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SMALL CARNIVORES OF PARAMBIKULAM TIGER RESERVE, SOUTHERN WESTERN GHATS, INDIA

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Small carnivores of Parambikulam Tiger Reserve, southern Western Ghats, India

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Abstract: The first ever detailed study on the small carnivores of the Parambikulam Tiger Reserve (PkTR) in the southern Western Ghats, using camera trap techniques, reported 11 species. A total of 1,350 camera-trap nights were used for the study. This was supplemented with 242km of day transects and 344km of night transects using spot-lights. The small carnivores reported were the Small Indian Civet *Viverricula indica*, Common Palm *Civet Paradoxurus hermaphroditus*, Brown Palm Civet *Paradoxurus jerdoni*, Indian Grey Mongoose *Herpestes edwardsii*, Stripe-necked Mongoose *Herpestes vitticollis*, Brown Mongoose *Herpestes fuscus*, Ruddy Mongoose *Herpestes smithii*, Smooth-coated Otter *Lutrogale perspicillata,* Nilgiri Marten *Martes gwatkinsii,* Jungle Cat *Felis chaus* and Leopard Cat *Prionailurus bengalensis*. About 90% of the small carnivores captured in the camera traps in PKTR were members of the Viverridae family such as the Small Indian Civet (31.67%), Common Palm Civet (30%) and Brown Palm Civet (28.33%). The study recorded all the four species of mongoose known from the Western Ghats from PkTR. Two out of the 11 small carnivores belong to the 'Vulnerable' category on the IUCN Red List.

Keywords: Anamalai Hills, camera trap, endemism, *Felis*, *Herpestes*, IUCN Red List, *Lutrogale*, *Martes*, *Paradoxurus*, *Prionailurus*, *Viverricula*, Viverridae

Small carnivores constitute more than 50% of the order Carnivora (Schipper et al. 2008). The small carnivores include mongooses of the family Herpestidae, civets (Viverridae), otters & martens (Mustelidae) and small cats (Felidae). They are mostly nocturnal and solitary animals and also one of the less studied groups of mammals of the Western Ghats. The Indian small carnivores consist of 36 species with nine viverrids, 10 small cats, 11 mustelids, and six herpestids (Nameer 2000; Mudappa 2013; Johnsingh & Nameer 2015). The Western Ghats support 17 species in four families (Nameer et al. 2001; Nameer 2015). Owing to their small size, low density and nocturnality, which are obvious hindrances to conduct research, these animals have not garnered enough attention from the research community (Mudappa 1998). However, the conservation status of many species is becoming a matter of great concern due to lack of quality data and research.

Studies on small carnivores of the Western Ghats are few and far between. Mudappa (2002) gave a detailed account of the eight species of small carnivores of Kalakad-Mundanthurai Tiger Reserve (KMTR), Tamil Nadu. Kumar et al. (2002), reported five species of small carnivores from Indira Gandhi Wildlife Sanctuary Tamil Nadu, which is adjacent to Parambikulam Tiger

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Reserve. Rajamani et al. (2002) reported the status and distribution of the Western Ghats endemic Brown Palm Civet. Anoop & Hussain (2004, 2005) studied the ecology of the Smooth-coated Otter in Periyar Tiger Reserve, while Kumara & Singh (2007) reported 11 species of small carnivores from Karnataka. Mudappa et al. (2007) studied the responses of small carnivores to rainforest fragmentation in the southern Western Ghats. Pillay (2009) reported seven species from the southern Western Ghats, Perinchery et al. (2011) studied the ecology of Asian small-clawed Otters of Eravikulam National Park, while Kumara et al. (2014) reported nine species of small carnivores from Biligiri Rangaswamy Temple Tiger Reserve, Karnataka. Apart from these there are some opportunistic records of the small carnivores from the Western Ghats. The present study is the first detailed study on the small carnivores of Parambikulam TR.

Study Area

Parambikulam Tiger Reserve (PkTR), the second Tiger Reserve of Kerala State, is situated in Palghat District, Kerala, India. PkTR is located within the Anamalai Hills of Western Ghats (76.58–76.83^{0}E & 10.33–10.43^{0}N) (Fig. 1). PkTR is surrounded by the Nemmara Reserve Forest, including the Nelliampathy Hills to the north, Anamalai Tiger Reserve to the east, Sholayar Reserve Forest to the south and Chalakudy Reserve Forest to the west. The total extent of the Tiger Reserve is 643.66km^2, with a core zone of 390.89km^2 and buffer zone of 252.77km^2 (Anonymous 2011). Before being declared as the Tiger Reserve in 2010, Parabikulam Wildlife Sanctuary had an extent of 285km^2, and the present study was carried out in this erstwhile Parambikulam Wildlife Sanctuary (Fig. 1). The major vegetation types of PkTR are IA/C4 west coast tropical evergreen forests, 2A/C2 west coast tropical semi evergreen forests, 3B/C2 southern moist mixed deciduous forests, 5A/C3 southern dry mixed deciduous forests and teak plantation. The altitude of the PkTR ranges from 300–1438 m (Anonymous 2011). The major peaks are Karimalagopuram (1,438m), Pandaravarai (1,290m), Vengoli (1,120m) and Puliyarapadam (1,010m). PkTR has three man-made reservoirs namely Parambikulam, Thunacadavu and Peruvaripallam whose cumulative water spread area is 20.66km^2.

