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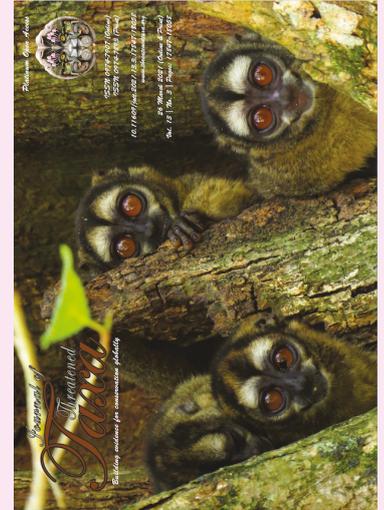
## SHORT COMMUNICATION

### OCCURRENCE OF MAMMALIAN SMALL CARNIVORES IN KALAKAD-MUNDANTHURAI TIGER RESERVE, WESTERN GHATS, INDIA

A. Venkatesh, N. Sridharan, S. Agnes Jeya Packiavathi & K. Muthamizh Selvan

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## Occurrence of mammalian small carnivores in Kalakad-Mundanthurai Tiger Reserve, Western Ghats, India

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**Abstract:** The small mammalian carnivores are important for maintaining healthy ecosystems. The present documentation is based on the camera trap survey in Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu. Paired camera-traps were set in a grid of 1.413 × 1.413 km area of 180km<sup>2</sup> within an altitudinal range of 80–1,866 m. A total of 11 species were recorded in different habitat types. Brown Palm Civet *Paradoxurus jerdoni* and Leopard Cat *Prionailurus bengalensis* had the highest capture rates and the lowest was Rusty Spotted Cat *Prionailurus rubiginosus*.

**Keywords:** Camera trapping, KMTR, lesser carnivores, smaller mammals.

Small carnivores are difficult to study due to their elusive, small, (semi-) arboreal, and crepuscular or nocturnal habits (Mudappa 2001). Extensive camera-trapping of carnivores across India has provided some published information on small carnivores, with a few systematic surveys specifically for them. Camera-trapping surveys in other protected areas provided important data on some species of small carnivores (Datta et al. 2008; Nixon et al. 2010; Gupta 2011; Prakash et al. 2012). The Western Ghats mountain range in India is a global biodiversity hotspot with a high diversity of plant and animal taxa (Myers et al. 2000), including small carnivores. The Western Ghats, with an estimated four-

fold increase in the number of forest fragments and an 83% reduction in the size of surviving patches between 1920 and 1990, and a very high human population density, is critically threatened by habitat degradation and fragmentation (Menon & Bawa, 1997; Menon 2003). The rainforests of the Western Ghats have six species of non-aquatic small carnivores including two endemic species (Nilgiri Marten *Martes gwatkinsii*, Brown Palm Civet *Paradoxurus jerdoni*), two endemic sub-species which otherwise also occur in Sri Lanka (Stripe-necked Mongoose *Herpestes vitticollis*, Brown Mongoose *H. fuscus*), and two geographically very widespread species (Small Indian Civet *Viverricula indica*, Leopard Cat *Prionailurus bengalensis*) (Ramesh et al. 2012).

The Western Ghats offer a wide range of habitats from lowland scrub forests to rainforests at high elevations, supporting many species of small carnivores. Mudappa (2001) and Mudappa et al. (2007) reported the small carnivore composition in part of the Agasthyamalai landscape of Kalakad-Mundanthurai Tiger Reserve (KMTR) using opportunistic sight records, sign surveys, live trapping, and radio-telemetry. The present study reports small carnivores in KMTR based on camera trap surveys and opportunistic sight records.

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**Competing interests:** The authors declare no competing interests.

