. auropunctata* avoided the hottest hours of the day by retreating to its burrow, re-emerging when the heat was more tolerable. There were two distinct peaks of activity: one in the morning and the other in the late afternoon. This activity pattern is similar to that observed in some other mongoose species, such as the Common Dwarf Mongoose *Helogale parvula* (Rasa 1983) and the Short-tailed Mongoose *Urva brachyura* (Jennings *et al.* 2009).

The mongoose's midday retreat to its burrow in our study is attributable to the high daytime temperatures in western India. The morning basking behaviour of the Small Indian Mongoose has never been reported before and could be due to the cold winter mornings.
The shift from an insect-based diet to a plant-based diet is similar to the results obtained for the Small Indian Mongoose on Korčula Island, where their diet shifted from mainly vertebrates to frugivory, as winter progressed (Cavallini *et al.* 1995). This shift in diet may indicate that the Small Indian Mongoose is an opportunistic predator, feeding on the most available prey, both in its native and introduced range (Mahmood *et al.* 2017). This could be primarily because of scarcity of insects towards the end of winter.

Soil comprised a significant part of the scats, which may signify that the mongooses may be feeding on burrowing grubs or earthworms.

Feathers and fish scales (cycloids) were found only in December. Small Indian Mongooses have been observed feeding on birds in Punjab, Pakistan (Mahmood *et al.* 2017). The presence of hair and bones was consistent throughout the duration of our study. Some hairs were identified to be of the house rat *Rattus rattus*. Other studies have shown that the Small Indian Mongoose feeds regularly on rodents (Mahmood *et al.* 2017) and that mammals comprised a significant amount of the diet (Cavallini & Serafini 1995).

Most of the seeds recovered from the scats were wheat *Triticum aestivum*; chaff of the seeds was also recovered occasionally. In the agricultural fields surrounding the village, wheat was sown during the winter so that it could be reaped around March–April. Other seeds were of grass, cumin *Cumin umcyminum* and coriander *Coriandrum sativum*. Cumin and coriander were not grown in the fields: the mongooses may have been foraging on left-over food from villagers' homes.

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IUCN/SSC Small Carnivore Specialist Group

ARTICLE

Toward a better understanding of the Japanese Marten *Martes melampus* diet

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Abstract

Examining diet is essential to understanding the ecology and life history of animals. Martens (*Martes*, Mustelidae: Carnivora) are typical generalist feeders; however, the feeding ecology of Asian martens is less understood compared to those in Europe and North America. On the basis of previous literature reviews, I expose here current gaps in our knowledge of the diet of the Japanese Marten *Martes melampus* and identify future research requirements. This paper addresses the lack of efforts in measuring food availability and quantifying the Marten diet by biomass/volume metrics, which prevents us from examining optimal foraging theory, a macronutrient framework and interspecific competition with other sympatric carnivores. There are also knowledge gaps in dietary differences between sexes, which could be associated with sexual size dimorphism. Moreover, researchers need to be aware of how environmental changes, including urbanisation and global climate change, may affect the feeding behaviour of the Japanese Marten. Enhancing studies of the Japanese Marten and other Asian *Martes* species by considering these perspectives will allow us to formulate a comprehensive understanding of adaptive foraging behaviour in Holarctic martens.

Keywords: Japanese Marten, *Martes melampus*, Mustelidae, carnivore, faeces, feeding ecology, food habits

Introduction

Accumulating dietary information is essential to improve our understanding of species ecology and life history (Carr & Macdonald 1986, Machovsky-Capuska *et al.* 2016). Many species of generalist feeders have evolved adaptive strategies to utilise diverse foods. Martens (*Martes* spp.) are typical opportunistic generalists whose food composition is associated with geo-climatic factors (e.g., Zhou *et al.* 2011a). The diets of Pine Martens *Martes martes* and Stone Martens *M. foina* in Europe and the American Marten *M. americana* and the Pacific Marten *M. caurina* in North America have been extensively studied and the findings systematically synthesised (Zalewski 2004, Papakosta 2014, Zhou *et al.* 2011a, Remonti *et al.* 2016). However, the feeding ecology of Asian martens has been less studied and is less understood (see Hisano *et al.* 2019, Tsuji et al. 2019) despite the importance of this knowledge in aiding the development of conservation and management policy (e.g., Caryl *et al.* 2012, Newsome *et al.* 2016). This paper focuses on dietary studies of the Japanese Marten *M. melampus*, a species endemic to the main islands of Japan.

The Japanese Marten is listed as Least Concern on the IUCN Red List of Threatened Species (Abramov *et al.* 2015); nonetheless, some of its local populations require conservation efforts. In Japan's national and regional Red Lists, for example, Marten

populations are listed as Nearly Threatened in Gunma Prefecture (2012), Aichi Prefecture (2015) and Tsushima Island (Ministry of the Environment 2017) because they are influenced by habitat loss and degradation as a consequence of intensive deforestation and plantation establishment, as well as urbanisation (Tatara & Doi 1994, Proulx *et al.* 2004, Abramov *et al.* 2015). Understanding the ecology and life history of the Japanese Marten is fundamentally important to inform conservation and management policy planners and practitioners (Watt *et al.* 1996, Proulx *et al.* 2004).

Regional studies have shown that the primary foods of the Japanese Marten are small mammals (mainly rodents), fruits (berries) and invertebrates, with occasional exploitation of birds, reptiles, amphibians and carcasses of ungulates (see syntheses by Hisano & Deguchi 2018, Hisano *et al.* 2019, Tsuji *et al*. 2019). However, most of dietary studies of the Japanese Marten have not produced more than simple dietary descriptions and many aspects of its feeding ecology remain unexplored. In order to facilitate studies of the Japanese Marten's diet and its ecological role, here I expose gaps in our knowledge of its diet, which I organise in terms of technical and biological concerns. I then identify future study requirements, on the basis of previous literature reviews (Hisano & Deguchi 2018; Hisano *et al.* 2019).

Technical concerns

Visual/olfactory techniques for faecal identification

Japanese Marten dietary surveys have been limited by the researchers' skills in distinguishing Marten scats from those of other sympatric carnivores (see Davison *et al.* 2002, Kurose *et al.* 2005). For example, ca. 20% of Pine Marten faeces were misidentified as confounded with fox faeces in a study in Scotland (Davison *et al.* 2002, Baines *et al.* 2013). However, a recent study comparing DNA diagnostic and visual/olfactory techniques found that visual/olfactory identification techniques were >95% reliable for fresh (unbroken and odoriferous) scats, without recourse to expensive DNA diagnostic techniques (Hisano *et al.* 2017). This is promising for future studies of the Japanese Marten.

Identifying food items

Misidentifying food items or poor knowledge of contents in samples leads to incorrect findings in dietary studies. Each scientist should improve his or her identification skills, for example, by collecting food specimens in the field (see Hisano et al. 2016, 2017). Regardless, food identification abilities will differ among researchers.

More attention must be paid to the taxonomic level of food item identification that is appropriate for comparing or compiling studies. If a study aims to describe local characteristics of Marten diet, it would be necessary to identify food items at species level.

However, for the purpose of general dietary examinations, class level identification of food categories may be suitable.

Dietary metrics

Standardised dietary metrics are important for further syntheses and meta-analyses. Dietary studies of the Marten should report the total number of food items used for calculating frequency of occurrence (FO) or relative frequency of occurrence (RFO; see Zhou et al. 2011b), as well as with the number of stomachs/faeces examined per season (Adachi *et al.* 2016). A lack of such data precluded the inclusion of eight annual and/or seasonal studies in a previous meta-analysis (Hisano *et al.* 2019), which reduced statistical power. This is particularly problematic when looking at the utilisation of specific species – for example, the consumption rate of endangered birds or nuisance foraging on domestic crops – and when performing geographic/climate analyses (*cf.* Zhou *et al.* 2011a; Tsuji et al. 2019).

No studies of the Japanese Marten have measured quantities of food consumed, which is crucial for the systematic understanding of their foraging strategy. Dietary switching in the Japanese Marten is often based on the authors' speculation (e.g., Hisano *et al.* 2017), whereas studies of switching in other marten species – for example, the American Marten (Thompson & Colgan 1990), the Yellow-throated Marten *Martes flavigula* (Zhou *et al.* 2011b) and the Pine Marten (Caryl *et al.* 2012) – has been based on reliable information about fluctuating environmental resource abundance.

Moreover, biomass-based methods of assessing Japanese Marten diet, e.g., the percentage of dry weight (Kondo 1980, Yamagishi 1990, Hisano *et al.* 2017), have rarely been employed, with studies relying on frequency-based methods. Biomass calculations, which introduce less potential for misinterpreting data, are proposed as the most accurate evaluation of carnivore diet (Klare *et al.* 2011). These data would enable the quantitative testing of Charnov's (1976) optimal foraging theory (*cf.* Zhou *et al.* 2011b, Thompson & Colgan 1990) and the dietary generalist–specialist distinction within the macronutrient framework (Machovsky-Capuska *et al.* 2016) with energy-based metrics (Remonti *et al.* 2016).

Biological concerns

Regional biases in survey effort

Although the Japanese Marten has an extensive distribution across Japan (Abramov *et al.* 2015), their diet is still unknown from large regions, such as Tohoku Region (northern Japan) and Chugoku/Shikoku Region (western Japan). More effort is needed to gather information about Japanese Marten ecology in these unexplored regions. Although a previous meta-analysis (Hisano *et al.* 2019) revealed that the thermal forest zone could generally determine

whether Martens were more carnivorous/insectivorous or more frugivorous/omnivorous, we still need to enhance the quantity and quality of dietary studies in several regions in Japan.

Urban Martens

The Japanese Marten inhabits not only forested areas but also suburban residential areas. Here Martens are known to scavenge human refuse and even to den and reproduce in attics (Watanabe 2016, ASWAT 2017, Wildlife Damage Controlling Society 2017), as do Stone Martens in Europe (e.g., Hisano *et al.* 2016). Examining the diet of suburban Japanese Martens may provide useful information for non-forest populations and aid in mitigating human–wildlife conflict (see Bateman & Fleming 2012; *cf.* Czernik *et al.* 2016, Hisano *et al.* 2016 for Stone Martens).

Marten diet under climate change

Few studies report Japanese Marten diet from sub-alpine regions (>1500 m asl) compared to temperate regions, even though the former is an important part of their population range (Ueuma *et al*. 2005, Hisano *et al.* 2017). The logistical difficulties and safety concerns that result from severe winter weather typically constrain sub-alpine studies to summer (Ueuma *et al.* 2005, Hisano *et al.* 2017). Nonetheless, monitoring Marten diet in highland habitats and comparing the findings with those from lowland habitats within the same study area (Suzuki 1977, Hisano *et al.* 2017, see also Hisano *et al.* 2016) are important because the zonation of species in relation to ecosystem composition is particularly vulnerable to climate change along elevational gradients in mountain ranges (Pauli *et al.* 2012). For example, Zhou *et al.* (2013) report that an unprecedented snow storm significantly impacted the diet of Yellow-throated Martens and other seed-dispersing species in central China. In recent years, Japan has also experienced regional climate extremes, such as record torrential rain and heavy snow (Tai *et al.* 2012, Nakai 2015), which may affect Japanese Marten food supply (e.g., fruit fertilisation). Shifts in forest type/composition with temperature warming are being observed across the Japanese archipelago, particularly at biome boundaries (Suzuki *et al.* 2015). As food diversity and availability alters, so too might the diet of Japanese Martens. It should also be noted that shifts in Marten diet can be attributed to fluctuations of food availability due to seasonality (a short-term factor) and climate change (long-term factors). Future studies should seek to disentangle these factors to better understand these abiotic effects on Marten diet.

Interspecific competition with sympatric carnivores

Martens potentially compete with other sympatric carnivores for food resources. Within a given study area, several studies have compared food habits of the Japanese Marten with other sympatric carnivores, such as Red Foxes *Vulpes vulpes* (Kitahara 1985, Kondo 1980,

Yamamoto 1994, Ueuma *et al.* 2005, Koike *et al.* 2008, 2012, Hisano *et al.* 2017); Raccoon Dogs *Nyctereutes procyonoides* (Yamamoto 1994, Koike *et al.* 2008, 2012, Takatsuki *et al.* 2018), Japanese Badgers *Meles anakuma* (Yamamoto 1994, Koike *et al.* 2008, 2012), Japanese Weasels *Mustela itatsi* (Tsuji *et al.* 2011), Siberian Weasels *M. sibirica* (Tatara & Doi 1994), Stoats *M. erminea* (Ueuma 2005), Leopard Cats *Prionailurus bengalensis* (Tatara & Doi 1994), and Asiatic Black Bears *Ursus thibetanus* (Koike *et al.* 2008, 2012). The dietary niche of Martens substantially overlaps with *V. vulpes* and *N. procyonoides* although Martens showed higher trophic diversity than these species (Yamamoto 1994; Hisano *et al.* 2017). In order to further understand mechanisms of food resource partitioning (or interspecific competition) among sympatric Japanese carnivores, dietary comparison and food availability data are necessary (e.g., Carvalho & Gomes 2004).

Sexual comparisons

Though sexual dimorphism can be substantial in small mustelids (Moors 1980, Noonan *et al.* 2016), leading to differences in diet (Macdonald & Newman 2017), there is a paucity of studies contrasting Japanese Marten diet between sexes. Such studies exist for such *Martes* species as Stone Marten (Loy *et al.* 2004, Bakaloudis *et al.* 2012, Hisano *et al.* 2013, 2014), Pine Marten (Zalewski 2007), American Marten (Nagorsen *et al.* 1989, Bull 2000, Hales *et al.* 2008) and Sable *Martes zibellina* (Dubinin 2010). Cooperative work with local hunters (e.g., Hisano *et al.* 2013, 2014) or collecting road-kill samples (Okawara *et al.* 2018; see also Iwama *et al.* 2017) will enable us to test the effects of sexual size dimorphism (Moors 1980; Noonan *et al.* 2014) on the Japanese Marten diet, which can also be combined with corporal and cranial measurements (see Loy 2004 for Stone Marten). Only two studies (Ohtsu 1972, Okawara *et al.* 2018) have examined the Japanese Marten diet by stomach content analysis. Considering the difficulty in obtaining large numbers of dead Marten bodies in Japan (where hunting is not a popular sport and Martens are often subject to conservation), developing stable isotope techniques for dietary analysis (see Manlick *et al.* 2017 for the American Marten and the Fisher *Pekania pennanti* would be a better approach for the Japanese Marten.

Conclusion

Dietary studies of Asian martens, including the Japanese Marten, are lagging behind those of other *Martes* species in Europe and North America. This paper has proposed ways to expand and improve research into the feeding ecology of the Japanese Marten. The issues raised here are relevant to the other Asian martens (subgenus *Charronia*: *M. flavigula* and *M. gwatkinsii*), for which ecological information is even scantier.

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IUCN/SSC Small Carnivore Specialist Group

ARTICLE

Summary and highlights of small carnivore photo-captures during a field season in the central Western Ghats, India

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Abstract

Camera-traps are very efficient at detecting certain types of cryptic species such as small carnivores and, because many small carnivore species remain poorly understood, such records can substantially advance our understanding of these species's conservation status, distribution, habitat relationships, diel activity patterns and other aspects of their biology and ecology. However, camera-trap surveys are expensive (in terms of equipment, effort, human power and cost) to conduct at large spatial scales. It is often possible to collate such records from large-scale surveys targeted at other taxa that are more likely to receive funding for conservation monitoring. This paper presents a summary and some notable records from camera-trap surveys, primarily targeted at monitoring of Tiger *Panthera tigris* and Leopard *P. pardus* populations, in the Malenad landscape of Karnataka and adjacent areas of Goa and Kerala, part of the Western Ghats biodiversity hotspot in India. Investing a total trap effort of 20,245 trap-days across 566 camera trap locations during the 2013-14 field season, we obtained 4452 images of small carnivores from 3204 distinct detection events of 11 species. Significant photo-captures include Brown Palm Civet *Paradoxurus jerdoni* in Nagarahole, Bandipur and Biligiri Rangaswamy Temple Tiger Reserves, Leopard Cat *Prionailurus bengalensis* in Bandipur, and Brown Mongoose *Herpestes fuscus* and Nilgiri Marten *Martes gwatkinsii* in Talakaveri Wildlife Sanctuary.