Methods

The study was carried out from June 2011 to May 2012. Three strata, the evergreen forests, moist deciduous forests and the teak plantations were selected for studying the small carnivores in the

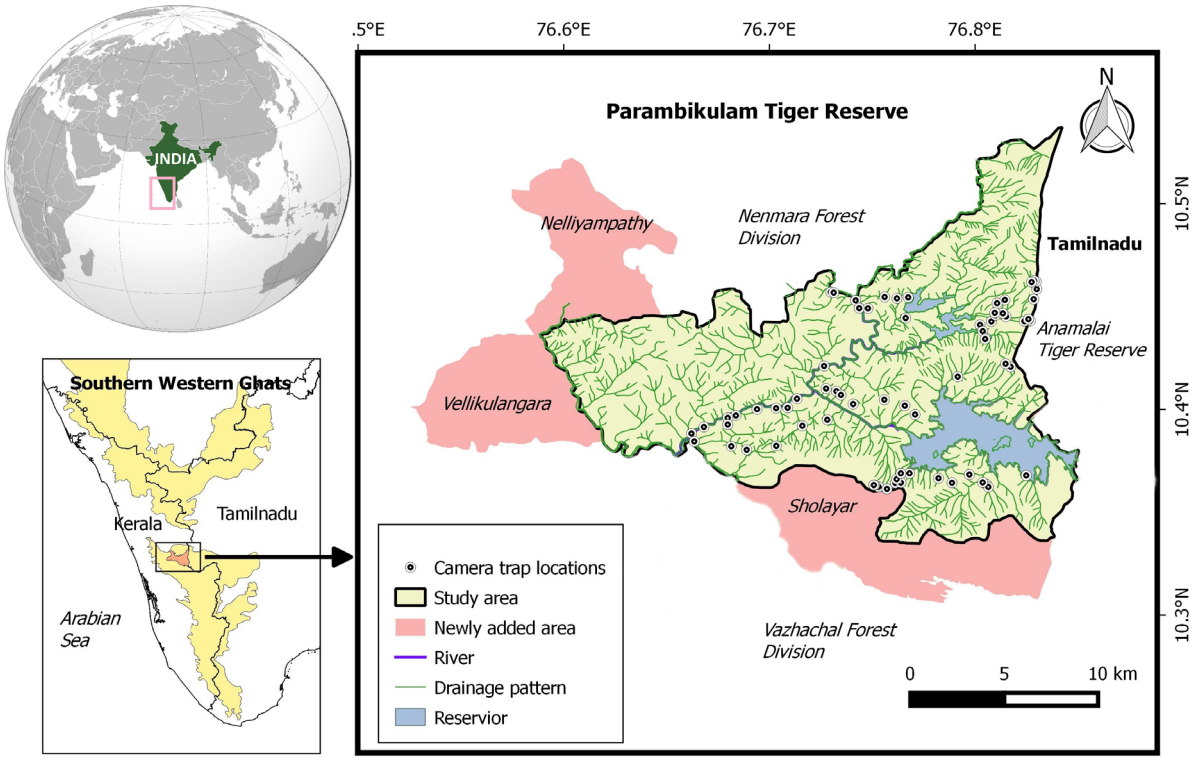

Figure 1. Location map of Parambikulam Tiger Reserve with Camera trap stations

PkTR. The semi-evergreen forests were treated along with the evergreen forests. Camera trapping was the primary method employed for the study, which was supplemented using night transect survey and survey based on indirect evidences.

Camera-trapping

Digital scout cameras having passive infra-red sensors for heat and motion detection (Bushnell trophy cam model no. 119436 and Cuddeback attack model no. 1149) were used for this survey. Overall, 90 trapping stations (Fig. 1) were identified based on footprints and scats of the small carnivore presence (Mudappa et al. 2007). Each of these 90 stations was at least 250m apart. The camera traps were set at a height of 30–40 cm from the ground. The cameras were set up in default mode with a delay of 10 seconds between pictures. At each trapping station, cameras were opened for 15 days each. Thus camera trap sampling was done for a total of 1,350 nights of which 570 nights (42%) were in moist deciduous forest, 524 nights (39%) in evergreen forest and 255 nights (19%) in teak plantations. The camera trap locations were recorded with a Garmin etrex e30 GPS.