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**STUDY AREA**

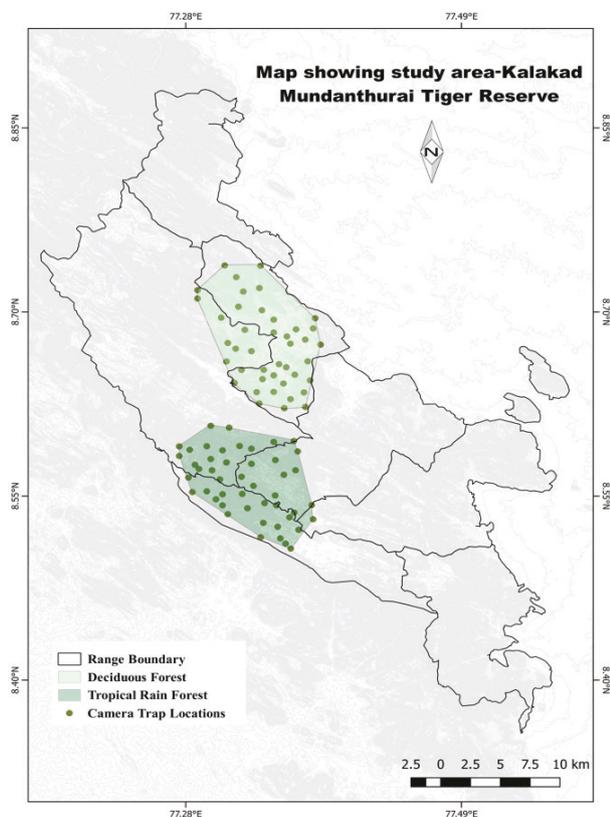
The Kalakad-Mundanthurai Tiger Reserve is located in the southern part of the Western Ghats of India. This region forms one of the important bio-diversity ‘hotspots’(Ganesh et al. 1996; Ramesh et al. 1997; Myers et al. 2000; Johnsingh 2001) and is recognized as Type-1 Tiger Conservation Unit (Wikramanayake et al. 1998), due to its large and contiguous forested tracts. The reserve is spread over an area of 895km<sup>2</sup> and located between 7.16–77.58 °E & 8.41–8.83 °N (Figure 1). The altitude varies from 60m to 1,866m characterized by hilly terrain with low and high altitude plateau. It receives both the south-west and north-east monsoons with mean annual rainfall of over 3,200mm. Mean monthly temperature ranges 15–30 °C. Besides three large carnivores, KMTR harbors several prey species such as Sambar *Rusa unicolor*, Gaur *Bos gaurus*, Chital *Axis axis*, Wild Boar *Sus scrofa*, Barking Deer *Muntiacus muntjak*, Indian Chevrotain *Tragulus meminna*, Asian Elephant *Elephas maximus*, Black-naped Hare *Lepus nigricollis*, Bonnet Macaque *Macaca radiata*, Common Langur *Semnopithecus priam*, Lion-tailed Macaque *Macaca silenus*, Nilgiri Tahr *Hemitragus hylocrius*, Indian

Porcupine *Hysterix indica*, Indian Giant Squirrel *Ratufa indica*, Grey Jungle Fowl *Gallus sonneratii*, Red Spur Fowl *Galloperdix spadicea* and Indian Peafowl *Pavo cristatus* (Johnsingh 2001). Major forest types include the southern hill top evergreen, southern tropical wet evergreen, Tirunelveli semi-evergreen, southern moist mixed deciduous, tropical riparian fringe, dry teak, southern dry mixed deciduous, Carnatic umbrella thorn, Ochlandra reeds, southern montane wet temperate forests, and grasslands of low and high altitudes (Champion & Seth 1968).