Keywords: By-catch records, data processing, endemics, landscape-scale surveys, species occurrence

Introduction

Over the last few decades, camera-trap surveys have revolutionised field studies in wildlife biology, from generating species inventories and occurrence records to long-term studies investigating population dynamics (Karanth et al. 2006, O'Connell et al. 2011). Particularly for some cryptic and poorly understood taxa such as small carnivores, camera-trap surveys are extensively used to generate reliable and verifiable records of species occurrence, as is evident from even a cursory look at recent issues of *Small Carnivore Conservation*. These records may be used to simply update the known distributional limits of species, to assess species–habitat relationships (in which case the modelling framework used must reasonably reflect the underlying processes that generated the data), to investigate species's diel activity patterns and other aspects of their behaviour, and to examine phenotypic variation in populations. Camera-traps are typically much more efficient at detecting

cryptic/nocturnal species than are direct observations (Mathai et al. 2013), and are also more reliable (and independently verifiable) than detections based on indirect signs such as scats and tracks. Camera-trap surveys, however, tend to be expensive (in terms of equipment, effort, human power and cost) to conduct at spatial scales sufficiently large to assess species's distributions reliably. There exists vast potential to mine data sets from surveys targeted at charismatic species (such as large cats [Felidae], which receive much greater conservation and research funding) for 'by-catch' data on other taxa, including small carnivores. This paper presents a summary and some notable records from camera-trap surveys conducted in the Malenad landscape of Karnataka, India, from November 2013 to June 2014.

Methods

The camera-trap surveys were conducted by the Centre for Wildlife Studies, under a long-term Tiger population monitoring programme across eight protected areas (PAs) within the circa 38,000 km^2 Malenad landscape (Karanth et al. 2011) forming the bulk of the central Western Ghats: Mhadei Wildlife Sanctuary (WLS; Goa), Kali (previously known as Dandeli–Anshi) Tiger Reserve (TR), Bhadra TR, Talakaveri WLS, Nagarahole TR, Bandipur TR, Biligiri Rangaswamy Temple (BRT) TR (all in Karnataka) and Wayanad WLS-North (Kerala). Table 1 contains details of the dominant vegetation types in each PA. Data from Nagarahole and Wayanad-North (Tholpetty Range) were processed together as these are contiguous. While surveys in Nagarahole, Bandipur, BRT and Bhadra covered the entire reserves and areas outside (Nagarahole, Bhadra), only small parts of Mhadei, Kali and Talakaveri were covered.

Table 1. Details of dominant vegetation types, number of camera-trap locations, durations of sampling and trap effort, by protected area.

Protected area	Dominant vegetation types[a]	No. camera-trap locations	Duration of sampling (days)	Trap effort (trap-days)
Bhadra	DDF, MDF, SEG, *shola*, teak	122	59	6928
Bandipur	DDF, SAV, teak	134	31	4154
BRT	SCR, DDF, MDF, *shola*	103	34	3493
Kali	DDF, MDF, SEG, EVG	17	10	151
Mhadei	MDF, SEG	12	14	122
Nagarahole	DDF, MDF, teak	141	31	4361
Talakaveri	EVG, SEG, *shola*	11	54	269
Wayanad	DDF, MDF, SEG, teak	26	31	767
Totals		566		20,245

[a]DDF: tropical dry deciduous forest; MDF: tropical moist deciduous forest; SEG: tropical semi-evergreen; EVG: tropical wet evergreen; *shola*: mosaic of montane grasslands on slopes and stunted evergreen *shola* forests in mountain folds; teak: teak *Tectona grandis* plantation; SCR: thorn scrub and dry evergreen; SAV: savanna woodland.

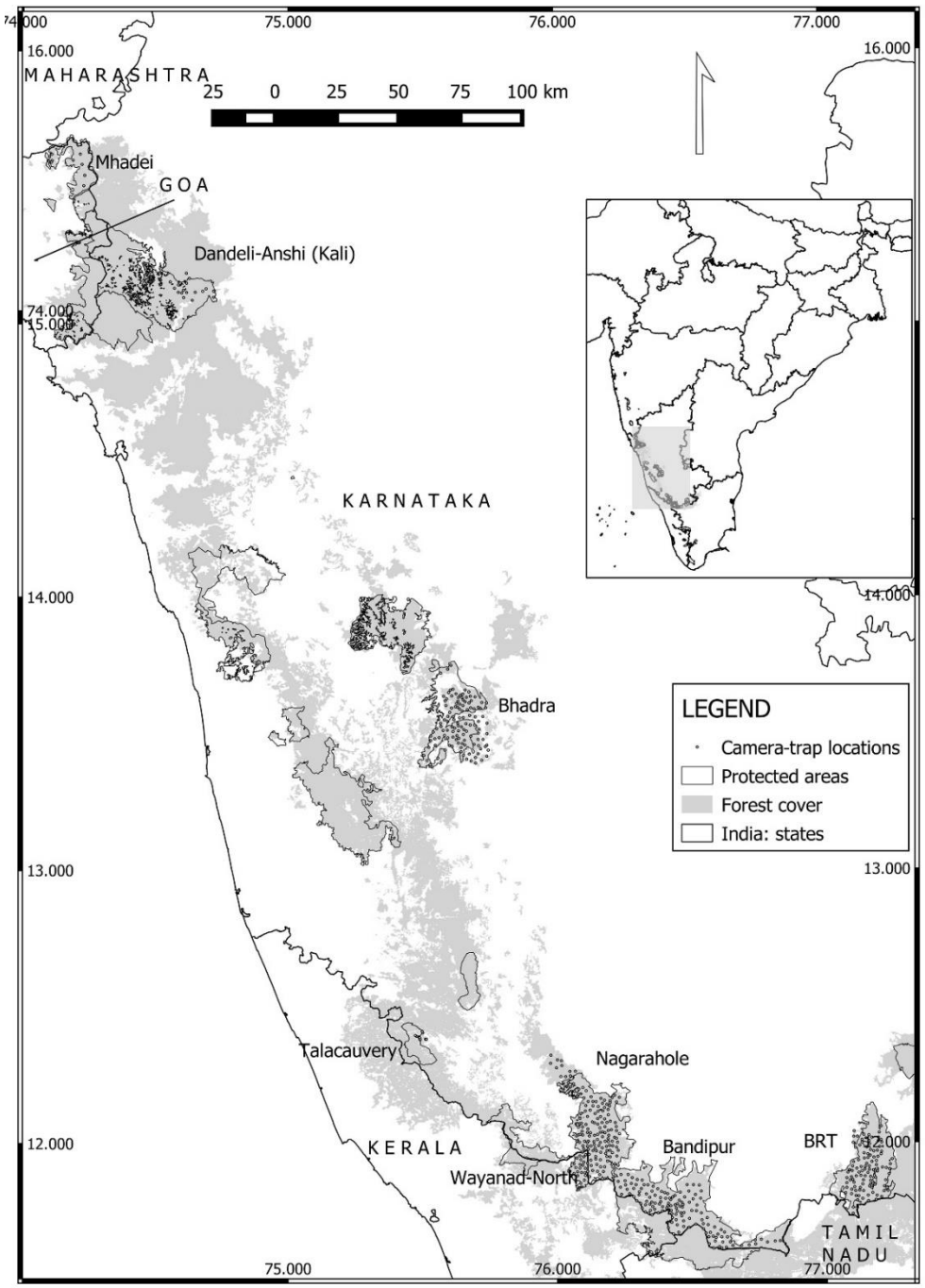

Fig. 1. Map of the study landscape, showing camera-trap locations, protected areas surveyed and forest cover. The inset map shows the location of the study landscape on the Indian peninsula.

Figure 1 shows camera-trap locations across these eight PAs. The surveys were carried out between the first weeks of November 2013 and June 2014 across all sites, with a maximum duration of 59 days at any given site. Details of the number of locations, duration of sampling and total camera-trap survey effort in each site are presented in Table 1. The locations of camera-traps in these PAs optimised capture probabilities of large cats, and

were spaced 2-3 km apart to ensure at least two to three camera-trap locations within individual Tiger home ranges, while also exposing the entire local population (or the entire protected area) to the sampling to the extent possible (Karanth et al. 2002, 2017). Camera-trap locations were mainly along forest roads and trails and were selected based on preliminary reconnaissance surveys to identify areas frequently used by Tigers. At each location, a pair of camera traps (mainly Panthercams; Olliff et al. 2014) was set up on either side of the road/trail (to obtain images of both flanks simultaneously, for the purpose of identifying individual Tigers), approximately 3.5 m from the centre of the road/trail (Karanth et al. 2002, 2017). In Talakaveri WLS, camera-trap surveys were carried out along with pre-baiting prior to live capture and radio-collaring of small carnivores (Jathanna 2016, Jathanna et al. in prep.). Here, traps were located away from roads and trails (to minimise the risk of theft), and a single camera-trap was placed facing a box-trap baited with chicken entrails (without a trap door during pre-baiting) at each location.

The photo-captures of small carnivores and small felids were separated from the larger camera-trap image data (more than 700,000 images; K. U. Karanth, unpublished data) and collated into a spreadsheet using MS-DOS commands; where required, the time and date recorded on the EXIF metadata on each image were corrected based on slate shots (i.e. exposures of a slate with GPS-derived time, date and the location written on it) taken by field teams when the camera was set up and when it was checked to retrieve images. Based on the corrected dates and times, simultaneous photo-captures taken by the two camera-traps deployed at each location were matched to define distinct photo-capture events, defined based on a time difference of at least 60 seconds between successive captures of the same species at a camera-trap location. We carefully identified species photo-captured; photographs which were in any way unclear or contained only a part of the animal's body sufficiently incomplete to lead to any degree of ambiguity in species identity were discarded to ensure no false-positive detections. In a few cases, species identity was confirmed with the help of a small carnivore expert familiar with the set of species we photo-captured.

Results and discussion

The camera-trap surveys yielded 4452 images of small carnivores across the eight PAs. After matching images from the same capture event and discarding photo-captures that could not be unambiguously assigned to species, we had 3204 distinct capture events of 11 small carnivore species. Table 2 provides a summary of the photo-captures of small carnivores, by PA and by species. The Small Indian Civet *Viverricula indica* appeared to be both ubiquitous (photo-captured in 298 locations across all eight PAs) and common (1036 detections), followed by the Common Palm Civet *Paradoxurus hermaphroditus*, of which we obtained 650 detections at 180 locations in all PAs other than Talakaveri.

Table 2. Number of distinct photo-capture events (no. of locations), by species and protected area (PA); values in boldface are discussed further in the main text.

PA	Species[a] HEED	HESM	HEVI	HEFU	PAHE	PAJE	VIIN	FECH	PRBE	PRRU	MAGW	Totals by PA
Bhadra	26 (13)	26 (17)	365 (70)	0 (0)	35 (14)	60 (28)	504 (96)	17 (5)	95 (36)	23 (6)	0 (0)	1151
Bandipur	21 (11)	205 (66)	65 (24)	0 (0)	192 (61)	1 (1)	138 (53)	54 (31)	2 (1)	59 (31)	0 (0)	737
BRT	14 (10)	46 (27)	46 (21)	0 (0)	331 (60)	35 (6)	224 (61)	77 (22)	22 (11)	20 (12)	0 (0)	815
Kali	0 (0)	1 (1)	6 (3)	0 (0)	1 (1)	0 (0)	10 (6)	2 (1)	3 (2)	1 (1)	0 (0)	24
Mhadei	3 (3)	0 (0)	1 (1)	0 (0)	4 (2)	0 (0)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	10
Nagarahole	13 (9)	31 (21)	32 (19)	0 (0)	60 (31)	2 (2)	131 (63)	10 (6)	8 (8)	36 (14)	0 (0)	323
Talakaveri	0 (0[b])	0 (0)	0 (0)	58 (4)	0 (0)	6 (2)	8 (6)	0 (0)	2 (2)	0 (0)	1 (1)	75
Wayanad	6 (1)	6 (5)	6 (3)	0 (0)	27 (11)	0 (0)	19 (12)	0 (0)	5 (4)	0 (0)	0 (0)	69
Total events by species (no. of locations across all PAs)	83 (47)	315 (137)	521 (141)	58 (4)	650 (180)	104 (39)	1036 (298)	160 (65)	137 (64)	139 (64)	1 (1)	3204

[a] HEED: Grey Mongoose *Herpestes edwardsii*; HESM: Ruddy Mongoose *H. smithi*; HEVI: Stripe-necked Mongoose *H. vitticollis*; HEFU: Brown Mongoose *H. fuscus*; PAHE: Common Palm Civet *Paradoxurus hermaphroditus*; PAJE: Brown Palm Civet *P. jerdoni*; VIIN: Small Indian Civet *Viverricula indica*; FECH: Jungle Cat *Felis chaus*; PRBE: Leopard Cat *Prionailurus bengalensis*; PRRU: Rusty-spotted Cat *P. rubiginosus;* MAGW: Nilgiri Marten *Martes gwatkinsii*. [b] Grey Mongoose was photo-captured at one location near Talakaveri outside the survey period reported here.

We did not obtain any photo-captures of otters during the 2013-14 field surveys, although at least two species are known to occur in different parts of the study landscape and have also been photo-captured during other field seasons by the Centre for Wildlife Studies (K. U. Karanth, unpublished data). The Small-clawed Otter *Aonyx cinereus* occurs in hill streams along the main Western Ghats ridge (where its presence was easily confirmed during our camera-trap surveys based on its distinctive spraints) and the Bababudans range, and the Smooth-coated Otter *Lutrogale perspicillata* occurs in larger

rivers (such as the Cauvery, Kabini and Bhadra) and in reservoirs formed by damming these rivers. We also did not obtain any records of species whose presence in the region is uncertain (Malabar Civet *Viverra civettina*, Fishing Cat *Prionailurus viverrinus*) or only recently confirmed (Eurasian Otter *Lutra lutra*; Mudappa et al. 2018).

The large number of small carnivore images obtained during surveys primarily designed for large cats indicates that small carnivores (even species of the predominantly arboreal palm civets) do extensively use forest roads and trails. Below, we discuss some notable photo-captures in our data set.

Brown Palm Civet Paradoxurus jerdoni

The photo-captures obtained in Nagarahole (2), and Bandipur (1; Fig. 2a, b) are the first occurrence records for these PAs and are particularly significant since these areas support mainly deciduous forests with a few small patches of evergreen forest along Nagarahole's western edge, where the two photo-captures occurred. Kumara & Singh (2007) state that they were unable to sight the species in Nagarahole, despite much effort to locate it. Rajamani et al. (2002) also did not obtain sightings of the species in any deciduous forest areas during their surveys (which included Nagarahole, BRT and Bhadra), though they do mention a few sightings in coffee estates and moist deciduous forests outside the survey period. The single photo-capture in Bandipur was obtained along the reserve's south-western border with Wayanad WLS-South, close to the transition from dry to moist deciduous forest. The photo-captures in Talakaveri were unsurprising, as the sanctuary is well within the species's known habitat and range. In Bhadra, we obtained 60 photo-captures of the species (Table 2) including in moist and dry deciduous forests over 8 km from the nearest evergreen patch, which is considerable given that Mudappa (2001) estimated 95% minimum convex polygon home ranges from radio-telemetry of seven individual Brown Palm Civets to range from 3.6 ha to 50.9 ha.

In BRT, we obtained 35 photo-capture events of Brown Palm Civet (Table 2; Fig. 2c), all of them in the evergreen, *shola*-grassland and coffee plantation areas along the main ridge in the east-central part of the reserve. Our photo-captures of the species here are significant as they are the first verified records of its presence in BRT since Morris's museum collections in the 1940s (Rajamani et al. 2002). Despite investing targeted search effort, Rajamani et al. (2002), Kumara & Singh (2007) and Kumara et al. (2012) were unable to confirm the presence of Brown Palm Civet in BRT using direct observation-based surveys, underscoring the efficacy of camera-trap surveys in confirming the occurrence of cryptic, nocturnal and even arboreal species such as the palm civets. Rajamani et al. (2002) were also unsure of the veracity of the location records of museum specimens reportedly collected in BRT (by R. C. Morris, as listed in their table 1), though they list presence of the species in BRT as likely, based on its proximity to the Nilgiris massif (straight line distance circa 50 km). The pelage of individuals photo-captured in BRT was unusually

dark, in fact nearly black; see Fig. 2c), and unlike that of individuals photo-captured anywhere else, certainly in our surveys and to our knowledge in any other photographic record. It would be of great interest to investigate demographic and genetic connectivity/divergence among populations of Brown Palm Civet in remnant evergreen forests separated by large swathes of deciduous forests, commercial plantations, open agriculture and settlements, and to assess the effects of historical and recent anthropogenic land-use changes on the species's population genetics, possibly based on non-invasive faecal DNA.

Stripe-necked Mongoose Herpestes vitticollis

The species was never photo-captured in the wettest camera-trap locations (in Talakaveri), although D.J. (pers. obs.) made several sightings of the species both within the forest and in commercial cardamom–coffee plantations areas 2-5 km from evergreen forests, while we obtained a large number of photo-captures in Bhadra, BRT, Nagarahole and Bandipur. A possible reason for this could be that camera-trapping in Talakaveri was conducted exclusively away from forest roads and trails unlike in the other sites. This might indicate that photo-capture rates of the species (and perhaps movements) are much higher along roads than away from them.