Day transect survey

A total of 71 transects were laid covering a length of 242km in different habitats and along the stream beds (the length of transects varied between 2–4 km). The length of each transect was measured using a GPS. A single transect could run through more than one vegetation type. During the transect walk, the indirect evidences, primarily the scats, of the small carnivores were recorded. Direct sightings if any were also noted. The signs were identified to the small carnivore group such as civet, mongoose, cat, etc., and the species level identification was impossible (Duckworth 1997).

Night spotlight survey

The night spotlight survey was carried out from 18:00–23:00 hr using high beam LED torches. A total of 19 transects were laid in a vehicle covering 344km in 29hr 30min with an average speed of 15 to 20km/hr. Once the eye-shine was detected, the animal was observed more closely using additional torches and the species was identified. Various parameters such as the habitat, altitude and degree of shyness were recorded. The encounter rate of the small carnivores was calculated as the number of animals per km.

Results & Discussion

A total of 645 photographs of 24 mammal species were obtained by camera trapping. Out of these, the carnivores accounted for 189 (29.3%) photographs, of which 60 (31.75%) photographs were of small carnivores comprising eight different species. The most common species recorded was the Small Indian Civet (31.67%) followed by the Common Palm Civet (30%), the Brown Palm Civet (28.33%) and the Stripe-necked Mongoose (3.3%). The Nilgiri Marten, Ruddy Mongoose, Smooth-coated Otter and Leopard Cat were captured only once (1.7%) in the camera trap during the study period (Table 1).

The 242km day-transect resulted in the evidence of

Table 1. Details of small carnivores recorded from Parambikulam Tiger Reserve (in parenthesis no. of detections)

Species	Camera trap (1,349 camera nights)	Night spot-light survey (344km)	Day transect walk (242km)	Total detections	IUCN status
1. Jungle Cat	-	3.23% (1)	-	1	LC
2. Leopard Cat	1.67% (1)	3.23% (1)	-	2	LC
3. Common Palm Civet	30% (18)	41.94% (13)	6.67% (1)	32	LC
4. Small Indian Civet	31.67% (19)	45.16% (14)	-	33	LC
5. Brown Palm Civet	28.33% (17)	6.45% (2)	-	19	LC
6. Indian Grey Mongoose	-	-	13.33% (2)	2	LC
7. Indian Brown Mongoose	-	-	6.67% (1)	1	LC
8. Stripe-necked Mongoose	3.33% (2)	-	40% (6)	8	LC
9. Ruddy Mongoose	1.67% (1)	-	-	1	LC
10. Smooth-coated Otter	1.67% (1)	-	33.33% (5)	6	VU
11. Nilgiri Marten	1.67% (1)	-	-	1	VU
Total	**(60)**	**(31)**	**(15)**	**106**	

LC - Least Concern; VU - Vulnerable

Table 2. Proportion of detections of small carnivores in different vegetation types in Parambikulam Tiger Reserve

Species	Evergreen forest	Moist deciduous forest	Teak Plantation
1. Asian Palm Civet	12 (37.5%)	12 (37.5%)	8 (25%)
2. Small Indian Civet	10 (30.3%)	13 (39.4%)	10 (30.3%)
3. Brown Palm Civet	14 (73.7%)	5 (26.3%)	-
4. Indian Grey Mongoose	-	2 (100%)	-
5. Brown Mongoose	1 (100%)	-	-
6. Stripe-necked Mongoose	-	6 (75%)	2 (25%)
7. Ruddy Mongoose	-	1 (100%)	-
8. Smooth-coated Otter	1 (16.7%)	1 (16.7%)	4 (66.7%)
9. Nilgiri Marten	-	1 (100%)	-
10. Jungle Cat	-	1 (100%)	-
11. Leopard Cat	1 (50%)	1 (50%)	-
Total	39 (36.79%)	43 (40.57%)	24 (22.64%)

Image 1. A carcass of Common Palm Civet *Paradoxurus hermaphrodites* from Parambikulam Tiger Reserve

Image 2. Camera trapped image of Small Indian Civet *Viverricula indica* from Parambikulam Tiger Reserve

five species of small carnivores including Indian Grey Mongoose (13.33%), Stripe-necked Mongoose (40%), Brown Mongoose (6.67%), Smooth-coated Otter (33.3%) and Common Palm Civet (6.67%) (Table 1).

The night-transect using the spot-light survey of 344km on vehicle resulted in 36 sightings of five species of small carnivores viz., Small Indian Civet (45.16%), Common Palm Civet (41.94%), Brown Palm Civet (6.45%), Jungle Cat (3.23%), and Leopard Cat (3.23%) (Table 1). The camera trap success rate was highest in the deciduous forests (40.57%), followed by evergreen forests (36.79%) while the detection rate was the lowest in the teak plantation (22.64%) (Table 2).