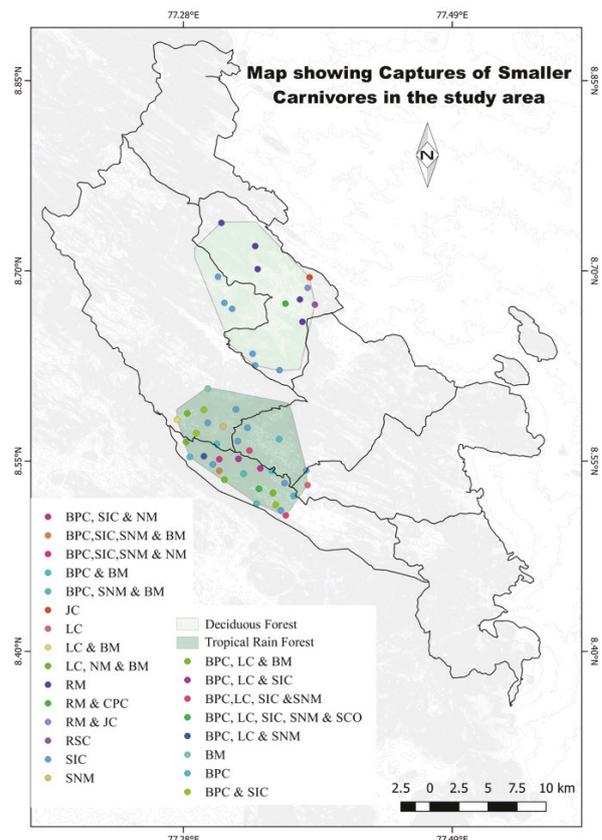
**METHODS**

**Field survey**

An area of 180km<sup>2</sup> within the altitudinal range of 80–1,866 m had three intensive camera-trapping zones, in deciduous & thorn forest (84km<sup>2</sup>) and tropical rain forest (96km<sup>2</sup>), from 09 April to 23 May 2015 (Image 1a&b). All the forest types had been surveyed during the dry season. Paired camera-traps were set in a grid of 1.413 × 1.413 km. Each station had two independently operating passive-infrared cameras (Cudde back Attack; Cudde back C3) mounted, opposite each other on trails,



**Figure 1. Camera trap locations in the study area of Kalakad-Mundanthurai Tiger Reserve**



**Figure 2. Species capture details in the study area.**



**Image 1** Study area. a—tropical riparian fringe forest | b—southern tropical wet evergreen forests. © S. Agnes

dirt roads, stream beds, termite mounds, and fresh animal carcasses; and in other locations with evidence of small carnivore movement. Camera-traps were active for 24 hours a day, without bait or lure. The latency after each photograph was set to 1minute and sensitivity was set to high. Camera-traps were set approximately 25cm above ground (targeting civets). All camera-traps were checked, on an average, every three days. Each camera trap pair were given a unique ID, memory card ID, location names, GPS-derived co-ordinates, habitat descriptions, set-up and removal dates, and presence of animal signs were recorded for each camera-trap site. Additional information was compiled from sign surveys, interviews with locals and frontline staff, and also based on opportunistic drives during day and night using a four-wheeler at a speed of 15 km/h to look for small carnivores.

**Data analysis**

Each photograph was recorded with date and time. A photographic event, in camera-traps at a single camera

station was considered notionally independent if it was at least 10 minutes after the species’ preceding image at that station. Detections involving more than one individual, but part of the same social unit, e.g., mother and young, were counted as a single event. Encounter rates were derived by dividing the number of notionally independent events by the camera-trap-nights × 100.

**RESULTS**

A total of 3,510 trap-nights yielded 187 notionally independent photographs of 11 species namely: Jungle Cat *Felis chaus*, Leopard Cat *Prionailurus bengalensis*, & Rusty-spotted Cat *P. rubiginosus* (27 notionally independent photographs), Small Indian Civet *Viverricula indica* (46), Common Palm Civet (one), Brown Palm Civet (76), Stripe-necked Mongoose *Herpestes vitticollis* (10), Brown Mongoose *H. fuscus* (nine), and Ruddy Mongoose *H. smithii* (eight) (Table 1, Image 2a–i, Figure 2). Smooth-coated Otter *Lutrogale perspicillata* was not camera-trapped, but was sighted opportunistically.

**Species Accounts**

**Smooth-coated Otter *Lutrogale perspicillata***

In 2015, two otters were sighted at around 11.30h, observed for 20 minutes, in the evergreen forests of Upper Kodayar dam site, Upper Kodayar range. Likewise, a group of otters with six individuals was sighted in the lower dam area of Papanasam range in deciduous forest. Tracks, specifically in moist mud and spraints were often observed in both the forest types. The spraint consisted of crushed crabs, shells and fish remains, deposited over rocks along the banks of perennial water bodies (large and small), and sometimes along the forest trails close to these water bodies.

**Small Indian Civet *Viverricula indica***

The Small Indian Civet was recorded at 30.76% of all camera-trap locations in both the forest types. It was sighted during the night survey in Mundanthurai plateau. All photographs were obtained between dusk and dawn (18.00–06.00 h). Capture rate was higher in the tropical rain forest (1.76) than in the deciduous forest (0.59).

**Common Palm Civet *Paradoxurus hermaphrodites***

The Common Palm Civet was recorded at 1.28 % of all camera-trap locations. Encounter rates were recorded only in the deciduous forest and none recorded in the tropical rain forest. During night drives, the animal was observed in deciduous forest. It was photographed between 18.00h and 05.00h.