Brown Mongoose Herpestes fuscus

The species, known to be an obligate of wet evergreen forests, was photo-captured only in Talakaveri WLS (Fig. 2d) and adjoining plantation areas during pre-baiting prior to live capture and radio-collaring. Our surveys did cover evergreen forest areas to the north (in Bhadra, Kali and Mhadei), but we did not obtain photo-captures of the species in these areas, nor are there any sighting records of the species north of Kodagu District, Karnataka. A recent record of the species in the dry deciduous forests of Tadoba-Andhari TR in central India (Chaoji 2020) is clearly misidentification of the Grey Mongoose *Herpestes edwardsii*. Although the species is known to be largely nocturnal with limited activity during the day (Mudappa 1998, 2002, Sreehari & Nameer 2013, Sreehari et al. 2013, 2016, Mudappa & Jathanna 2015, Kamath & Seshadri 2019), individuals quickly showed cathemeral activity once they learned that the box-traps were baited, visiting the traps through the day and night (leading to the large number of photo-captures relative to the low trap effort at this site; Table 2), and also spending time within or on top of the box-trap to groom themselves after consuming the bait (unlike Brown Palm Civets, Small Indian Civets and Leopard Cats, which remained wary and avoided entering the box-traps). In one location, two individuals regularly visited the trap. Based on the size difference between the two individuals, it was likely that this was a female with her pup (Fig. 2d). Although both individuals were photo-captured, only the larger individual usually entered the trap to

consume the bait. In the following season (2014-15), we obtained a photo-capture of the species in a coffee plantation about 3 km from the nearest large forest patch (Talakaveri) but within 1 km of steep, uncultivated (forested) slopes.

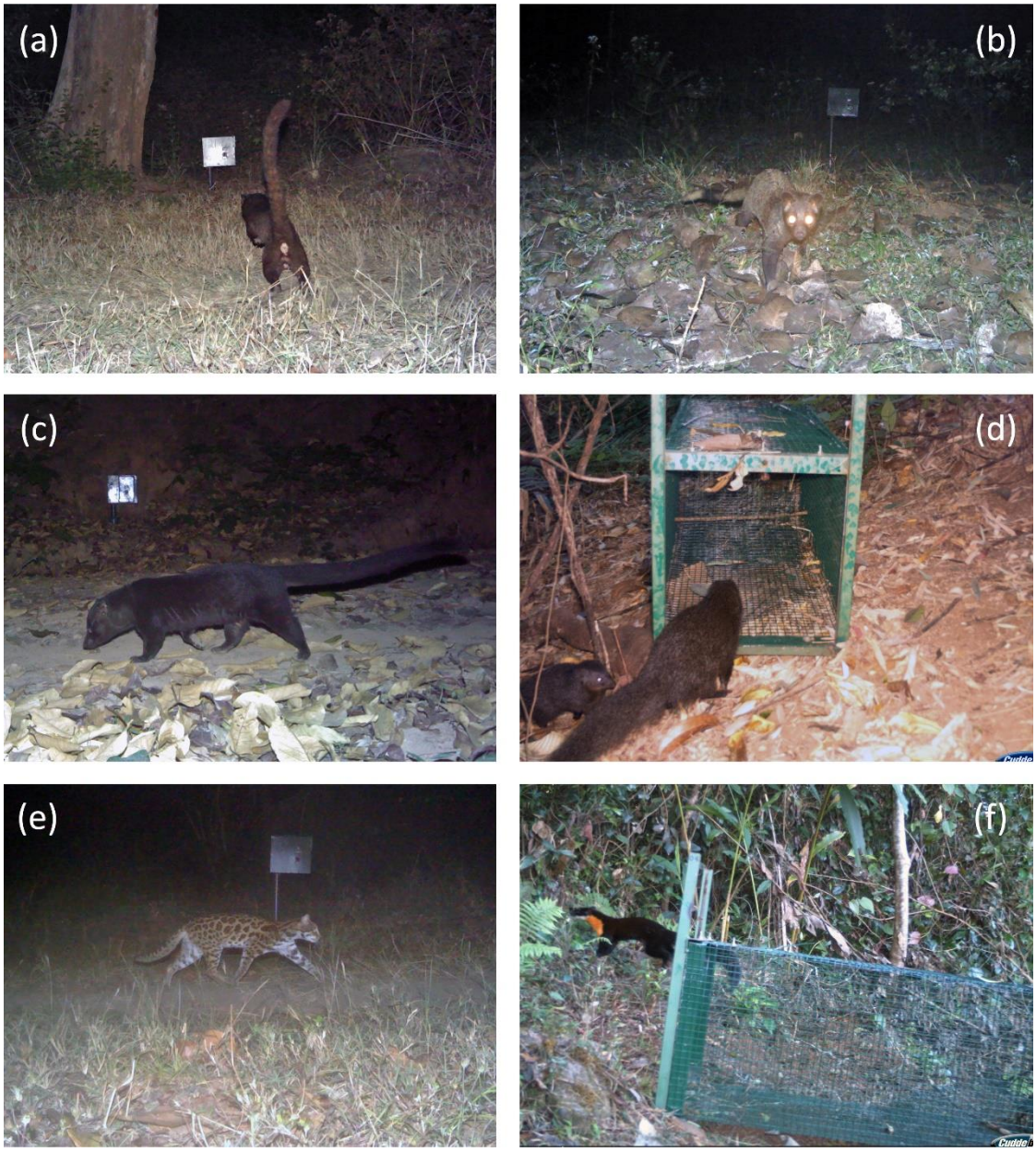

Fig. 2. Camera-trap images of small carnivores taken in the central Western Ghats, India, during 2013-14: (a) Brown Palm Civet *Paradoxurus jerdoni*, Bandipur, 9 January 2014; (b) Brown Palm Civet, Nagarahole, 7 December 2013; (c) Brown Palm Civet, BRT, 1 February 2014; (d) Brown Mongoose *Herpestes fuscus* (most likely female with young), Talakaveri, 27 December 2013; E: (e) Leopard Cat *Prionailurus bengalensis*, Bandipur; 6 January 2014; (f) Nilgiri Marten *Martes gwatkinsii*, near Talakaveri, 6 December 2013.

Leopard Cat Prionailurus bengalensis

Given that in peninsular India the species is known to occur in relatively wet, cool, close-canopied forested areas such as moist deciduous and evergreen forests, and adjoining commercial tree plantations (Yoganand & Kumar 1995, Mudappa 2002, Kumara & Singh 2004, 2007, Kumara 2007, Nag 2008, Sridhar et al. 2008, Kumara et al. 2012, Kalle et al. 2013, Srivathsa et al. 2015), the two photo-captures in the dry deciduous forests of Bandipur (Fig. 2e) are noteworthy, particularly as they were obtained at a location in a fairly dry part of the reserve near the Kekkanhalla checkpost. Kumara & Singh (2007) report two direct sightings of the species in the reserve. Previous studies (Kalle et al. 2013, Srivathsa et al. 2015) mention the species's use of plantation areas and forests adjoining human settlements, and we obtained one photo-capture of the species in a cardamom–coffee plantation adjoining a small patch of unprotected forest between Bhagamandala and Talakaveri and also found a road-killed female next to a small uncultivated wooded patch in an intensively cultivated coffee plantation area near Ayyangeri village, some 4 km from the nearest forest, in November 2013 (D. Jathanna pers. obs.).

Nilgiri Marten Martes gwatkinsii

During pre-baiting prior to live trapping and radio-tracking of small carnivores (Jathanna et al. in prep), we obtained a single photo-capture of a Nilgiri Marten, which moved past the box-trap without entering it (Table 2; Fig 2f) at 08h06, 6 December 2013. The traps were located at the edge of a mixed coffee–cardamom plantation, along a path bordered on one side by dense *Strobilanthes* understory at the edge of a patch of unprotected forest about 2.2 km from the nearest large forest.

For poorly understood taxa such as small carnivores, reliable occurrence records (such as carefully validated photo-captures) can still add substantially to our understanding these species's conservation status, distribution, habitat relationships, diel activity patterns and other aspects of their biology and ecology. Given the large costs associated with conducting camera-trap surveys across landscape scales, we recommend the 'mining' of by-catch records from large-scale surveys targeted at species such as Tiger and Leopard, which are more likely to receive funding for conservation monitoring. In doing so, however, we note the following.

(i) It is relatively easy to obtain photo-captures of most small carnivores, but it is critical to reference photo-captures reliably in space and time and to ensure that false positive detections do not vitiate conclusions/inferences. To ensure this, it is important to invest very substantial time and effort to maintain meticulous records during fieldwork and to organise, process and validate camera-trap image and other associated data with care. This is particularly important when the number of camera-trap locations and the number of images obtained are large.

(ii) Use of information we have presented either in the summary (Table 2) or in the in the main text in any formal modelling framework to assess species–habitat relationships would be inappropriate and misleading. Such summary records lack associated information on where we sampled (including where we did not observe the species), how much we sampled the different locations and how each species was or was not detected across multiple sampling occasions even where present. Consequently, observation processes such as unequal sampling probability across space, unequal sampling effort over time across sites, and imperfect and spatially variable detectability (MacKenzie et al. 2002, 2018, Yackulic et al. 2013) can seriously mislead inferred species–habitat relationships, unless they are accounted for or it can be reasonably demonstrated that such observation processes are relatively invariant across space. To separate these potentially confounding observation effects ('noise') from 'signal' in the data that is actually informative on species–habitat relationships, it is necessary to use a modelling framework that explicitly accounts for these factors (fit to data that were generated from underlying processes that reasonably match the model). We are currently finalising analyses of habitat relationships for those species in our data set with adequate detections at a large number of locations (and therefore excluding Nilgiri Marten and Brown Mongoose), using such a modelling framework (Jathanna 2016). We do not suggest a blanket ban on any particular modelling approach nor do we prescribe one approach over another for all situations, but we do recommend that, when modelling species–habitat relationships, investigators carefully think about the key processes (ecological as well as observation) that likely generated the data and select a modelling framework that reasonably matches these processes.

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ARTICLE

An observation of Yellow-throated Marten *Martes flavigula* hunting behaviour in eastern Cambodia

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Abstract

Two Yellow-throated Martens *Martes flavigula* were observed hunting together in an open dry deciduous forest in Srepok Wildlife Sanctuary, eastern Cambodia, on 24 January 2014. By climbing several trees and investigating tree holes for potential prey, one marten successfully killed a squirrel (Sciuridae). The martens appeared to systematically target large trees that had holes and other cavities, and were observed ignoring and moving past many smaller trees in between climbs. Regularly checking trees with holes may be a strategy used by Yellow-throated Martens to hunt arboreal or tree hole-nesting prey species.

Keywords: Cambodia, predation, squirrel, Srepok Wildlife Sanctuary

The Yellow-throated Marten *Martes flavigula* (Fig. 1) is a relatively common and widely distributed small carnivore species in Asia (Chutipong *et al*. 2016). Little is known about its ecology or behaviour because there has been only one ecological study that examined the home range size and activity of this species (Grassman *et al*. 2005) and one detailed dietary study (Zhou *et al*. 2011). Most of the available information on the species' prey items and hunting behaviours are from anecdotal observations (Pierce *et al*. 2014, Chutipong *et al*. 2016). The Yellow-throated Marten is reportedly omnivorous, with prey items including flowers, fruit, insects, eggs, frogs, reptiles, small mammals and birds (Nandini & Karthik 2007, Zhou *et al*. 2011, Chutipong *et al*. 2016). Ungulates are sometimes consumed, which probably involves scavenging, although predation on fawns and small deer has been reported in India and temperate regions of its range (Pierce *et al*. 2014, Chutipong *et al*. 2016). Predation on Small Indian Civet *Viverricula indica* has been reported in South-east Asia (Lamichhane *et al*. 2014, D. Willcox pers. comm.), indicating Yellow-throated Martens may prey on other small carnivore species.

Yellow-throated Martens are reported to hunt in pairs (Chutipong *et al*. 2016), although larger groups comprising up to five individuals have been reported (Parr & Duckworth 2007). Observations of the species's hunting behaviour are rare; the only published records are of Yellow-throated Martens chasing small ungulates, though the outcomes of these chases were not observed (Sathyakumar 1999, Naniwadekar *et al*. 2013).

Fig. 1. Yellow-throated Marten *Martes flavigula*. Credit: Rushenb / Thai National Parks (www.thainationalparks.com/kaeng-krachan-national-park), used in accordance with a CC BY 2.0 Creative Commons license (https://creativecommons.org/licenses/by/2.0).

Observation

On 27 January 2014, just before sunset (17h45), while walking near the Thmier Ranger Station in the western part of Srepok Wildlife Sanctuary (SWS), formerly Mondulkiri Protection Forest (12º58'8"N, 107º11'16"E; Fig. 2), I observed two Yellow-throated Martens crossing a dirt track in front of me. The habitat was open dry deciduous forests dominated by dipterocarp trees *Dipterocarpus* spp. The martens apparently did not notice me, and I was able to observe their behaviour for about 5 minutes. After crossing the dirt track, the martens ran past several dipterocarp trees and appeared to head straight for a much larger dipterocarp tree. Upon reaching the tree the first marten did not hesitate and climbed the tree without stopping, followed by the second marten. The first marten climbed all the way to near the top of the tree, then inserted the front half of its body inside a tree hole for a few seconds, before turning around and climbing back down the tree. The second marten never reached the hole, but instead turned around and followed the first marten down the tree. The martens then ran past about 10 –15 more trees and appeared to run straight towards another tall dipterocarp tree and repeated the same behaviour as with the first tree. After running down the second tree, the martens again ran past 10–15 more trees before running straight to a third large dipterocarp tree which the first marten climbed without hesitating, but this time the second marten stayed near the bottom of the tree. The first marten climbed directly to the top of the tree without stopping and inserted the front half of its body inside a tree hole, but this time it stayed in that position for several seconds, while loud squealing was heard coming from the hole. The first marten backed out of the hole with a small squirrel in its mouth. The distance and low light prevented identification of the squirrel species that was killed by the marten. It was probably a Cambodian Striped Squirrel *Tamiops rodolphii*, a species that shelters in holes in trees (Duckworth 2017) and is relatively common in the dry deciduous forests of SWS (pers. obs.). The first marten carried the apparently dead squirrel, which was motionless

and had stopped squealing, down the tree and began running along the forest floor with it. The second marten, which had stayed near the bottom of the tree, followed behind the first marten until both had disappeared from view.

Fig. 2. Srepok Wildlife Sanctuary (SWS), Cambodia, indicated by the yellow outline.

Discussion

Predation events by Yellow-throated Martens are rarely observed and this is the first reported observation on the predation of a squirrel by this species. Although there appeared to be no obvious difference in body size between the two martens, the first marten appeared to be leading, whilst the second marten followed, once staying at the base of the tree. The first marten might have been a parent, and the second marten a grown offspring. Alternatively, the two martens might have been a mated pair, and the first marten could have been older with more knowledge of which trees contained holes likely to have prey. Yellow-throated Martens often travel in duos, and sometimes trios or even larger groups (Parr & Duckworth 2007, Chutipong *et al*. 2016), but it has never been confirmed if such groupings are mated pairs, mated pairs with a grown offspring, or adult females with one or more grown offspring.

The first marten apparently knew which trees had holes that potentially contained prey, as it moved past many trees in between climbs and every tree it climbed had a hole near the top. Choosing which trees to climb did not appear to be based on scent, because the first marten never stopped at the base of the trees it climbed; instead it ran straight towards the larger trees and started climbing. This may indicate that martens use their memory when choosing which trees to climb, and that knowledge of trees with holes could be important to their hunting success. Regularly checking known trees with holes may be a strategy often used by Yellow-throated Martens when hunting arboreal or tree hole-nesting prey species.

Yellow-throated Martens are generalist feeders with opportunistic and varied diets (Zhou *et al*. 2011, Chutipong *et al*. 2016), and it is unknown if tree squirrels are an important part of their diet in SWS. Compared to wetter or temperate forest types, the open, dry deciduous forests in South-east Asia may offer relatively low amounts of alternative foods, including fruits, for martens, and small mammals such as squirrels may form an important part of the species's diet in this habitat type.

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ARTICLE

Honey Badger *Mellivora capensis* predation on an African Sharptooth Catfish in the Okavango Delta, Botswana

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Abstract

Honey Badgers *Mellivora capensis* are generalist opportunist carnivores with a wide geographic distribution range. References to fish as a Honey Badger food item are rare, but we observed a Honey Badger capturing and carrying off a large African Sharptooth Catfish *Clarias gariepinus* in a drying lagoon of the Okavango Delta in Botswana. Such fishing by Honey Badgers likely occurs somewhat regularly where opportunities present themselves through their geographic range.

Keywords: Botswana, catfish, diet, fishing, food habits, Honey Badger, *Mellivora capensis*, Okavango, predation, Ratel

Matshwane *Mellivora capensis* seji sa Tlhapi ya Toni mo Lecheng la Okavango

Bomatshwane *Mellivora capensis* ke dingwe tsa dibatana tse di tsomang ka tshono mme ebile ba fitlhelwa mo mafelong a a farologanyeng. Go ja tlhapi ga Matshwane ke sengwe se se sa tlwaelesegang, mme re bonye Matshwane a tsoma a bo a tshwara Tlhapi ya Toni *Clarias gariepinus* mo ledibeng le le kgadileng mo lecheng la Okavango mo Botswana. Letsomo la go nna jalo di diragala ka dinako dingwe fa tshono e letla mo mafelong a Matshwane a fitlhelwang mo go one.