Species account on the small carnivores of Parambikulam Tiger Reserve

Common Palm Civet *Paradoxurus hermaphroditus*: Common Palm Civet is the most abundant species of small carnivores in PkTR. During the present study, 30% of the small carnivores belonged to the Common Palm Civet. Apart from the camera trap images, 13 individuals were sighted during the night spot-light survey. The species was sighted either moving through the tree canopy or taking rest in the branches of trees. The Common Palm Civet was recorded between the altitude ranges from 450–1,200 m from PkTR. It was recorded from evergreen forests, moist deciduous forest, teak plantation and also near human habitations inside the PkTR (Image 1 & Fig. 2). The Common Palm Civet is known to occur in various forest types varying from thick woody areas to urban habitat (Kumara & Singh 2007).

Small Indian Civet *Viverricula indica*: The Small Indian Civet constitutes about 31.67% of the images captured. Apart from this, 14 individuals were sighted during the night transects. On most of the occasions, the species was seen foraging on the ground. All the sightings were of solitary animals. The species were mostly reported from the moist deciduous forest type. The Small Indian Civet is reported to be the most common small carnivore in the drier forests of the southern Western Ghats and it is rare in the tropical wet evergreen forests (Mudappa 2002). The Small Indian Civet was recorded between the altitude ranges from 450–1200m from PkTR (Image 2 & Fig. 2).

Brown Palm Civet *Paradoxurus jerdoni*: During the present study, 17 camera trapped images (28.3%)

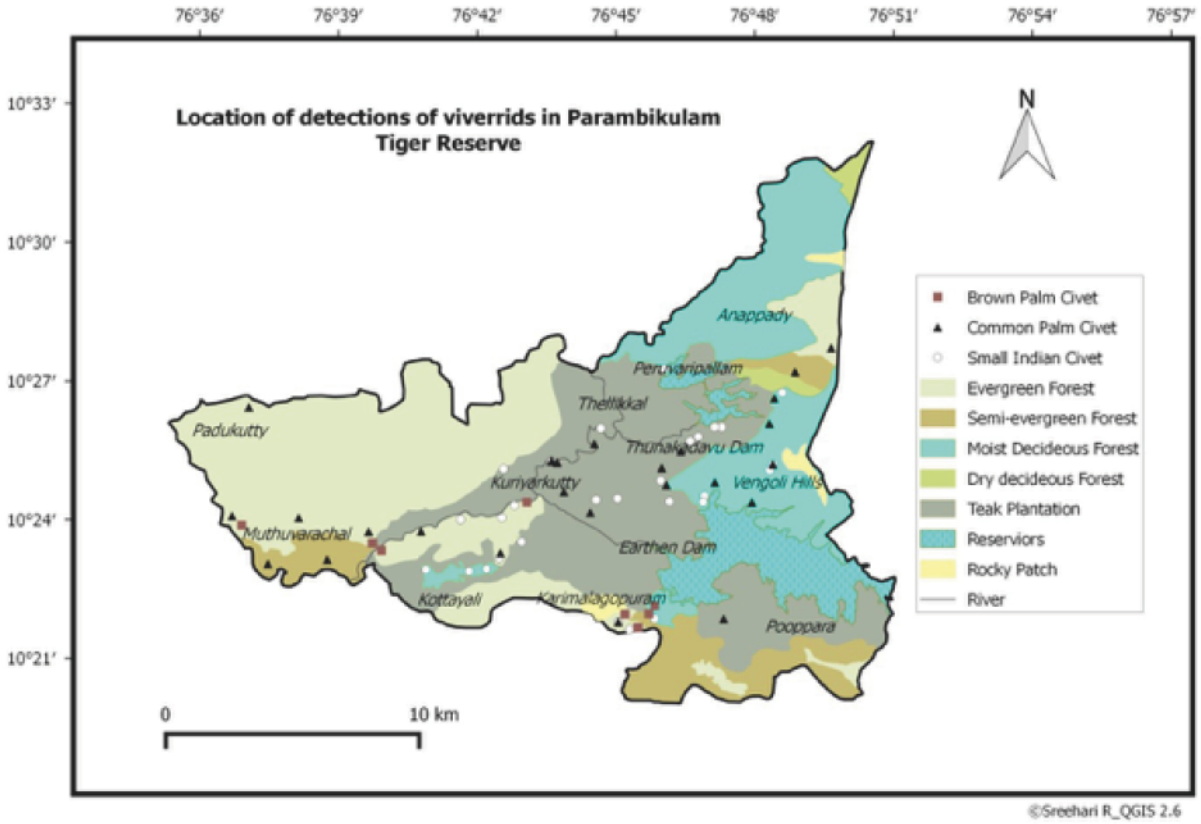

Figure 2. Distribution map of viverrids in Parambikulam Tiger Reserve

were obtained and two individuals were sighted in the night transect. The species was recorded between the altitude ranges from 450–850 m from the evergreen forest of Karimalagopuram and Orukomban section in the Tiger Reserve (Fig. 2). However, Mudappa (1998) stated that the species is common at higher altitudes and reported it from an altitude range of 500–1,300 m.