**Table 1.** Number of camera-trap stations with records (CS), notionally independent photo-captures (NIPC) and capture rate CR (NIPC/100 trap nights) of small carnivores in Kalakad-Mundanthurai Tiger Reserve, India (2015).

	Species	Deciduous forests			Tropical rainforests		
		CS	NIPC	ER	CS	NIPC	ER
1	Leopard Cat				12	23	1.06
2	Small Indian Civet	5	8	0.59	19	38	1.76
3	Brown Palm Civet				20	76	3.52
4	Ruddy Mongoose	7	8	0.59			
5	Stripe necked Mongoose				8	10	0.46
6	Nilgiri Marten				3	8	0.37
7	Brown Mongoose				8	9	0.42
8	Rusty Spotted cat	1	1	0.07			
9	Common Palm civet	1	1	0.07			
10	Smooth Coated otter				1	2	0.09
11	Jungle Cat	2	3	0.22			

#### **Brown Palm Civet *Paradoxurus jerdoni***

The Brown Palm Civet was photographed only in tropical rain forests, being recorded in 25.64% of all camera-trap locations. All photographs were obtained during night hours (23.00–03.45 h).

#### **Stripe-necked Mongoose *Herpestes vitticollis***

The Stripe-necked Mongoose was photographed in 12.82% of all camera-trap stations. During night surveys very often it was recorded in deciduous forest.

#### **Brown Mongoose *Herpestes fuscus***

The Brown Mongoose was photographed in 10.25% of all camera-trap stations of tropical rain forests during day time.

#### **Ruddy Mongoose *Herpestes smithii***

The Ruddy Mongoose was camera-trapped most often in the open habitats of deciduous and thorn forests amounting to 10.25% of all camera trapping sites. None was recorded in the tropical rain forest.

#### **Leopard Cat *Prionailurus bengalensis***

The Leopard Cat was photographed in 10.16% of camera-trap stations with a capture rate of 0.17. Totally 13 individuals have been identified based on the unique spots from 23 photos. It was photographed at 18.00–06.00 h. In 2015, two individuals were sighted during field survey (19.33h & 19.17h) in the upper Kodayar.

#### **Rusty Spotted cat *Prionailurus rubiginosus***

The Rusty Spotted Cat has a relatively restricted

distribution in KMTR. In the entire camera trapping session for 45 days, the species was camera-trapped only once in deciduous forest and the encounter rate was 0.03.

#### **Nilgiri Marten**

The Nilgiri Marten was captured in four camera trap locations of tropical rain forest at altitudes varying 1,300–1,800 m.

#### **DISCUSSION**

KMTR with its diverse forest types is inhabited by many species of smaller carnivores as evidenced in this study. Seven species were recorded in the tropical rain forest through camera trap and direct sighting and four species were recorded in the deciduous forests. Among the former seven species, the Brown Palm Civet showed the highest encounter rate followed by Small Indian Civet, Leopard Cat, and Brown Mongoose. The Brown Palm Civet has been recorded only in the evergreen forests occurring in both little-disturbed, large contiguous forests as well as fragments surrounded by tea plantations and/or human habitations (Mudappa 2001; Rajamani et al. 2002).

Forest type has been observed to influence the distribution of the Brown Palm Civet, with the species being more common in evergreen forests at altitudes above 900m. Nevertheless, the higher capture rates indicating higher abundances in KMTR are probably sustained by the higher forage species densities in the relatively undisturbed rainforests, particularly species such as *Palaquium ellipticum*, *Holigarna nigra*,