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Introduction

Honey Badgers (or Ratels) *Mellivora capensis* have a wide geographic distribution in Africa, south-west Asia, and India and occur in all habitats (except dune deserts) up to altitudes exceeding 4000 m (Vanderhaar & Hwang 2003, Skinner & Chimimba 2005, Begg *et al.* 2013). They have been described as generalist opportunist carnivores that often prey on ants, bees, beetles, grasshoppers, scorpions, spiders, centipedes, freshwater crabs, mollusks, venomous snakes, skinks and other lizards, young crocodiles, sea turtle eggs, tortoises, frogs, toads, small rodents, hedgehogs, porcupines, Springhares *Pedetes capensis*, young small carnivores, young ungulates, bird chicks and domestic chickens, goats and sheep, as well as consuming wild fruits, roots and honey (Sweeney 1960, Marlow 1983, Neal & Cheeseman 1996, Lloyd & Stadler 1998, Pati *et al.* 2001, Vanderhaar & Hwang 2003, Skinner & Chimimba 2005, Begg *et al.* 2013, Lee & Simmons 2014, Estienne *et al.* 2017, Arbon 2019).

Honey Badgers also pirate food from carnivores (Kruuk & Mills 1983) and scavenge kills from other predators (Kingdon 1977).

Honey Badgers are reputed to be good swimmers and to chase turtles under water (Kingdon 1977), but references to fish as a honey badger food item are rare. Kingdon (1977:98) indicated that Honey Badgers peel away "the clay capsules of aestivating lungfish". Pocock (1909) reported that "according to native reports the species ... lives to a great extent upon fish, which it catches with its paws at the edge of streams", and Pati *et al.* (2001) noted fish scales in Honey Badger scats collected along riverbanks in India. Especially pertinent to our observation (below) is Ivy's (1970) report that "in the Limpopo region … [Honey Badgers] would feed on the fish as the pans began to dry up. Before completely drying up these pans were teeming with fish and provided food for many birds and several animals …" Here we document an observation of a Honey Badger capturing and carrying off a large African Sharptooth Catfish *Clarias gariepinus* in a drying lagoon of the Okavango Delta in Botswana.

Observation

We made our observation during a wildlife safari in the Moremi Game Reserve (Fig. 1). The dry season of 2019 was one of the driest on record (Charles 2019), and the floodwaters that typically would have arrived from Angola had not yet reached the area. On the afternoon of 18 July 2019, we slowly drove west along the south side of Xini Lagoon (19°23′37″S, 23°29′51″E), a wetland usually covered with 2–3 m of water at that time, but then nearly dry with the ground surface covered by mud and some Giant Salvinia *Salvinia molesta*.

At about 16h30 at a distance of about 125 m from the vehicle we espied African Fish Eagles *Haliaeetus vocifer*, a Hamerkop *Scopus umbretta* and a Blacksmith Lapwing *Vanellus armatus*, all on the ground at the nearly dry channel bottom of the lagoon. Through binoculars and telephoto camera lenses we saw, near the birds, some sun-lit water splashes and a Honey Badger pacing back and forth over a 10-m area (Fig. 2). The Honey Badger sometimes stopped and lowered its head as if grabbing something, and we noticed splashing by the Badger and also after the Badger moved away; we then realized that the Badger was trying to catch a fish that also caused splashes. The Honey Badger made four or five brief attempts to grab the fish in its mouth, then spent 5–10 seconds in a more intense effort and succeeded in grabbing the fish mid-body. It then turned and walked up the lagoon bank (Fig. 3) and into the grass and forest edge without changing its grip on the fish, an African Sharptooth Catfish which, given the size of a Honey Badger (75–115 cm total length; Proulx *et al.* 2016), likely measured about 70–80 cm (Fig. 3).

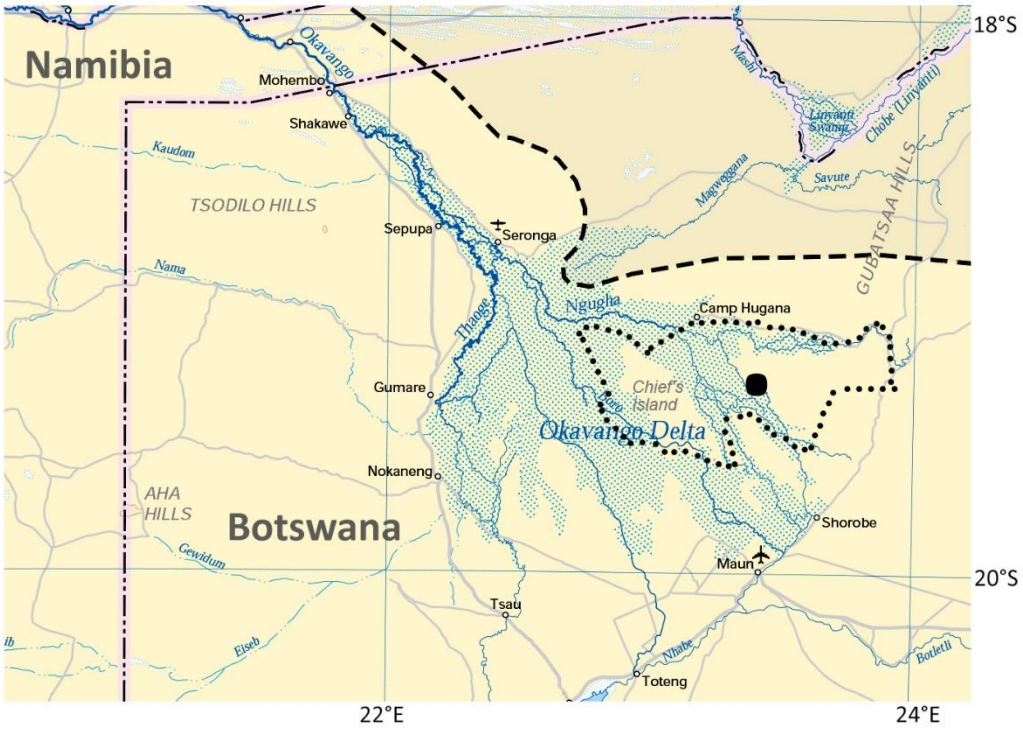

Fig. 1. Map of north-western Botswana; a large black dot shows the approximate location of Xini Lagoon, in Moremi Game Reserve (approximate boundary indicated by a dotted line). The dashed black line represents the boundary of the Okavango catchment area. (Modified from United Nations map of the Okavango River Basin, map no. 4032, January 2000.)

Fig. 2. Honey Badger *Mellivora capensis* just after capturing an African Sharptooth Catfish *Clarias gariepinus* in the nearly dry Xini Lagoon, Moremi Game Reserve, Botswana, as an African Fish Eagle *Haliaeetus vocifer* looks on. The birds in the background are Helmeted Guinea Fowl *Numida meleagris*.

Fig. 3. Honey Badger *Mellivora capensis* carrying African Sharptooth Catfish *Clarias gariepinus* in Xini Lagoon, Moremi Game Reserve, Botswana.

Discussion

African Sharptooth Catfish are the largest of six species of catfish in the Okavango region that can survive desiccation using air-breathing organs located in chambers above their gills (Brunton *et al.* 2018). It is common in almost all habitats and migrates into floodplains or into the shallows of backwater lagoons with the onset of rising floodwaters. When water levels recede, they are often the last species to survive, largely by using their air-breathing organs and by crawling overland using their locked pectoral fins. They are recorded as having been preyed on extensively by Crocodiles *Crocodylus niloticus*, and also Marabou Storks *Leptoptilos crumenifer*, Baboons *Papio ursinus*, African Fish Eagles and hyaenas (Brunton *et al.* 2018), as well as otters and cats (Ivy 1970). Mitchell *et al.* (1965) wrote that "the record of a catfish *Clarius* sp. being taken by a Leopard *Panthera pardus* may refer to a particular animal which was liberated in the Kafue National Park after having been rescued on one of the temporary islands in the Kariba lake. When trapped on the island, it was apparently entirely on a diet of fish to which it had become adapted living under unusual conditions". Notably, Harvey (2016) compiled data from the footage of a wildlife film unit (Natural History Film Unit, Botswana) working in the Savute portion of Chobe National Park in Botswana and reported that African Sharptooth Catfish were the main prey species of Leopards, specifically in the dry season (37 of 98 predation events overall, and 94% of events in the dry season).

Honey Badger predation on African Sharptooth Catfish in drying lagoons likely occurs somewhat regularly where the ranges of the two species overlap, and videos of similar behaviour are available (e.g. https://www.shutterstock.com/video/clip-4014460-honey-badger-catching-fish-pond, 25 July 2015; https://www.youtube.com/watch?v=qcgBw8ethLs, 23 February 2018). The most extensive investigation of the food habits of Honey Badgers (Begg *et al.*

2003) did not record catfish as prey probably because the study area was a dune area of the semi-desert region of the Kalahari thornveld in southern Africa, where no catfish occur.

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ARTICLE

Otter Civet *Cynogale bennettii* and other small carnivores recorded in the Bukit Tigapuluh Landscape, Sumatra, Indonesia

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Abstract

The Bukit Tigapuluh Landscape in Central Sumatra, Indonesia, is an important habitat for various wildlife species, including small carnivores belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae. An extensive camera-trap survey conducted between March 2013 and March 2014, and totalling 7068 camera-trap nights, in the southern part of the landscape detected 12 small carnivore species, including the first records of the Endangered Otter Civet *Cynogale bennettii* for the landscape.

Keywords: Viverridae, Mustelidae, Herpestidae, Prionodontidae, tropical lowland forest, wildlife conservation, camera-trapping

Introduction

The Indonesian island of Sumatra is home to a variety of small carnivore species. Most representatives of this group are elusive animals that are difficult to observe directly. Camera-trapping is among the most popular techniques to overcome detection problems and has been widely used to monitor wildlife populations in Sumatra and elsewhere (Linkie *et al.* 2008, Rowcliffe & Carbone 2008, Evans *et al.* 2016, Ancrenaz *et al.* 2012, Sunarto *et al.* 2013, McCarthy & Fuller 2014, Trolliet *et al.* 2014). However, by-catch records for non-target species are rarely published (Scotson *et al.* 2017). In contrast to neighbouring Borneo, where there has been considerable effort to clarify the conservation status of small carnivores (e.g. Wilting *et al.* 2016), very little up-to-date information is available from Sumatra (e.g. Holden 2006, McCarthy & Fuller 2014, Jennings *et al.* 2015), with several recent contributions covering only individual records of particular significance (e.g. Eaton 2009, Holden & Meijaard 2012, Ross *et al.* 2012, Pusparini & Sibarani 2014).

This survey contributes to closing the knowledge gap for small carnivores in Central Sumatra by presenting new records for species belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae, based on an extensive camera-trap survey

conducted between March 2013 and March 2014 in the Bukit Tigapuluh Landscape, Jambi, Indonesia.

Materials and methods

Survey site

The Bukit Tigapuluh Landscape is located roughly in the geographical centre of the Indonesian island of Sumatra, at the border between Riau and Jambi provinces. The tropical climate is marked by high rainfall (average precipitation 2577 mm/year, max. 347 mm/month, min. 83 mm/month) and temperatures ranging between 20 and 33 °C; the altitude ranges between 15 m and 843 m asl (Pratje & Sitompul 2009). In addition to a 1440 km² national park, the area includes a variety of land-use types and management units. These include forest concessions that are predominantly rubber tree *Hevea brasiliensis* and pulpwood *Acacia* and *Eucalyptus* monoculture plantations, as well as an ecosystem restoration concession (Menteri Kehutanan 2004), agriculture concessions (predominantly oil palm *Elaeis guineensis*), inactive logging concessions and community land. The study at hand was conducted in the southernmost part of the landscape in Jambi Province (Fig. 1). This area functions as an important buffer zone for the Bukit Tigapuluh National Park and as important habitat for conservation flagship species such as Asian Elephant *Elephas maximus* (Moßbrucker *et al.* 2015, 2016), Tiger *Panthera tigris* (Moßbrucker 2014), and re-introduced Sumatran Orangutans *Pongo abelii* that are released at a station located just south of the national park (Kelle 2012).

Data collection and processing

A camera-trap survey was conducted by well-trained Frankfurt Zoological Society field rangers as part of a wildlife monitoring programme implemented in cooperation with the Jambi Department of Conservation of Natural Resources and Ecosystem (Konservasi Sumber Daya Alam dan Ekosistem) under a general Memorandum of Understanding with the Indonesian Ministry of Forestry. The survey area was divided into four survey blocks of roughly 250 km^2 each (Fig. 1). In each of the four blocks 30 camera-trap stations were operated over a period of three months, starting in the westernmost block in March 2013 and completing the survey in the easternmost block in March 2014. Camera-traps (Bushnell® Trophy Cam™ HD) were set in pairs in the centre area of the blocks with approximately 3 km spacing in between individual trapping locations (referred to as camera-trap stations). Camera-trap pairs were set close to the ground (approximately 20–30 cm above ground level, 90° to the trail, with the cameras slightly angled away from each other or a few metres apart to prevent overexposure of images) for target animal size ranging from Leopard Cat *Prionailurus bengalensis* to Tiger *Panthera tigris*, with a pre-set delay interval of 10 seconds between motion-activated triggers. Locations for the stations were chosen on the basis of signs of animal activity, with priority given to active wildlife trails that showed tracks of

tigers and/or tiger prey. Recently burnt areas and other wasteland were not included in the survey, and neither lures nor baits were used. All camera-trap stations were visited monthly to collect memory cards, exchange batteries and maintain the stations. The location of each station was recorded using handheld GPS units (Garmin GPSMAP® 60CSx), and for all locations elevation information was obtained based on Shuttle Radar Topography Mission data (digital elevation model with a resolution of 1 arc-second, courtesy of the U.S. Geological Survey). All pictures were cross-checked by a minimum of three different qualified persons independently in order to minimise misidentifications, and all records were entered into a standardised Microsoft Excel database, using a lag time of one hour in between records for each individual species at each individual camera-trap station (i.e., discarding pictures of the same species taken within a period of one hour following the first photo) to result in 'notionally independent records'.

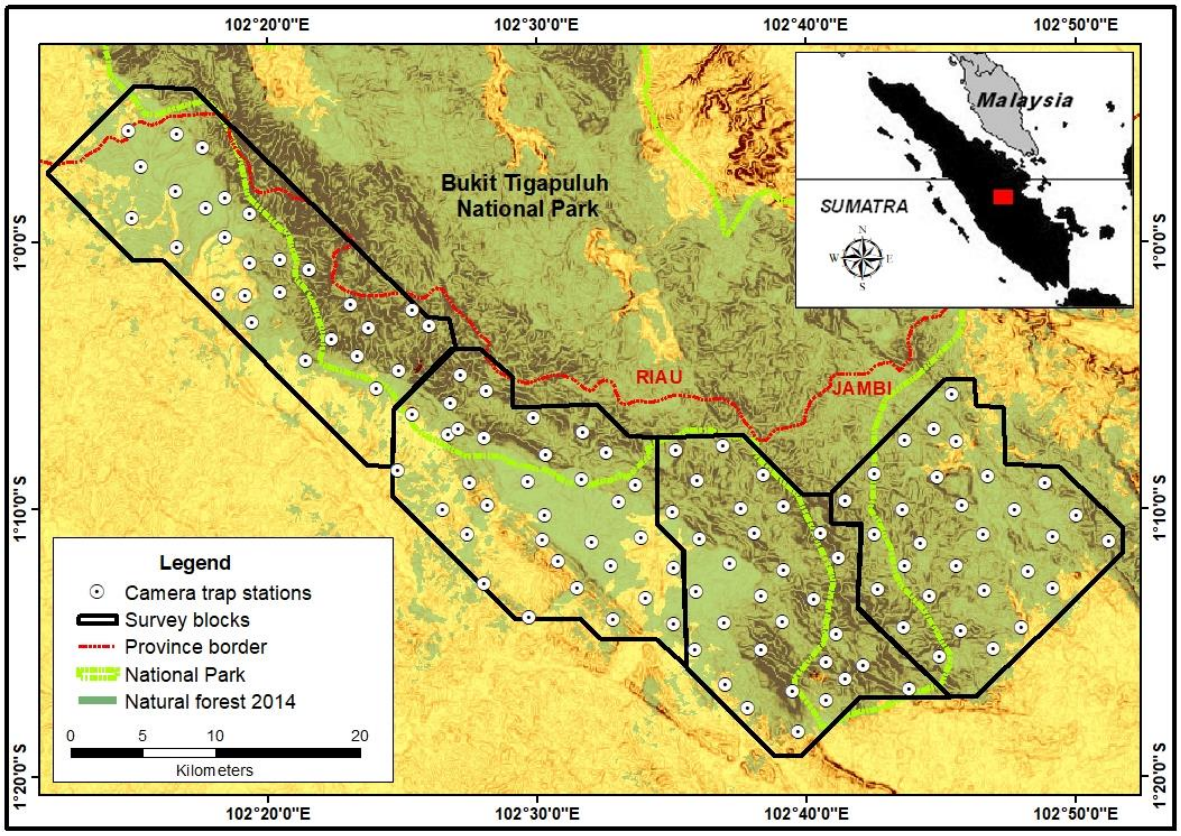

Fig. 1. Survey area showing 120 camera-trap stations (white dots) in four survey blocks (black outlines) in the Bukit Tigapuluh Landscape, Sumatra, Indonesia. (Map data sources forest cover: Frankfurt Zoological Society based on Landsat imagery; administrative boundaries: Frankfurt Zoological Society and Badan Koordinasi Survei dan Pemetaan Nasional, Indonesia; digital elevation model: Shuttle Radar Topography Mission data, courtesy of the U.S. Geological Survey.)