The Brown Palm Civet, which is an endemic viverrid of the Westren Ghats, has been reported from Chandoli NP, Maharastra, Bhagwan Mahaveer WS in Goa, Coorg, Anshi NP, Sharavathy WS, Mookambika WS, Haliyal RF, and Uttara Kannada District of Karnataka, Kalakkad-Mundanthurai TR, Kakachi-Upper Kodayar, High Wavy mountains, Palani Hills, Nilgiris, Kodaikanal RF and Anamalais in Tamil Nadu, Malakapara RF, Achenkoil RF, Chalakudy RF, Periyar TR and Silent Valley NP in Kerala (Kinnear 1913; Ryley 1913; Pocock 1933, 1939; Web-Peploe 1947; Hutton 1949; Schreiber et al. 1989; Ramachandran 1990; Ganesh 1997; Gupta 1997; Mudappa 2002; Rajamani et al. 2002, Bhosale et al. 2013).

Although the Brown Palm Civet has been recorded from the Anamalai region of Tamil Nadu (Rajamani et al. 2002), it has not been reported from the PkTR until now.

Image 3. Camera trapped image of Brown Palm Civet *Paradoxurus jerdoni* without white tail tip from Parambikulam Tiger Reserve

Hence the present sighting is the first confirmed sight record of the Brown Palm Civet from PkTR.

The Brown Palm Civet has a uniform brown pelage, darker around the head, neck, shoulders, legs and tail (Mudappa 2013). The dark tail is occasionally white tipped in some individuals. During the present study we recorded the Brown Palm Civet with and without white tail tips at PkTR (Images 3 & 4). Mudappa (2001) has noted that higher food plant species densities

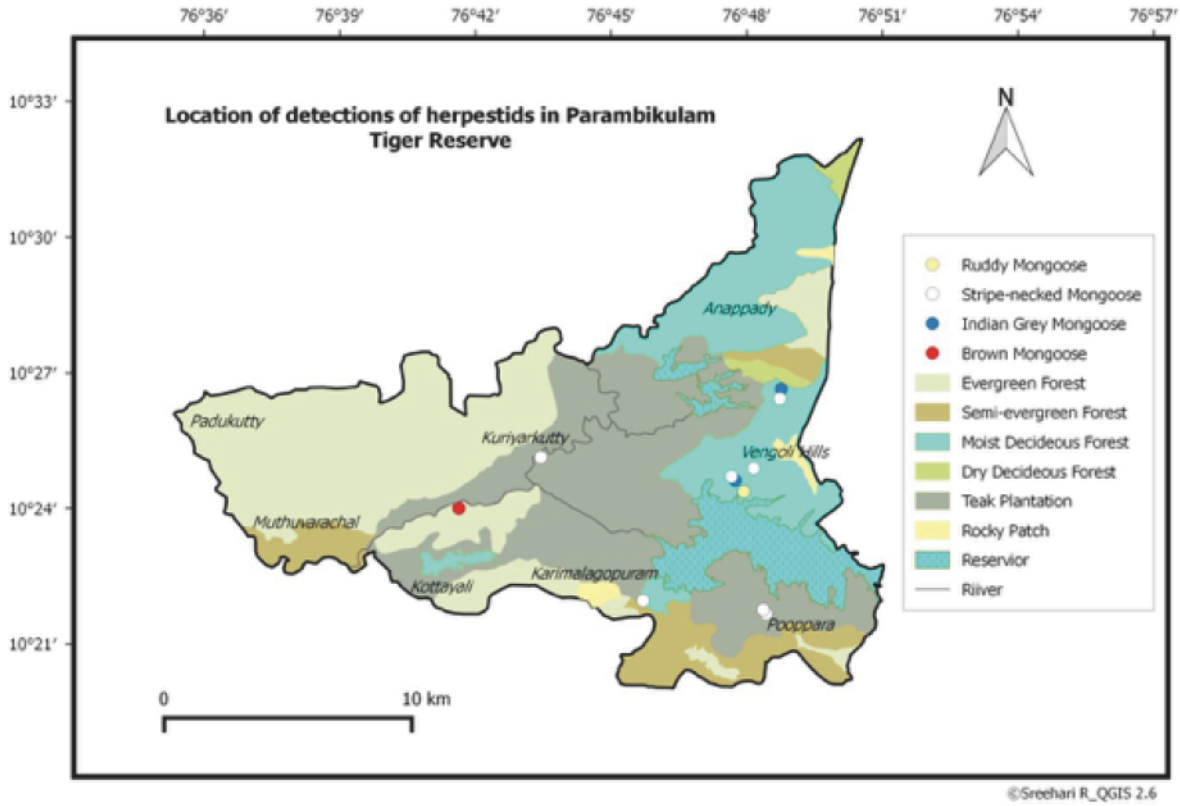

Figure 3. Distribution map of herpestids in Parambikulam Tiger Reserve

Image 4. Camera trapped image of Brown Palm Civet *Paradoxurus jerdoni* with white tail tip from Parambikulam Tiger Reserve

in the relatively undisturbed rainforests, particularly species such as *Palaquium ellipticum*, *Holigarna nigra*, *Elaeocarpus* sp., *Ficus* sp. and *Acronychia pedunculata* support a good population of the Brown Palm Civet. Most of these plant species occur in good population in PkTR too (Menon 1991).