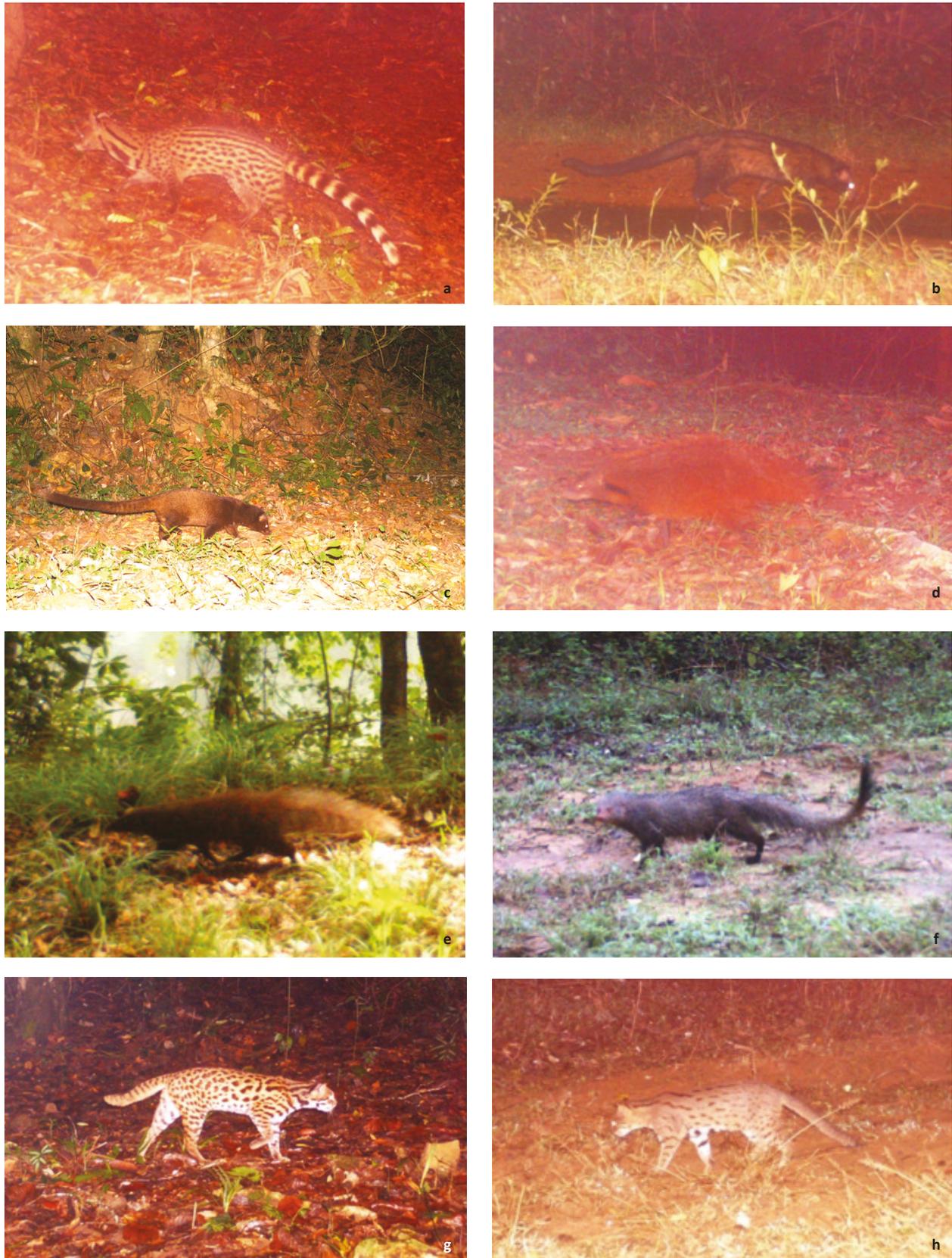


Image 2. a—Small Indian Civet *Viverricula indica* | b—Common Palm Civet *Paradoxurus hermaphrodites* | c—Brown Palm Civet *Paradoxurus jerdoni* | d—Stripe-necked Mongoose *Herpestes vitticollis* | e— Brown Mongoose *Herpestes fuscus* | f— Ruddy Mongoose *Herpestes smithii* | g—Leopard Cat *Prionailurus bengalensis* | h—Rusty-spotted Cat *Prionailurus rubiginosus*. © N. Sridharan



Image 2i— Nilgiri Marten *Martes gwatkinsii*. © KMTR

*Elaeocarpus* spp., *Ficus* spp., *Acronychia pedunculata*, and *Gnetum ula* (Mudappa 2001). The endemic Brown Palm Civet, is an important frugivore and seed-disperser in these rainforests and one of the species with the smallest distribution range among southern Asian carnivores. KMTR with its large tract of relatively undisturbed rainforests is potentially one of the most significant areas for the long-term conservation of small carnivores in the Western Ghats.

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