Results and discussion

A total of 6480 notionally independent records of mammals (excluding humans [793 records] and domestic dogs [8 records]) were obtained over the course of 12 months. With very few exceptions (four camera-traps had to be moved to new stations when fields were opened), camera-trap stations were recording data for 46 to 66 days, with an average of 60 days per station. The survey detected a total of 35 medium-sized and large-bodied wild mammal species, including rare and/or cryptic species such as Sumatran Orangutan, Asian Elephant, Tiger, Sunda Clouded Leopard *Neofelis diardi*, Sun Bear *Helarctos malayanus*, Asian Tapir *Tapirus indicus*, Dhole *Cuon alpinus*, Marbled Cat *Pardofelis marmorata* and Asiatic Golden Cat *Catopuma temminckii*.

Small carnivores were frequently detected, with a total of 406 notionally independent records for 12 species belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae (Table 1). Most records were obtained during night time (18h00–06h00 Western Indonesian Time [WIB]), but several species were also frequently or even exclusively recorded during daytime hours (06h00–18h00 WIB).

Table 1. Notionally independent species records for small carnivores belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae collected during a camera-trap survey from March 2013 to March 2014 in the Bukit Tigapuluh Landscape, Sumatra, Indonesia, with IUCN Red List conservation status (IUCN 2019) and recorded altitude ranges for each species.

Species name (conservation status[1])	**No. of stations[2]**	**No. of records[3]**	**Day-/night-time records[4]**	**Altitude (m asl)**
Herpestes brachyurus, Short-tailed Mongoose (NT)	16	31	28/3	90 - 373
Herpestes semitorquatus, Collared Mongoose (NT)	1	1	1/0	122
Aonyx cinereus, Asian Small-clawed Otter (VU)	3	3	2/1	128 - 180
Martes flavigula, Yellow-throated Marten (LC)	20	25	25/0	108 - 572
Mydaus javanensis, Sunda Stink-badger (LC)	4	10	1/9	116 - 445
Prionodon linsang, Banded Linsang (LC)	22	40	0/40	147 - 730
Arctictis binturong, Binturong (VU)	4	6	3/3	176 - 376
Cynogale bennettii, Otter Civet (EN)	2	3	0/3	271 - 524
Hemigalus derbyanus, Banded Palm Civet (NT)	39	71	2/69	104 - 572
Paguma larvata, Masked Palm Civet (LC)	5	6	1/5	107 - 673
Paradoxurus hermaphrodites, Common Palm Civet (LC)	35	59	1/58	98 - 730
Viverra tangalunga, Malay Civet (LC)	54	151	9/142	75 - 471
Total	**205**	**406**	**73/333**	**75 - 730**

[1] Least Concern (LC); Vulnerable (VU); Near Threatened (NT); Endangered (EN). [2] Number of camera-trap stations that recorded the species. [3] Number of notionally independent records. Notionally independent records of a given species are photographs of the same species at the same camera-trap station, separated by a minimum of one hour. [4] Number of notionally independent records recorded during day (06h00 – 18h00 Western Indonesian Time [WIB]) and night-time (18h00 – 06h00 WIB) hours.

In general, species that may prefer habitat close to rivers and streams, such as Oriental Small-clawed Otter *Aonyx cinereus* (Wright *et al.* 2015), Otter Civet *Cynogale bennettii* (Ross *et al.* 2015) and Collared Mongoose *Herpestes semitorquatus* (Mathai *et al.* 2015), were rarely recorded in this survey. This is probably because camera-traps were placed predominantly some distance from water to prevent damage from flooding. Nevertheless, the endangered Otter Civet (Fig. 2) was detected at two, Collared Mongoose (Fig. 2) at one and Oriental Small-clawed Otter at three camera-trap stations. To our knowledge, these represent the first records for these species in Bukit Tigapuluh Landscape (see Veron *et al.* 2006, Holden & Meijaard 2012, Ross *et al.* 2012, Pusparini & Sibarani 2014 for additional records from Sumatra).

Fifty percent of all detected small carnivores are either listed on The IUCN Red List of Threatened Species as Near Threatened (Banded Civet *Hemigalus derbyanus*, Collared Mongoose and Short-tailed Mongoose *Herpestes brachyurus*), Vulnerable (Oriental Small-clawed Otter and Binturong *Arctictis binturong*) or Endangered (Otter Civet) (IUCN 2019). Our findings underline the importance of the Bukit Tigapuluh Landscape, particularly the surveyed southern part, for the conservation of small carnivores and other threatened mammals.

Fig. 2. Otter Civet *Cynogale bennettii* (top; photographed 7 July 2013) and Collared Mongoose *Herpestes semitorquatus* (bottom; photographed 18 August 2013) recorded by camera-traps in the Bukit Tigapuluh Landscape, Jambi, Sumatra.

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Appendix 1. Information on location, altitude, and small carnivore species recorded for each camera-trap station set from March 2013 to March 2014 in the Bukit Tigapuluh Landscape, Sumatra, Indonesia.

No.	Latitude	Longitude	asl (m)	Recorded species[1]	No.	Latitude	Longitude	asl (m)	Recorded species[1]
1	-1.185154064	102.6007251	193	MAFL, PAHE	61	-1.166572875	102.4417656	133	PAHE
2	-1.200356423	102.6192933	119	HEDE, VITA	62	-1.142262134	102.4139422	109	PAHE
3	-1.181839193	102.6350796	231	MAFL, PAHE, PRLI	63	-1.182494096	102.4568729	90	HEBR, VITA
4	-1.166157643	102.6268035	279	PRLI	64	-1.164031604	102.4699192	143	VITA
5	-1.144989345	102.6402563	334	HEDE, MAFL, VITA	65	-1.198896773	102.5134947	131	VITA
6	-1.164616108	102.6532446	340		66	-1.18576363	102.5036284	166	PAHE
7	-1.168109908	102.584359	135	HEBR, PAHE, VITA	67	-1.21290017	102.4677105	122	
8	-1.149032113	102.5996421	225		68	-1.233886638	102.4954573	141	PAHE
9	-1.129659071	102.5866005	344	PRLI, VITA	69	-1.215701416	102.5250909	75	VITA
10	-1.127233548	102.6156546	376	ARBI, MAFL	70	-1.235471805	102.5472007	139	VITA
11	-1.204941463	102.6526808	308		71	-1.170091978	102.505133	108	HEBR, MAFL, VITA
12	-1.181819438	102.6756472	673	PALA, PRLI	72	-1.149384088	102.494492	128	AOCI, HEDE, PAHE, VITA
13	-1.197052239	102.6871574	524	CYBE, MAFL	73	-1.238345075	102.5851055	119	HEDE, PAHE, VITA
14	-1.222738743	102.6712835	256	HEBR, PRLI	74	-1.201674018	102.5458662	104	HEBR, HEDE, PAHE, VITA
15	-1.220803059	102.6390606	182	PAHE	75	-1.222275326	102.5673381	98	PAHE
16	-1.236986359	102.6519883	181	HEDE, VITA	76	-1.109310369	102.4984056	245	

No.	Latitude	Longitude	asl (m)	Recorded species[1]	No.	Latitude	Longitude	asl (m)	Recorded species[1]
17	-1.25443926	102.6391117	409	HEDE, PRLI, VITA	77	-1.132898349	102.5056144	355	PALA, PRLI
18	-1.218172564	102.5984421	122	HEDE, HESE, PAHE, VITA	78	-1.118456378	102.5289476	386	PRLI
19	-1.237722504	102.6161171	107	HEDE, PAHE, PALA, VITA	79	-1.131592674	102.5429007	308	
20	-1.253958418	102.5977363	139	HEBR, HEDE, PAHE, VITA	80	-1.148084662	102.5278539	135	HEDE, MAFL, PAHE, VITA
21	-1.279191288	102.7306027	197	HEDE, MAFL	81	-1.151774197	102.5610686	187	HEDE, VITA
22	-1.272511679	102.6913045	269	PAHE	82	-1.16197022	102.5506876	121	HEBR, PAHE, VITA
23	-1.261770685	102.6794135	445	MAFL, MYJA, PRLI	83	-1.186830533	102.5340254	88	VITA
24	-1.244682071	102.6858144	450	MAFL	84	-1.184119168	102.5648125	122	HEDE, PAHE, VITA
25	-1.280003018	102.658614	471	PAHE, PRLI, VITA	85	-1.203281905	102.5849392	124	
26	-1.28551827	102.6794282	197	HEBR	86	-1.119902717	102.4453449	119	HEDE, PAHE, VITA
27	-1.26432193	102.7018562	387	HEDE, VITA	87	-1.107347442	102.4232665	139	
28	-1.305254138	102.6621566	157	HEDE, PAHE, VITA	88	-1.14982179	102.4582043	201	
29	-1.275625468	102.6169539	134	HEDE, VITA	89	-1.121784258	102.4678101	221	HEDE
30	-1.290725316	102.6308698	128	PAHE, VITA	90	-1.116274905	102.4517055	151	PAHE
31	-1.253426659	102.7827205	176	ARBI, MYJA, PAHE, VITA	91	-1.092934476	102.4687146	378	VITA

No.	Latitude	Longitude	asl (m)	Recorded species[1]	No.	Latitude	Longitude	asl (m)	Recorded species[1]
32	-1.202283837	102.7595715	188	HEBR, MAFL, VITA	92	-1.083159737	102.4529907	488	MAFL, PRLI
33	-1.216517776	102.711382	373	HEBR, HEDE, VITA	93	-1.100733868	102.4467891	328	MAFL, PRLI
34	-1.182606733	102.709039	308	VITA	94	-0.978715528	102.2954373	151	HEDE, PAHE
35	-1.201895956	102.7279921	329	VITA	95	-0.968126814	102.2765204	158	AOCI, HEDE
36	-1.188135537	102.7372904	271	CYBE, MAFL, VITA	96	-1.003146238	102.2777488	139	PAHE
37	-1.242307687	102.7623496	218	ARBI, HEBR, MAFL	97	-0.985130193	102.2495195	164	
38	-1.22106467	102.7429666	284		98	-0.953117308	102.2551205	167	PRLI
39	-1.240460104	102.726837	436	PAHE, VITA	99	-0.932702456	102.2774279	180	AOCI
40	-1.258939506	102.749159	374	HEDE, MYJA	100	-0.941200939	102.2936622	242	
41	-1.095126928	102.7569246	234	VITA	101	-0.930392742	102.2475523	160	HEDE
42	-1.145788337	102.7793851	185	HEDE, MAFL, PAHE, VITA	102	-1.091303311	102.4006259	122	VITA
43	-1.164362677	102.7632934	177	PAHE, VITA	103	-1.080479318	102.4151363	239	MAFL
44	-1.124600482	102.7597136	186	VITA	104	-1.070696156	102.3892401	299	HEDE
45	-1.147128541	102.7477418	246		105	-1.052196428	102.4333606	407	MAFL, PALA, PRLI
46	-1.161691696	102.6912821	420	HEDE	106	-1.042381701	102.4232312	403	PALA
47	-1.166927718	102.7267003	301		107	-1.053358548	102.396357	572	HEDE
48	-1.14459365	102.7091955	266	ARBI, HEDE	108	-1.03899717	102.38528	730	PAHE, PRLI
49	-1.123988156	102.7279556	261	VITA	109	-1.060288792	102.3729792	485	HEDE
50	-1.116896446	102.7457892	251	HEBR, VITA	110	-1.073533195	102.3569319	160	HEDE, PRLI
51	-1.186629493	102.8545513	255	HEDE, MAFL	111	-0.972715692	102.3076881	184	HEDE
52	-1.183682053	102.8198732	192	VITA	112	-0.982289109	102.3225393	225	PAHE

No.	Latitude	Longitude	asl (m)	Recorded species[1]	No.	Latitude	Longitude	asl (m)	Recorded species[1]
53	-1.150453453	102.8145904	325	HEDE, PAHE, PRLI	113	-0.996890172	102.307525	133	VITA
54	-1.170972931	102.8341287	294	HEBR, PRLI, VITA	114	-1.013043075	102.3223797	210	
55	-1.205701408	102.8040563	117	HEBR, VITA	115	-1.010600606	102.341344	270	PRLI
56	-1.215866738	102.8196771	120	HEDE	116	-1.017104396	102.3593315	493	PRLI
57	-1.182698164	102.7765359	161	HEBR, PAHE	117	-1.031296588	102.3415065	278	
58	-1.167353865	102.7959399	140	HEBR, VITA	118	-1.033555602	102.319732	163	HEDE, PAHE, VITA
59	-1.217440775	102.7768582	157		119	-1.049690958	102.324055	147	HEDE, PRLI, VITA
60	-1.240739118	102.7997343	116	MYJA, VITA	120	-1.032592289	102.3028358	147	

[1] AOCI = *Aonyx cinereus*, ARBI = *Arctictis binturong*, CYBE = *Cynogale bennettii*, HEDE = *Hemigalus derbyanus*, HEBR = *Herpestes brachyurus*, HESE = *Herpestes semitorquatus*, MAFA = *Martes flavigula*, MYJA = *Mydaus javanensis*, PALA = *Paguma larvata*, PAHE = *Paradoxurus hermaphrodites*, PRLI = *Prionodon linsang*, VITA = *Viverra tangalunga.*

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ARTICLE

Yellow-bellied Weasel *Mustela kathiah* breeding in peri-urban Dalat City, southern Vietnam

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Abstract

The paper presents details of sightings of Yellow-bellied Weasels *Mustela kathiah* in the peri-urban environment of Dalat City in the south of Vietnam. The sightings, which indicate breeding, were within an area of human habitation, with adjacent agriculture and remnant pine forest. The paper also gives details of two additional previously unpublished records of the species from the same highland area, these together being the southernmost records from Vietnam.

Keywords: Yellow-bellied Weasel, *Mustela kathiah*, peri-urban environment, breeding habitat, Lam Dong Province

Loài Triết bụng vàng *Mustela kathiah* sinh sản ở vùng ven đô thị thành phố Đà Lạt, miền nam Việt Nam

Bài báo cung cấp thông tin chi tiết về các lần quan sát loài Triết bụng vàng *Mustela kathiah* và cho thấy sơ lược về sinh sản của loài ở vùng ven đô thị thành phố Đà Lạt, miền nam Việt Nam. Các điểm quan sát thấy loài đều ở trong khu vực dân cư gần kề đất trồng trọt và những mảng rừng thông còn sót lại. Bài báo cũng bổ sung thêm các thông tin cụ thể chưa được công bố của các ghi nhận trước đây tại cùng khu vực cao nguyên. Tất cả những ghi nhận này đều là những điểm phân bố xa nhất của loài ở phía nam Việt Nam.

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Introduction

The Yellow-bellied Weasel *Mustela kathiah* has a relatively large global distribution through much of the Himalaya and southern and central China, extending southward through the mountain belts of South-east Asia (Willcox *et al.* 2016). Records presented by Roberton (2007) indicate that in Vietnam the species is likely to occur throughout the mountainous region of the country, although documented occurrences from the far southern reaches of the Southern Annamites, the most southerly mountain region in Vietnam, are relatively few.

Observations

At about 06h30 on the morning of 1 February 2020, while R.J.T. was standing talking with friends at a small hostel on the edge of Dalat City, Lam Dong Province, in the Southern Annamites of Vietnam (11°55'50.5"N, 108°27'08.7"E, datum WGS84; altitude 1434 m asl measured by Google Earth, 1375 m asl measured by a GPS altimeter; Fig. 1), he saw a Yellow-bellied Weasel and quickly alerted N.T.A.M.

Fig. 1. Google Earth image of south-east Dalat City, Vietnam, and the peri-urban edge (dot marked "1 Feb") where the Yellow-bellied Weasels *Mustela kathiah* were seen.

As we watched, the weasel ran towards and then past us along the top of a retaining wall against a steep slope. It was carrying prey, which appeared to be a rodent similar in body proportions, except the body length, to the Weasel. The latter was easily recognisable as a Yellow-bellied Weasel on account of its distinctively long and slender body, with uniform bright brown upper parts and clearly demarcated yellowish underparts, with a paler chin and upper throat. The animal's body length was considerably smaller than a *Dremomys* squirrel and a little bigger than a British Least Weasel *Mustela nivalis*. Yellow-throated Marten *Martes flavigula* is apparently sometimes confused with this Weasel; however, the Marten is considerably larger (the size of a giant squirrel in the genus *Ratufa*) and is very different in colouration from a Yellow-bellied Weasel in southern Vietnam.