Indian Grey Mongoose *Herpestes edwardsii*: Though we did not get any photographic evidence of this species in the camera traps, a pair was sighted near the tunnel entry of Parambikulam reservoir in the moist deciduous forests at 10:05hr on 14 August 2011. During the second occasion a solitary Indian Grey Mongoose was sighted near Anapadi checkpost at 18:45hr on 19 September 2011 (Fig. 3). The Indian Grey Mongoose is widely distributed in South Asia and it ranges throughout India, southwards from the Himalayan foothills to Kanyakumari (Mudappa 2013). It is mostly a commensal species and the two sightings of the Indian Grey Mongoose were from near human habitations within PkTR.

Stripe-necked Mongoose *Herpestes vitticollis*: On 15 August 2011, three Stripe-necked Mongooses were sighted on the way to Vengoli hills and on another occasion two individuals were sighted on the way to Poopara on 24 January 2012. The other sightings were all of solitary individuals from moist deciduous forest of Thelikkal on 18 August 2011, Vengoli on 28 August 2011, and twice from the moist deciduous forest of Seechali on 20 and 29 September 2011 respectively. Apart from the above sightings in the day transects, two camera trapped images were also obtained from the evergreen forest of Karimalagopuram and moist deciduous forest of Vengoli at altitudes of 833m and 574m respectively (Image 5 & Fig. 3).

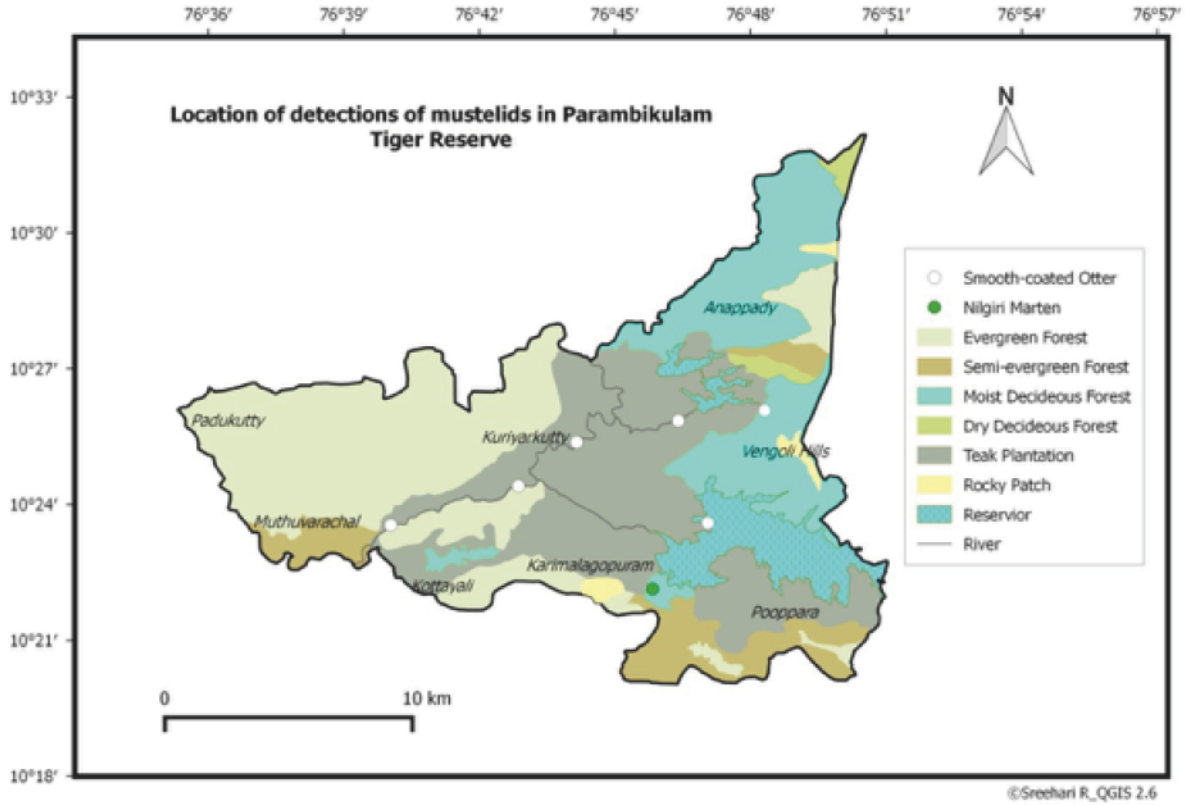

Figure 4. Distribution map of mustelids in Parambikulam Tiger Reserve

Image 5. Camera trapped image of Stripe-necked Mongoose *Herpestes vitticollis* from Parambikulam Tiger Reserve