R.J.T. had first noticed the weasel as it crossed the 3-m wide concrete driveway of the hostel and then proceeded to climb the 2.5 m of the near-vertical retaining wall. The wall at its closest was less than 3 m from us and had an angle of about 80 degrees from the horizontal (Fig. 2). The wall was separated from an approximately 2.5-m wide all-weather road running parallel to it by a strip less than 2-m wide of grasses and ornamental shrubs. The weasel did not make use of this cover of vegetation, instead moving in full view on top of the wall. Halting several times, it appeared to recognise that it had been noticed by us. At one point it disappeared into the vegetation, but it very quickly reappeared and continued to follow the open path along the wall top. The whole event probably took no more than about 60 seconds,

when the animal disappeared into the vegetation very close to the point where the wall went behind the hostel building. Before coming into our view, the Weasel had already probably crossed another 2-m wide all-weather road and must have been hunting in or moving through a corridor of house and hostel gardens and yards. Upslope above the higher road was a relatively large area of semi-natural habitat (ca. 1.5 hectares), while below the corridor of yards and gardens was the transition to an even larger area of semi-natural habitat and cultivation (Figs. 3, 4).

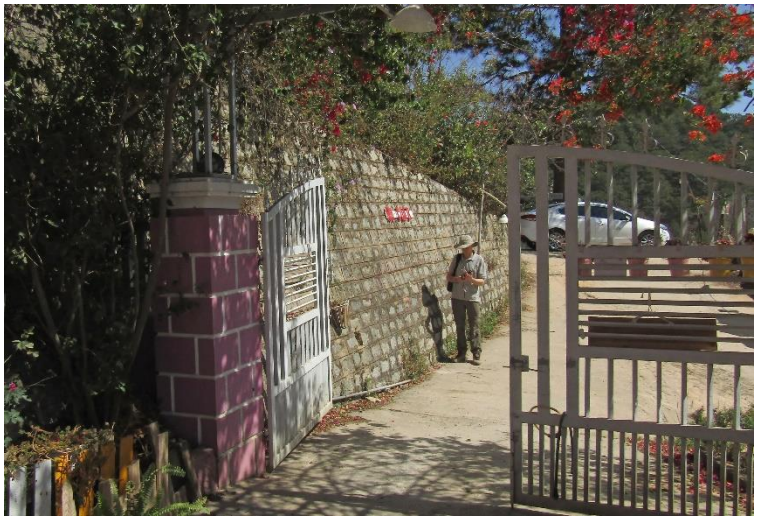

Fig. 2. R.J.T. standing next to the location where the Yellow-bellied Weasel *Mustela kathiah* climbed the retaining wall, south-east Dalat City, Vietnam. (Photo: Minh Nguyen.)

Fig. 3. The lower property where the Yellow-bellied Weasels *Mustela kathiah* were videoed and the landscape of the valley below, south-east Dalat City, Vietnam. (Photo: Tuyen Nguyen.)

Fig. 4. Google Earth image of the landscape around the hostel, south-east Dalat City, Vietnam, where the Yellow-bellied Weasels *Mustela kathiah* were observed. The dots marked "1 Feb" and "3 Feb" indicate the locations of the animal sightings.

We tried our luck to observe the Weasel again during our stay, without success. The hostel owner described observing a similar animal in the preceding days. On 3 February, after we had left, the owner saw the species at about 14h00–15h00 and recorded a video clip, which he shared with us. In the video, two Weasels are seen just outside a raised wooden chalet as they move away from the chalet, across a concrete yard (Fig. 3). Within seconds of the video starting, one animal, presumably a female, turns around and picks up the second animal, a youngster, by its scruff and carries it in its mouth. They cross the concrete yard this way and disappear below a wooden platform (less than 15 cm in height). This sighting was approximately 20 m from our sighting on 1 February, further downslope but on the same hostel property, and separated from the upper grounds by the lower all-weather road and another steep retaining wall and steep concrete driveway. This is in the direction opposite to that in which the Weasel we observed was seen carrying prey.

The hostel and adjacent properties were constructed approximately six years ago, but Google Earth historical aerial images show that the lower valley area had already been extensively cultivated since at least 2006. Before this, the habitat was primarily relatively mature natural pine *Pinus kesiya* with breast height diameters in the 30–60 cm range and a relatively open understorey probably mostly of grasses with some shrubs. The relatively narrow valley bottom within 200 m of the sightings probably had small copses of broadleaf trees and shrubs, as well as patches of at least seasonally wet graminoid beds. Such habitat

characterises the rolling hills of the Dalat Plateau, amidst which Dalat City sits. A good number of relatively mature *Pinus kesiya* were still present on the upper slope in 2020. However, below the corridor of yards and gardens, the slope and valley bottom had been modified and converted to coffee, some silviculture and other crops, although this was rather haphazard and appeared not to be particularly well kept. More natural vegetation was visible on the opposite slope and further down the valley within a few hundred metres (Figs. 3, 4).

In the mixed agriculture below the corridor of yards and gardens we observed from the hostel property Red-cheeked Squirrel *Dremomys rufigenis*, Northern Treeshrew *Tupaia belangeri*, Lesser Necklaced Laughingthrush *Garrulax monileger* and White-cheeked Laughingthrush *Dryonastes vassali*. None of these species is typically associated with agriculture or peri-urban settings.

Discussion

Hoang Xuan Thuy & Roberton (2004) mapped the Yellow-bellied Weasel in Lam Dong Province without giving further details; however, this was based on two unpublished sightings (S. Roberton *in litt.* 2020). One sighting was in Bi Doup–Nui Ba National Park, "Long Lanh East [sic]" (probably east of K'long K'lanh village), 1500–1800 m asl, on 24 May 1991, observed by Jonathan Eames (pers. comm. to S. Roberton). The other sighting was in Di Linh District, "Deo Nui San", 1220 m asl, on 1 March 1994, observed by Craig Robson (pers. comm. to S. Roberton). More recently, there seem to be only two further records of Yellow-bellied Weasel from the Southern Annamites of Vietnam (Abramov 2013, Morris 2017), only one of which has information on precise location, habitat and altitude (within evergreen forest, 1900–2000 m asl). Robson's record would appear to be approximately 50 km south-west of our own record whilst Eames & Morris's records are within 25 km to the north. These four records, in addition to our own, fit within the general pattern of occurrence of the species in South-east Asia in forested high-elevation habitat (e.g. Duckworth & Robichaud 2005, Than Zaw *et al.* 2008). However, we have not traced other records of the species in peri-urban environments, although Supparatvikorn *et al*. (2012) and Chutipong *et al*. (2014) mentioned sightings in and around building complexes within the forested landscape of two different Thai protected areas.

Although recent years have seen many extensions of the known range of this Weasel in South-east Asia (e.g. Supparatvikorn *et al*. 2012, Phan *et al*. 2014), overall it remains poorly known in the region, including the extent to which it tolerates human activity and habitat change.

Acknowledgements

We express sincere thanks to Mr. Kham Doan of Nha cua Ba Homestay for sending us the video clip of the Yellow-bellied Weasels, as well as for his interest in and concern for these

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ARTICLE

Yellow-throated Marten *Martes flavigula* observed hunting Small Indian Civet and chickens in Vietnam

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Abstract

This note presents observations of Yellow-throated Martens *Martes flavigula* hunting at two localities in Vietnam. In Cat Tien National Park Martens were photographed capturing a Small Indian Civet *Viverricula indica*. In Bach Ma National Park, Martens were documented attempting to steal chickens from a restaurant's kitchen, on the top of Bach Ma mountain.

Keywords: Yellow-throated Marten, hunting behaviour, predator–prey, mustelid, Small Indian Civet, intraguild predation

Ghi nhận loài cầy họng vàng *Martes flavigula* săn cầy hương và gà nhà tại Việt Nam

Bài báo ghi nhận tập tính săn mồi của loài cầy họng vàng *Martes flavigula* ở hai địa điểm khác nhau ở Việt Nam. Tại vườn quốc gia Cát Tiên, chúng tôi đã chụp ảnh được hai cá thể cầy họng vàng săn và bắt một cá thể cầy hương *Viverricula indica.* Trong khi đó, tại vườn quốc gia Bạch Mã, chúng tôi cũng quan sát được hai cá thể cầy họng vàng đang cố gắng bắt trộm gà của nhà hàng trên đỉnh Bạch Mã.

Introduction

Yellow-throated Marten *Martes flavigula*, listed as Least Concern in the IUCN Red List of Threatened Species, has a wide range in tropical, sub-tropical and temperate South, South-east and East Asia (Corbet 1978, Corbet & Hill 1992, Chutipong et al. 2016). The species's varied diet includes fruits, insects, birds, reptiles, amphibians, mammals, honey bees and eggs (Pocock 1941, Grassman et al. 2005, Parr & Duckworth 2007, Zhou et al. 2011, 2008). In Vietnam, the species inhabits the entire country except, perhaps, the Mekong Delta and the Red River Delta (Roberton 2007). However, the species has received little recent research or conservation attention in Vietnam; Yellow-throated Marten is mainly mentioned in location-specific mammal lists resulting from camera-trap and other surveys (Roberton 2007, Willcox et al. 2015). This paper presents observations of Yellow-throated Marten hunting behaviour in the wild, made by two of the authors (T.A.P. and H.N.P.) while photographing wildlife.

Observations

In Cat Tien National Park (11°24'23.04"N, 107°23'9.96"E, 116 m asl), right next to the Dong Nai river and not far from the village of Tran Le Xuan, Tan Phu commune, Dong Nai province, Vietnam), at 16h32 on 23 July 2018, T.A.P observed and photographed a Small Indian Civet *Viverricula indica* emerging from grass and onto a dirt path. A few seconds later, two Martens appeared on the path and followed the Civet. One Marten chased the Civet from behind while the other ran on the left side of the civet. The Marten on the left caught the Civet with a strong bite on the neck, which did not seem to kill the Civet (Fig. 1). The Martens – one carrying the Civet in its mouth – went into the grass and out of sight of the observer; the Civet's fate is unknown. The habitat is grassland, with cultivated land on one side and secondary semi-evergreen forest on the other side.

Fig. 1. Yellow-throated Marten *Martes flavigulas* hunting a Small Indian Civet *Viverricula indica* in Cat Tien National Park, southern Vietnam. (Photo: Tang A Pau.)

Possible predation by Yellow-throated Marten on Small Indian Civet was recorded by camera-trap in Nepal (Lamichhane et al. 2014), but it was unclear whether the Marten had killed or merely scavenged the Civet.

Fig. 2. Two Yellow-throated Martens behind the Do Quyen restaurant in Bach Ma National Park, Thua Thien Hue Province, central Vietnam. (Photo: Hoang Nhu Phuong.)

In Bach Ma National Park, Thua Thien Hue Province, central Vietnam, at 11h21 on 27 December, two Martens were observed in the landfill area behind the kitchen of the Do Quyen restaurant (16°11'40.39"N, 107°51'12.53"E, 1280 m asl; Fig. 2). As observed by H.N.P, the Martens came inside the restaurant and approached a steel, locked cage containing two live chickens. The commotion made by the chickens and the Martens alerted the restaurant staff, who chased the Martens away. However, the Martens re-entered the restaurant and attempted to force open the chicken cage several times before they gave up and left. The Martens came back a few more times during the following days to try to steal the chickens from the cage, without success.

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IUCN/SSC Small Carnivore Specialist Group

ARTICLE

A Ruddy Mongoose *Urva smithii* observed to attempt to prey on an Indian Giant Squirrel *Ratufa indica*, Similipal Tiger Reserve, India

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Abstract

Many aspects of Ruddy Mongoose *Urva smithii* ecology, including its diet, are unknown. We observed a predation attempt by a Ruddy Mongoose on an Indian Giant Squirrel *Ratufa indica* in Similipal Tiger Reserve, Odisha, India. The rare observation also highlights the arboreal ability of the Ruddy Mongoose.

Keywords: Deccan Peninsula, diet, *Herpestidae*, predation, Similipal

Introduction

The Ruddy Mongoose *Urva smithii* is a relatively large member of the family *Herpestidae*, weighing 1.8–2.7 kg (Hunter & Barrett 2018). It is distributed across India (up to 28°N), as well as Sri Lanka (Muddapa & Choudhury 2016). It has not yet been reported in north-east India (Choudhury 2013) but has been recorded in Nepal (Subba *et al.* 2014). On account of its wide geographical distribution and assumed large population, the Ruddy Mongoose is listed as of Least Concern on The IUCN Red List of Threatened Species (Muddapa & Choudhury 2016). It is thought to prefer dry forests, thorn scrub and mosaics of dry grasslands and forests; evergreen forests and heavily modified habitats near humans are apparently avoided (Hunter & Barrett 2018, Muddapa & Choudhury 2016). Though the Ruddy Mongoose is widespread, its diet and other aspects of its ecology are poorly known (Muddapa & Choudhury 2016). Here, we present a rare observation of a Ruddy Mongoose predation attempt on an Indian Giant Squirrel *Ratufa indica* in Similipal Tiger Reserve, Odisha, India.

Among the first nine tiger reserves in the country declared in 1973, Similipal Tiger Reserve lies in the Deccan Peninsula Biogeographic Zone and the Chhotanagpur Biotic Province (Rodgers & Panwar 1988). The Reserve is situated between 21°31' and 22°02'N and 86°06' and 86°36'E. It is spread over an area of 2750 km^2 in the Mayurbhanj District of Odisha State.

Similipal Tiger Reserve is a high rainfall area, receiving an average of 2000 mm of precipitation annually; this protected area gives rise to many perennial rivers (Nayak 2014). The two major forest types in Similipal Tiger Reserve are Tropical Moist Deciduous Forest and Tropical Semi-evergreen (see Champion & Seth 1968). The minimum temperature in Similipal Tiger Reserve drops as low as 2°C in winter.

Four species of the mongoose family *Herpestidae* are known from Similipal Tiger Reserve: Small Indian Mongoose *Urva auropunctata*, Indian Grey Mongoose *Urva edwardsii*, Striped-Necked Mongoose *Urva vitticollis* and Ruddy Mongoose (Nayak 2014). The Ruddy Mongoose (Fig. 1) has been recorded in both Tropical Moist Deciduous and Tropical Semi-evergreen forest types by the authors, using camera-traps.

Fig. 1. Camera-trap picture of a Ruddy Mongoose *Urva smithii* in Tropical Semi-evergreen forests of Bhanjabasa Range, Similipal Tiger Reserve, Odisha, India, 400 m away from the reported observation.

Fig. 2. Camera-trap picture of an Indian Giant Squirrel *Ratufa indica* on the ground, Similipal Tiger Reserve, Odisha, India.

Observation

On 10 January 2020, at about 14h15, H.S.R. observed a Ruddy Mongoose attempting to predate upon an adult Indian Giant Squirrel in the Tropical Semi-evergreen forest of the Bhanjabasa range of Similipal Tiger Reserve (21°35'13.2"N, 86°21' 06.0"E). This predation event was initially detected by a loud sound that came from a distance of approximately 60 m, repeated every 5-10 seconds.

On moving towards the noise, H.S.R. reached the edge of a stream that was 4 m wide, where, along with the peculiar sound, rustling in the leaf litter could also be heard. Upon closer approach towards the source of the noise, now some 8 m away, H.S.R. saw a Ruddy Mongoose, identified through its long black-tipped tail and the absence of a black stripe on the neck, on the ground, on the other side of the stream, trying to subdue a struggling Indian Giant Squirrel, with their bodies entwined. The Indian Giant Squirrel was continuously emitting what was apparently a distress call and trying to escape from the hold of the Ruddy

Mongoose, which was trying to choke it but could not get a firm grip on the throat of the fighting Squirrel. The Indian Giant Squirrel suddenly broke free of the Ruddy Mongoose and ran towards a tree pole, which was approximately 4.5 m from H.S.R., who was on the other side of the stream. As the Indian Giant Squirrel ascended the tree, the Ruddy Mongoose quickly followed, catching the Squirrel by the rump at approximately 3.5 m above the ground. However, the Mongoose let go of the Squirrel, possibly because it had noticed the presence of H.S.R. at very close range on its right. The Ruddy Mongoose descended from the tree and vanished into the undergrowth and the Indian Giant Squirrel ascended higher up in the canopy and started giving its characteristic alarm call. Two other Indian Giant Squirrels, higher in the canopy, then came to the attention of H.S.R. when they also gave alarm calls.

Discussion

Indian Giant Squirrels are highly arboreal and spend most of their time in trees foraging and resting (Borges 2013). The water requirements of the Indian Giant Squirrel are reportedly fulfilled through its diet (Borges 2013), though it is possible that the observed Giant Squirrel came to the ground to drink from the stream. Very occasionally, the Indian Giant Squirrel has been observed to descend to the ground to feed on germinating seeds (Borges 1989). In Similipal Tiger Reserve, multiple images of the Indian Giant Squirrel on the ground have been captured during annual camera-trapping exercises conducted by the authors (Fig. 2).