The Stripe-necked Mongoose is mainly distributed in the Western Ghats and Sri Lanka (Jerdon 1874; Blanford 1891; Pocock 1939; Prater 1971; Phillips 1984; Corbet & Hill 1992; Mudappa 1998; Van Rompaey & Jayakumar 2003; Punjabi et al. 2014). However the species was recently recorded from Odisha (Nayak et al. 2014) in India. In Kerala the Stripe-necked Mongoose has been reported from Periyar TR (Ramachandran 1985), Eravikulam NP (Madhusudan 1995), Anaikatty RF (van Rompaey & Jayakumar 2003) and Parambikulam WS (Pillay 2009).

Brown Mongoose *Herpestes fuscus*: There was a single sighting of the Brown Mongoose from the PkTR in the evergreen forests at Orukomban at an elevation of 492m on 21 September 2011 at 07:50 hr (Fig. 3). In southern India the Brown Mongoose is found from an elevation of 492 right up to 2,032m from Virajpet in southern Coorg and Ooty in the Nilgiri Hills, Tiger Shola in the Palni Hills, High Wavy Mountains in Madurai, KMTR in Agasthyamalai Hills, Valparai plateau in the Anamalai Hills, Eravikulam NP, and Peermade in Kerala and is also seen in Sri Lanka (Pocock 1939; Prater 1971; Phillips 1984; Corbet & Hill 1992; Mudappa 1998, 2001; Sreehari et al. 2013).

Ruddy Mongoose *Herpestes smithii*: The Ruddy Mongoose is distributed in peninsular India, from the state of Rajasthan in the west to Bihar in the east, and in Sri Lanka (Phillips 1984; Dookia 2013; Mudappa 2013). During the present study a pair of Ruddy Mongoose were camera trapped in the moist deciduous forest of Vengoli Hills at an elevation of 574m and one was sighted near the tunnel entry of the Parambikulam reservoir at 541m attitude (Fig. 3). In Kerala the Ruddy Mongoose