The species's average bodyweight of around 2 kg (Thorington *et al.* 2012) is similar to the Ruddy Mongoose (Mudappa 2013). The observation reported here shows that the Ruddy Mongoose attempts to prey on animals its own size and is an able climber; it has also been reported that Ruddy Mongooses carry their prey into trees (Shekhar 2003).

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ARTICLE

Carnivores of Seville province, Spain: a distribution atlas

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Abstract

This note provides information dating from 2010 to December 2019 on carnivore distribution in the province of Seville, Spain. The authors' own observations (507) of live animals and roadkills have been combined with confirmed sightings registered in the online wildlife observation database Observado España (54), and the results plotted on 185 UTM squares representing areas of 10 × 10 km. Ten species were recorded, including several small carnivores: Wild Cat *Felis silvestris*; Spanish Lynx *Lynx pardinus*; Western Polecat *Mustela putorius*; Least Weasel *Mustela nivalis*; Beech Marten *Martes foina*; Eurasian Otter *Lutra lutra*; Eurasian Badger *Meles meles*; Common Genet *Genetta genetta*; Egyptian Mongoose *Herpestes ichneumon*; and Red Fox *Vulpes vulpes*. Eight squares (4.3% of total squares) had eight or more species; 43 squares (23.2%) had five to seven; 76 squares (41.1 %) had three or four; and 58 squares (31.4%) had one or two species.

Keywords: *Mustela putorius, Mustela nivalis, Martes foina, Lutra lutra, Meles meles, Genetta genetta, Herpestes ichneumon, Felis silvestris*

Introduction

Seville is a province in the region of Andalusia, in the south of Spain (Fig. 1). The province is characterized by a Mediterranean climate and is dominated in the north by the Sierra Morena mountain range and in the south by the Sierra Sur part of the Betic mountain range, with the alluvial valley of the Guadalquivir River dividing the two ranges. The mountain ranges are mostly still covered by natural vegetation, which is also found in isolated patches in the valley. The most important natural protected areas are the Sierra Norte de Sevilla Natural Park in the north and the Doñana National Park in the south-west.

The carnivores in the province comprise two cats (Felidae: Wild Cat *Felis silvestris* and Spanish Lynx *Lynx pardinus*), five species of Mustelidae (Western Polecat *Mustela putorius*, Least Weasel *Mustela nivalis*, Beech Marten *Martes foina*, Eurasian Otter *Lutra lutra* and Eurasian Badger *Meles meles*), one civet (Viverridae: Common Genet *Genetta genetta*), one mongoose (Herpestidae: Egyptian Mongoose *Herpestes ichneumon*) and one dog (Canidae: Red Fox *Vulpes vulpes*). Until recently (Consejería de Medio Ambiente, Junta de Andalucía 2012) the Grey Wolf *Canis lupus* was present in the province but now is probably extinct.

This note aims to provide recent information (from 2010 to December 2019) bearing on carnivore distribution in the province, and for this purpose we have collected observations of live individuals by the authors, camera-trap records and roadkills (identified by the

authors). Tracks and other signs have been not included. The surveys covered the entire province of Seville, including 185 UTM squares of 10 × 10 km (91 entirely in Seville and the rest shared with other provinces).

We gathered a total of 507 of our own records (Table 1), including 133 roadkills. These are complemented by 54 photographically supported sightings since 2012 registered by experienced users on the online wildlife observation database Observado España (www.observado.es), as well as information published by Palomo *et al.* (2007). Distribution is shown in a 10 × 10 km UTM grid map for each species (Fig. 1). Summarizing, we found eight squares (4.3% of total squares) with eight or more species; 43 squares (23.2%) with five to seven; 76 squares (41.1%) with three or four; and, finally, 58 squares (31.4%) with one or two species recorded (Fig. 1).

Species accounts

Felis silvestris

Probably the least abundant carnivore of the province, the Wild Cat has only three recent records, all unconfirmed, in the north of the province. All three lack photographs, preventing confirmation of this species that is difficult to distinguish from free-ranging Domestic Cat *F. catus* and potential hybrids. Thus, we have decided to maintain it as doubtful. This species needs special attention involving specific surveys, particularly using camera-trapping (Gil-Sánchez *et al.* 2018, Gil-Sánchez *et al.* 2020).

Lynx pardinus

The threatened Spanish Lynx has increased its distribution in the province in recent years, mainly because of the well-executed work of several EU-LIFE projects for the species. Its main distribution area is the Doñana–Aljarafe region in the south-west. Thirty-two records were collated, without any roadkills detected by the authors. The squares in the north of the province correspond with individuals that have naturally dispersed recently from reintroduction areas (J. Salcedo, pers. comm.).

Mustela putorius

Western Polecat was recorded mostly in the Guadalquivir valley, where it is usually detected as roadkill (Rodríguez-Rodríguez & Salcedo 2018). We gathered 12 records, 11 of which were roadkills.

Mustela nivalis

Least Weasel is difficult to detect, due to its secretive behaviour. We gathered 19 records, including 11 roadkills. The actual distribution is probably wider than reflected by past and present records.

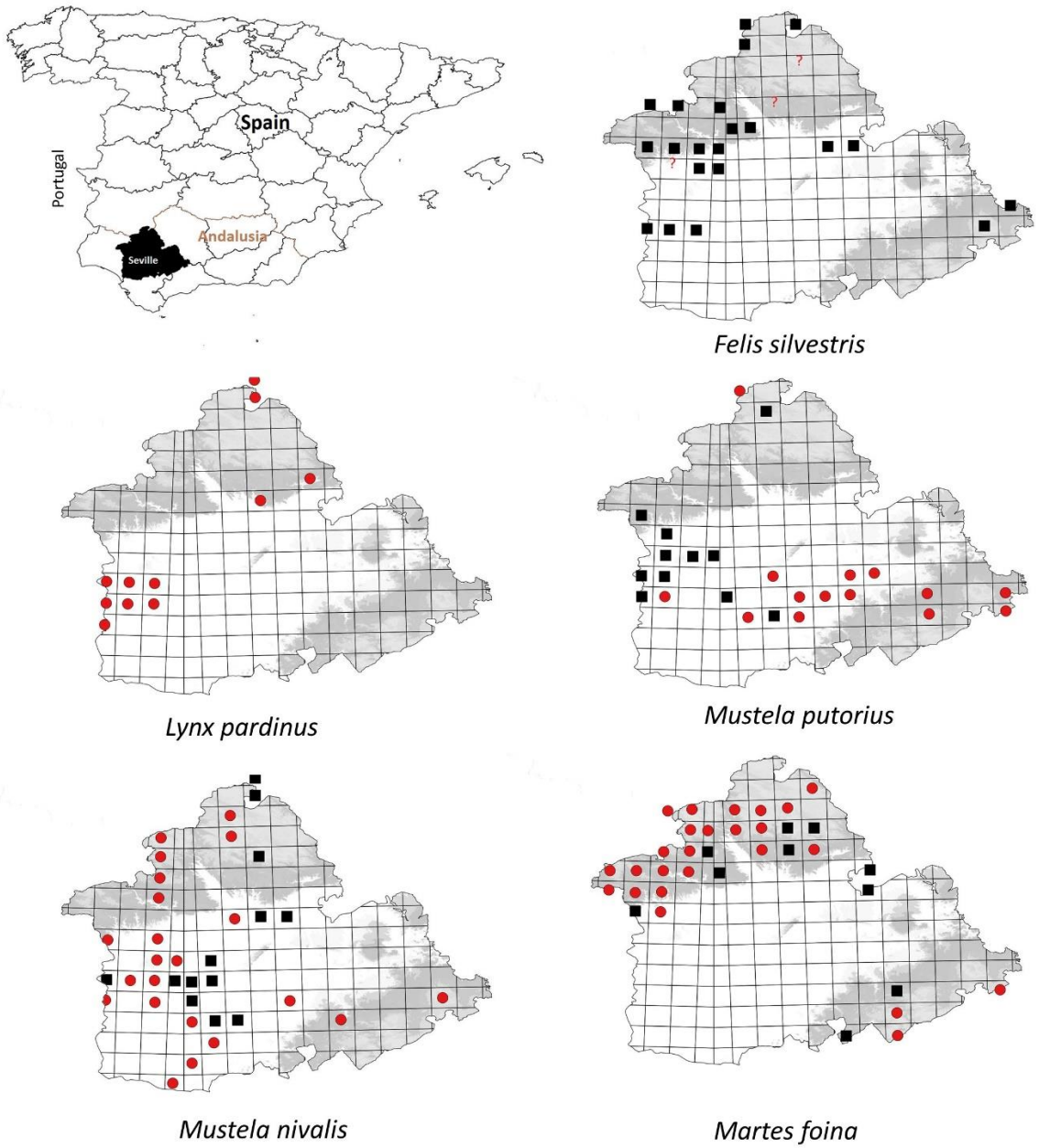
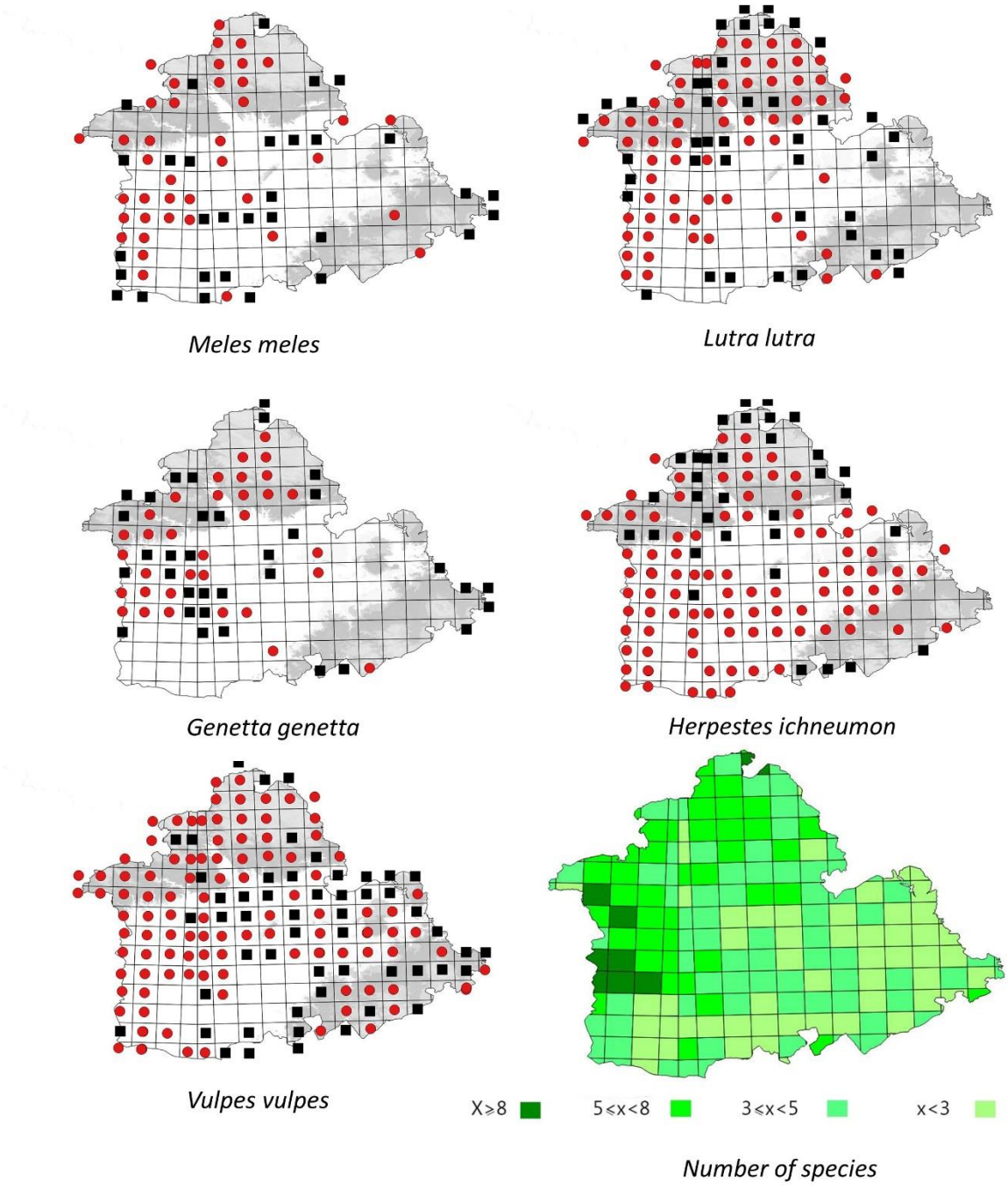


Fig. 1 (continued next page). Map of Spain showing the location of the province of Seville, distribution maps for the species recorded in 10 × 10 km UTM squares, and a map indicating the number of species detected per square. Grid squares containing black squares represent that the species was recorded by Palomo *et al.* (2007). Grid squares with red dots indicate that the authors and/or external recent records document the species in that grid square in the period 2010-19 (Table 1). Squares with both past (Palomo *et al.* 2007) and recent records are marked as recent records). Dark shading indicates mountain ranges.



Martes foina

The Beech Marten is distributed mainly in the mountain ranges of the province, where it is not difficult to detect. We gathered 43 records, 15 being roadkills.

Meles meles

The Eurasian Badger is relatively well distributed, with confirmed presence throughout all regions of the province. We gathered 32 records, eight being roadkills.

Table 1. Summary of record data for each species of wild carnivore in the province of Seville, Spain, in the period 2010-19. The authors' own observations are represented in the three first columns.

Species	Direct observations of live animals[a]	Road-kills [a]	Total Records [a]	External records [b]	10 × 10 km UTM cells with records in Palomo *et al.* (2007) but not detected in the present study
Felis silvestris	3	0	3	0	22
Lynx pardinus	32	0	32	– [c]	0
Mustela putorius	1	11	12	4	12
Mustela nivalis	8	11	19	2	13
Martes foina	28	15	43	4	5
Meles meles	24	8	32	4	31
Lutra lutra	64	2	66	6	43
Genetta genetta	33	7	40	4	34
Herpestes ichneumon	61	42	103	15	33
Vulpes vulpes	124	38	162	16	54

[a] Our own records. [b] Photographically supported sightings since 2012 on the online wildlife observation database Observado España (www.observado.es). [c] External records exist for this species but were neither sought nor collated (see text).

Lutra lutra

A relatively commonly observed species throughout the province's water bodies, the Eurasian Otter is especially common in the Sierra Morena region. We gathered 66 records, including two roadkills.

Genetta genetta

The Common Genet is a widely distributed species, and indeed the areas lacking records may simply indicate gaps in data. We gathered 40 records, seven of which were roadkills.

Herpestes ichneumon

The Egyptian Mongoose is one of the most commonly observed carnivores of the province. We gathered 103 records, 42 being roadkills.

Vulpes vulpes

The Red Fox is most commonly observed carnivore in Seville province. We gathered 162 records, including 38 roadkills.

Discussion

Only three unconfirmed records of *F. silvestris* were traced; the species's status throughout the Andalusia region is a concern (see Gil-Sánchez 2018). No Grey Wolf *Canis lupus* were

detected; the species must be close to extirpation in this province. No other carnivore species have been extirpated from the area.

Although many historic locality records have not been replicated during this collation and review of records since 2012, differences in survey methods and effort may explain many of these non-detections; i.e. these non-detections may not represent genuine range contractions or changes in occupancy. Squares with a low number of species detected are in areas where intense agriculture dominates; low quality habitat, increased human–wildlife conflict and survey biases may all be contributing to the detection patterns.

Not all carnivores recorded are native. Although *H. ichneumon* has been traditionally considered to have been introduced to Europe in historical times (Detry *et al.* 2011), recent studies point to a native origin (Gaubert *et al.* 2011). In the case of *G. genetta,* studies conclude a human introduction with several nuclei, possibly during the 17th century (Gaubert *et al*. 2011). The only exotic carnivore species that poses a real risk to native ecosystems in the Seville province is the Domestic Cat *Felis catus*. No other exotic species of carnivorous mammals have wild populations in the area.

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ARTICLE

Photographic documentation of Ruddy Mongoose *Urva smithii* in West Bengal, India

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Abstract

Ruddy Mongoose *Urva smithii* was recorded from West Bengal, India, through camera-trapping and direct observation during a wildlife survey in the Ajodhya Hill, Purulia District. This is the first photographic evidence of the species's occurrence in West Bengal and is the easternmost global record for this species.

Keywords: Ajodhya Hill, camera-trapping, Purulia, West Bengal, Ruddy Mongoose

Introduction

Seven species of mongoose (Herpestidae) are present in India (Kamalakannan and Venkatraman 2017). Out of the five mongoose species found in West Bengal, Ruddy Mongoose *Urva smithii* is the least known: there is only one sighting record from the state (Mallick 2019). A recent wildlife survey in the Ajodhya Hill, Purulia District, provided the first photographic evidence of this species from West Bengal. Ruddy Mongoose is placed under Schedule II of the Indian Wildlife (Protection) Act of 1972 and is listed as of Least Concern in The IUCN Red List of Threatened Species (Mudappa & Choudhury 2016).