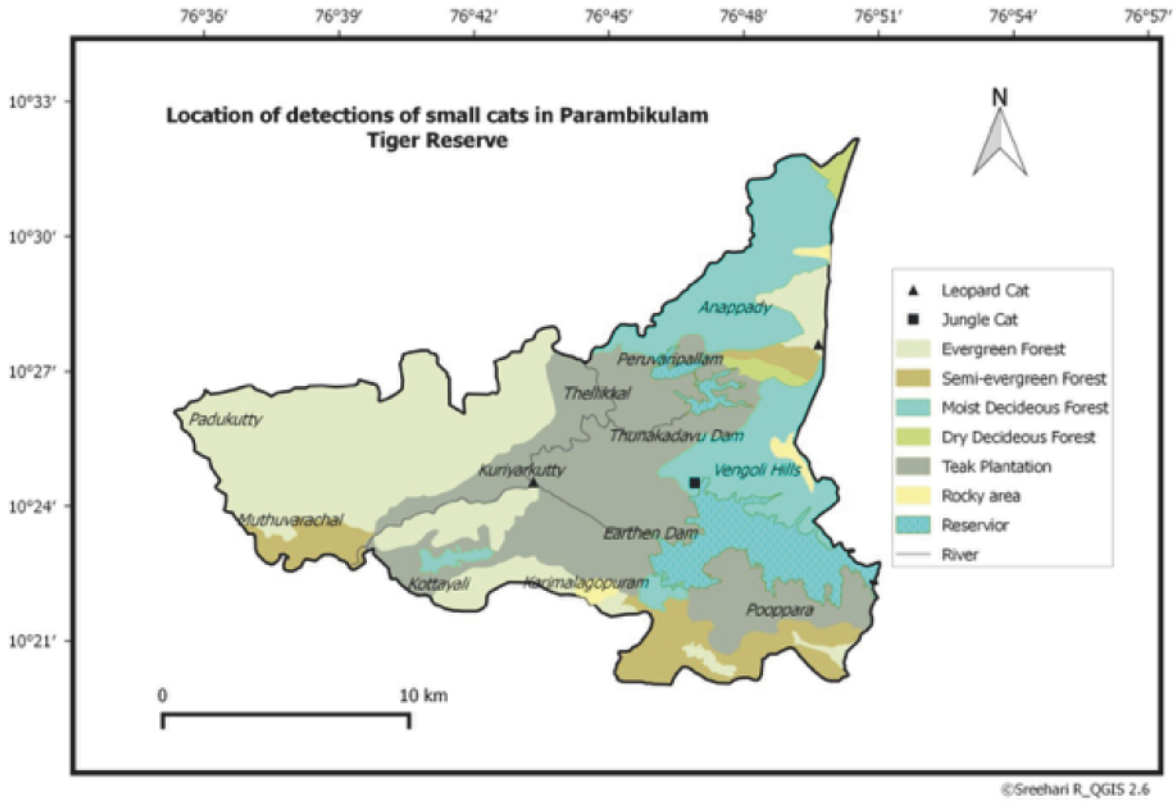

Figure 5. Distribution map of small cats in Parambikulam Tiger Reserve

is known only from Chinnar WS and Parambikulam TR (Pillay 2009; Sreehari et al. 2013).

Nilgiri Marten *Martes gwatkinsii*: The Nilgiri Marten, a mustelid endemic to the Western Ghats is known from 21 different locations in the Western Ghats. A single Nilgiri Marten was camera trapped from the semi-evergreen forest of Karimalagopuram at an elevation of 708m on 27 July 2011 (Fig. 4), which was the first record of this species from PkTR (Sreehari & Nameer 2013).

Smooth-coated Otter *Lutrogale perspicillata*: There were five direct sightings of the Smooth-coated Otter from PkTR. These sightings were from the Parambikulam reservoir on 05 July 2011, Thunakadavu reservoir on 07 July 2011, Kuriyarkutti River on 24 September 2011 and Medamchalu on 25 December 2011 and a stream near Kannimara teak on 05 October 2011. Apart from these direct sightings, a group of seven Smooth-coated Otters was also camera trapped from Seechali on 09 September 2011 at an elevation of 563m (Fig. 4). In addition, otter prints and tracks were found on the banks of the Parambikulam reservoir and from the Kuriarkuttiu, Kothala, Kottayali river banks. The only published record of the Smooth-coated Otters from Kerala was from Periyar TR (Anoop & Hussain 2004, 2005).

Image 6. Camera trapped image of Leopard Cat *Prionailurus bengalensis* from Parambikulam Tiger Reserve

Jungle Cat *Felis chaus*: A solitary Jungle Cat was sighted during the spot-light survey in the moist deciduous forests of Parambikulam at 20:45hr on 18 November 2011 (Fig. 5). Indirect evidence like the pug marks and scats were also recorded from moist deciduous, evergreen and from the plantations of PkTR during the present study. The Jungle Cat is reported to

be the most common and wide-spread wild cat in India (Mukherjee 2013).

Leopard Cat *Prionailurus bengalensis*: One Leopard Cat was captured in the camera trap on 20 September 2011 from the moist deciduous forest near Anapadi (Image 6 & Fig. 5). The Leopard Cat was also sighted near the tramway bridge at Kuriyarkutti tribal settlement at 20:20hr on 18 November 2011. In India, the species is distributed along the Himalaya, northeastern India, Terai belt, West Bengal, Odisha and Western Ghats in two populations, the Himalayan-Eastern Indian population and the Western Ghats population (Mukherjee et al. 2010).

Night transetcs

The night transect was an effective method of sampling small carnivores in PkTR. During the night transect survey the small carnivores at PkTR recorded an encounter rate of 1.06 animals/hr of drive and 0.09 animals/km. The encounter rate of Small Indian Civet was found to be higher than the rest of the viverrids in the PkTR. The Small Indian Civet had an encounter rate of 0.48 animals/hr of drive and 0.04 animals/km, while the encounter rate for Common Palm Civet was 0.45 animals/hr of drive and 0.04 animals/km and the Brown Palm Civets had an encounter rate of 0.07 animals/hr of drive and 0.01 animals/km. Mudappa et al. (2007) recorded small carnivore encounter rate of 1.7 animals/hr of drive and 0.09 animals/km, and of the Brown Palm Civet was 0.30 animals /hr during the night transects survey in Kalakad-Mundanthurai TR, and 0.26 animals/hr of drive and 0.01 animals/km in Anamalais.

Conclusion

Viverrids were the most commonly observed small carnivores at Parambikulam TR. The Common Palm Civet and Small Indian Civets were recorded from all the major vegetation types of PkTR while the Brown Palm Civet was recorded only from the evergreen forest. The present study recorded all the four species of mongoose seen in the Western Ghats from PkTR. The Stripe-necked Mongoose was the most common species of mongoose. Among the lesser cats, Leopard Cat and Jungle Cat were recorded. Among the mustelids, Smooth-coated Otter and Nilgiri Marten were reported. The study also recorded two threatened small carnivores including the Nilgiri Marten and Smooth-coated Otter from PkTR, both belonging to the Vulnerable category of IUCN Red List of Threatened Species. The study highlights the significance of Parambikulam TR as an important repository for the small carnivores.

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