Survey area and methods

The survey was conducted at Ajodhya Hill, Purulia, West Bengal, between October 2018 and April 2019. The survey area (Fig. 1) is a dry deciduous forest with some moist patches and with a 2.8° to 52°C temperature range (Samanta *et al.* 2017). The annual average rainfall ranges from 1100 to 1500 mm (Das 2016).

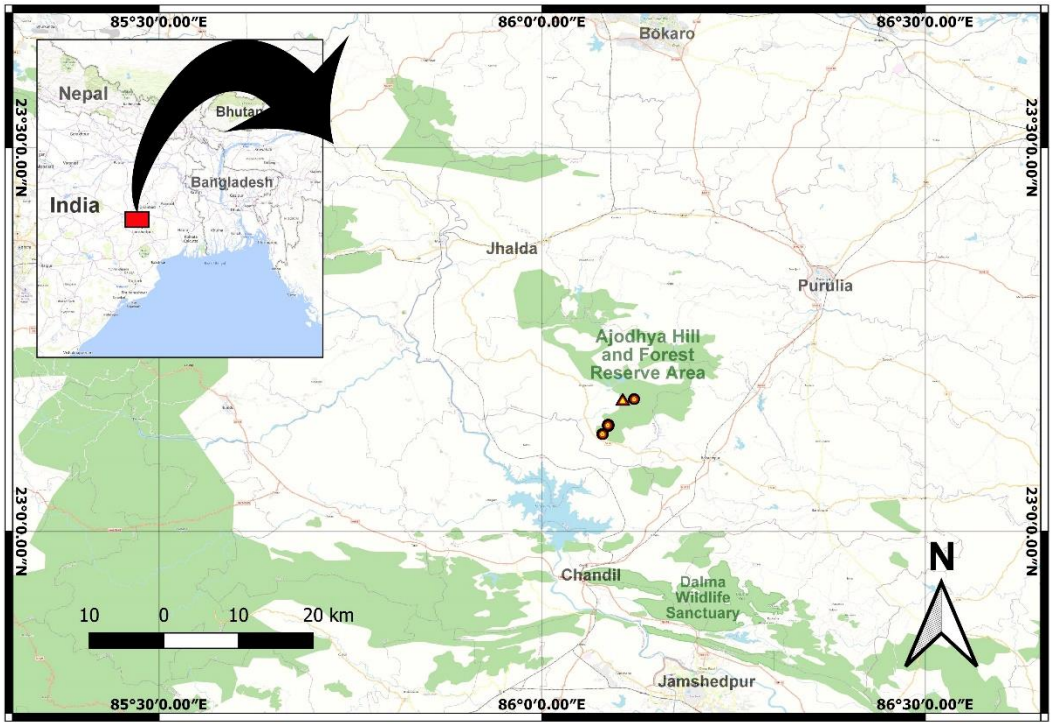

Fig. 1. Location of the camera-trapped (circles) and direct sightings of (triangle) Ruddy Mongoose *Urva smithii* in Ajodhya Hill, Purulia, West Bengal, India.

Six unbaited Moultrie M-50i camera-traps were set up for a total of 102 camera-trap days in order to assess the mammalian diversity of the area. The camera-traps were set up at various locations that were selected on the basis of secondary signs of animals. A Canon EOS 750D camera was used for photography by hand. A Garmin eTrex 20x was used to record location and altitude

Observations and discussion

Ruddy Mongoose were camera-trapped five times during the survey and directly observed on one occasion (Table 1). This is the first photographic evidence of the species's occurrence in West Bengal and is the easternmost global record for the species.

Table 1. Records of Ruddy Mongoose *Urva smithii* in Ajodhya Hill, Purulia, West Bengal, India.

Date	Time	Location	Record	Altitude	Forest type
2 Nov. 2018	15h17	23°10'N, 86°07'E	Camera-trapped	208 m	Mixed deciduous
26 Nov. 2018	09h34	23°10'N, 86°07'E	Camera-trapped	307 m	Mixed deciduous
19 Jan. 2019	13h56	23°10'N, 86°06'E	Camera-trapped	330 m	Dry hill stream
25 Jan. 2019	15h00	23°10'N, 86°06'E	Camera-trapped	330 m	Dry hill stream
9 Feb. 2019	10h44	23°08'N, 86°05'E	Camera-trapped	329 m	Dry deciduous
24 Feb. 2019	17h39	23°07'N, 86°04'E	Direct sighting	369 m	Dry deciduous

Fig. 2. A Ruddy Mongoose *Urva smithii* camera trapped in Ajodhya Hill, Purulia, West Bengal, India. © Supriya Samanta and Green Plateau.

Fig. 3. An adult Ruddy Mongoose *Urva smithii* photographed by hand in dry deciduous forest of Ajodhya Hill, Purulia. © Kirity Kumar.

Though similar to Grey Mongoose *Urva edwardsii*, the Ruddy Mongoose is readily identified in the field by its black tail tip, which is often held pointed upwards (Figs. 2, 3), and its reddish-brown colouration (Menon 2014).

The documented distribution of Ruddy Mongoose is restricted to Sri Lanka and Peninsular India, from south of Delhi in the north to Bihar in the east (Shreehari *et al.* 2013, Menon 2014, Mudappa & Choudhury 2016). Recently it was recorded in Rajasthan and Nepal (Dookia 2013, Subba *et al.* 2014). In West Bengal the only known record is a sighting record from the Turga Dam area, Purulia, in 2004 (Mallick 2019).

Other small carnivores encountered during this survey were Small Indian Mongoose *Urva auropunctatus*, Common Palm Civet *Paradoxurus hermaphroditus* and Small Indian Civet *Viverricula indica*.

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ARTICLE

An extension of the known range of Brown Mongoose *Urva fuscus* in Southern India

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Abstract

The Brown Mongoose *Urva fuscus* is a cryptic species restricted in India to the Western Ghats. Previous Indian records of this species are from the southern parts of the Western Ghats, in Karnataka, Kerala and Tamil Nadu. This camera-trap record from Biligiri Rangaswamy Temple Tiger Reserve, which essentially forms the confluence between the Eastern and the Western Ghats, extends the species's known range by approximately 150.4 km to the south-east (102°E) of the previous record in Karnataka.

Keywords: Biligiri Rangaswamy Temple Tiger Reserve, camera-trapping, cryptic species, small carnivores, Western Ghats

Introduction

The Brown Mongoose *Urva fuscus* (see Patou *et al*. 2009) is a relatively large mongoose with uniformly dark blackish-brown fur and a thick, conical tail (Sreehari *et al.* 2013). It occurs in India and Sri Lanka and was introduced to the island of Viti Levu in Fiji (Veron *et al*. 2009, Mudappa & Jathanna 2015). Four subspecies of the Indian Brown Mongoose have been identified, of which *U. f. fusca* is the one that is found in India and its range is restricted to the Western Ghats (Corbet & Hill 1992; Kumara & Singh 2007; Mudappa *et al*. 2007).

From 1998 to 2015, the status of *U. fuscus* changed from Not Evaluated to Vulnerable to Least Concern in the IUCN Red List of Threatened Species mainly because there has been more information about its distribution and status (Mudappa & Jathanna 2015).

In India, the species inhabits evergreen forests, high altitude shola forests and adjoining tea and coffee plantations (Mudappa & Jathanna 2015). Even though its geographic range is restricted, locally it is quite common and even uses anthropogenic vegetation in the vicinity of human settlements (Chowdhury 2013, Mudappa *et al.* 2007, Mudappa 2013, Mudappa & Jathanna 2015). It tends to be nocturnal but has been observed to have significant daytime activity as well (Mudappa 2002, Kamath & Seshadri 2019). Generally, it is observed as

solitary individuals or in duos (Mudappa 2002, Veron et al 2009, Mudappa & Jathanna 2015). Information regarding the behaviour and ecology of the Brown Mongoose is still scarce.

The Brown Mongoose has been documented at 450–2000 m asl (Mudappa & Jathanna 2015). In the Western Ghats, in south India, it has been sighted and/or camera-trapped in protected areas of Kerala (Peppara Wildlife Sanctuary, Shendurney Wildlife Sanctuary, Periyar Tiger Reserve, Pampadum Shola National Park and Eravikulam National Park) and Anamalai and Kalakkad-Mundutthurai Tiger Reserves in Tamil Nadu (Sreehari *et al.* 2016). The sightings in Karnataka state are all from the taluk of Virajpete in Kodagu District (Pocock 1942, Prater 1971, Jathanna 2014). This note documents the Brown Mongoose at a new location, outside its previously known range.

Study area

Biligiri Rangaswamy Temple (BRT) Tiger Reserve, which is in Chamarajanagar District in the south-eastern part of Karnataka, covers an area of 574.8 km^2 and forms a crucial link between the Eastern Ghats and the Western Ghats. It is part of a larger protected area network including Satyamangalam Tiger Reserve, Malai Mahadeshwara Wildlife Sanctuary, Cauvery Wildlife Sanctuary and other protected and reserved forest areas (Gubbi *et al.* 2017). The tiger reserve's altitude ranges between 620 to 1950 m asl and it receives an average of 650 mm (range 600 – 3000 mm) of rainfall in low-lying plateaus and 1990 mm in the higher altitudes (Lingaraja *et al.* 2017). The temperature ranges from 8°C to 16°C in winter and from 20°C to 38°C in summer (Kumara *et al.* 2012). Because of its altitudinal variations, BRT encompasses a variety of habitats, such as dry open scrub forests at lower elevations, deciduous forests in the hills at 500-1000 m asl, riparian and moist deciduous forest at mid-elevation and sholas and evergreen forests at higher elevations (Kumara & Rathnakumar 2010, Kumara *et al.* 2014).

Camera-trapped Brown Mongoose

Camera-traps (Panthera V4 and V6) were deployed between January and March 2018 to estimate the density and abundance of Leopard *Panthera pardus* in the reserve. A total of 209 stations was selected, where there was a perceived high probability to photo-capture Leopard individuals, covering different types of vegetation. At each station, two camera-traps were deployed at a height of approximately 40 cm from the ground level on either side of animal tracks and forest roads. The study area was divided into three blocks and each camera-trap was kept for 16 days in each block. All the camera-traps were active throughout the day and night. No baits or lure were used to attract any animal during the study. The total amount of effort was 3342 camera-trap days. The elevation of each camera-trap station was measured using a Garmin GPS (model GPSMAP 64s).

Brown Mongoose was photographed twice, at the same camera-trap station (11°53′ 25.08″N, 77°9′4.32″E) at a measured elevation of 1171 m asl (Fig. 1) on 25 February 2018 at 19h17 and on 1 March 2018 at 18h58.

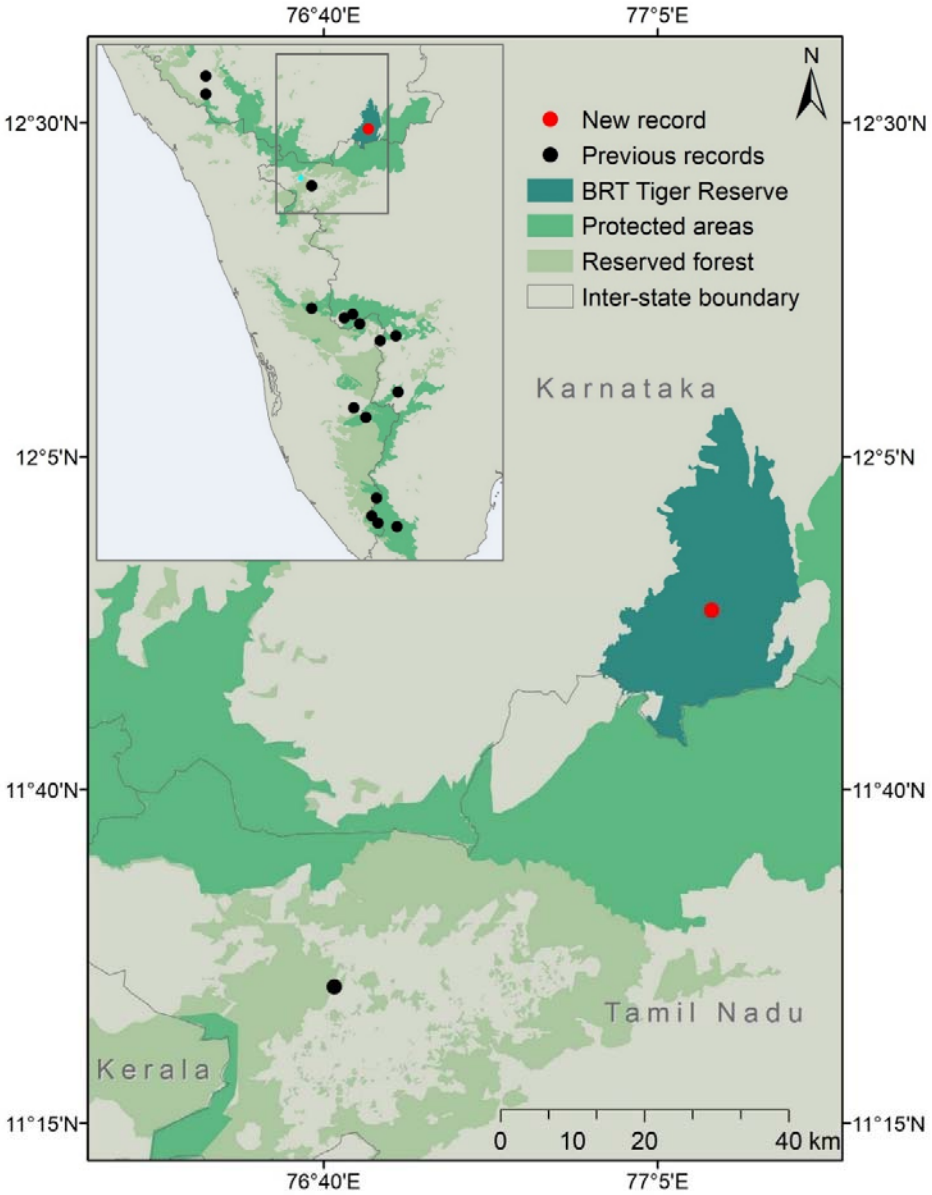

Fig 1. Previous records of Brown Mongoose *Herpestes fuscus* in the Western Ghats (Sreehari *et al.* 2016), and current record from Biligiri Rangaswamy Temple Tiger Reserve, Karnataka, India.

The individual(s) photographed had dark brown fur and a thick conical tail (Figs. 2, 3). The identification of the species was confirmed with the help of biologists working on small carnivores. The habitat of this location was characterized as moist deciduous forests (Fig. 4).

Discussion

The species was not recorded in the study area during previous studies done by Kumara *et al.* (2010, 2013, 2014) and Lingaraja et al. (2017). BRT Tiger Reserve is frequented by tourists and naturalists who carry out informal surveys covering observed species. The camera-trap station where *U. fuscus* was photo-captured is also on the regular tourism route and just 3.5 km away from the well-known K. Gudi camp but there has not been a previous record or observation from this area.

Fig. 2. Brown Mongoose *Urva fuscus* photo-captured on 25 February 2018 at Biligiri Rangaswamy Temple Tiger Reserve, Karnataka, India.

Fig. 3. Brown Mongoose *Urva fuscus* photo-captured on 1 March 2018 at Biligiri Rangaswamy Temple Tiger Reserve, Karnataka, India.

The habitat and elevation of the current Brown Mongoose record is well within the preference and range, respectively; however, the location lies outside the geographic range identified previously (Mudappa & Jathanna 2015). The current record is 150.4 km to the south-east (102°E) of the taluk of Virajpete in Kodagu District (12°10′48.00″N, 75°47′60.00″E), which is the nearest record in Karnataka (Pocock 1942) and 73.27 km to the north-east (44°E) of Ooty (11°25′12.00″N, 76°40′48.00″E), which is the closest in all prior records (Prater 1971).

Fig. 4. Habitat of the camera trap station where the Brown Mongoose *Urva fuscus* was photo-captured at Biligiri Rangaswamy Temple Tiger Reserve, Karnataka, India.

BRT has only 10.3% of the evergreen and semi-evergreen forests that are described as the preferred habitats of the Brown Mongoose (Ramesh 1989, Mudappa & Jathanna 2015); the current record in a moist deciduous habitat shows that the species also occurs in these habitats, at least occasionally. The current recorded habitat is not connected to areas that have previously documented the species within Karnataka. Considering that the record is only from one camera-trap station, there is a possibility that it could be a dispersing individual. Further surveys focused on camera-trapping small mammals and analyses must be conducted to determine whether there is a resident population of *U. fuscus* within the BRT Tiger Reserve. If a resident population is confirmed, taxonomic work to assess whether there is variation at the sub-species level would be helpful.

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