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Nilgiri Martens *Martes gwatkinsii* (Photo: Ramakrishnan Prakash)

Records of small carnivores from in and around Namdapha Tiger Reserve, Arunachal Pradesh, India

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Abstract

For most of Northeast India's diverse assemblage of small carnivores, direct observations and ecological information are limited. Opportunistic direct observations and camera-trap records from 2008 to 2013 in eastern Arunachal Pradesh recorded 11 small carnivore species of the 20 likely to occur. Observations included the first confirmed Small-toothed Palm Civet *Arctogalidia trivirgata* sighting from India; dietary observations on five species; and hunting of two species.

Keywords: *Arctictis binturong*, *Arctogalidia trivirgata*, Binturong, Eastern Himalaya Biodiversity Hotspot, Northeast India, Small-toothed Palm Civet

Introduction

Northeast India is a distinct area for biodiversity in India: it includes two global biodiversity hotspots (Myers *et al.* 2000) and is at the junction of two biogeographic realms, the Indo-Malayan and Palaearctic. Northeast India encompasses a diversity of habitats from the Brahmaputra floodplains in Assam to alpine meadows in the upper reaches of the Eastern Himalaya. As a consequence of its biogeographic history and this ecological complexity, it harbours a stunning diversity of floral and faunal elements (Champion & Seth 1968, Mani 1974).

Namdapha Tiger Reserve is situated in the eastern portion of the state of Arunachal Pradesh, northeast India. It is at the junction of the Eastern Himalaya and Indo-Burma Biodiversity Hotspots (Myers *et al.* 2000). Sixty percent (20 out of 33) of small carnivore species known to occur in India (Mudappa 2013) are expected to occur in this reserve, comprising 16 forest-dwellers, three otters and Stone Marten *Martes foina*.

Thirteen species were confirmed in Namdapha by Athreya & Johnsingh (1995), Datta (1999) and Datta *et al*. (2008a). Additional surveys that have occurred are not formally published yet (e.g. Sarma 2012). As many small carnivores are nocturnal, direct observations and ecological information in northeast India are limited. This paper reports direct observations of 11 species (six civets, one linsang, two mongooses and two mustelids) between 2008 and 2013, including the first record of Small-toothed Palm Civet *Arctogalidia trivirgata* for the area.

Study area

Namdapha Tiger Reserve (Namdapha TR), eastern Arunachal Pradesh, India, is part of the Eastern Himalaya Biodiversity Hotspot (Myers *et al.* 2000). It covers 1,985 km^2 over 200–4,500 m asl. Its forests are thought to include the northernmost tropical rainforest in the world (Proctor *et al.* 1998). The reserve is known to contain over 639 plant genera (Chauhan *et al.* 1996), 137 species of mammals and almost 500 species of birds (Srinivasan *et al.* 2010). It is famous for holding three, perhaps four, species of big cats (Tiger *Panthera tigris*, Leopard *P. pardus*, Clouded Leopard *Neofelis nebulosa* and possibly Snow Leopard *P. uncia*) and several other large carnivores (Datta *et al*. 2008a). To the east and southeast of Namdapha TR are large tracts of contiguous forest of Hkakaborazi National Park and Hukaung Valley Tiger Reserve in Myanmar while to the north is the Kamlang Wildlife Sanctuary in India. To the west and southwest are Reserved Forests that are administered by Namsai Forest Division and Jairampur Forest Division of the Arunachal Pradesh Forest Department. Reserved Forests are state-owned forestlands where activities like logging are permitted under Working Plan prescriptions made by the Forest Department. Several Reserved Forests were visited frequently: sites in Tengapani (444 km^2) and Turung (164 km^2) Reserved Forests of Namsai Forest Division to the northwest of Namdapha TR, and Rima (68 km^2) and Miao (124 km^2) Reserved Forests of Jairampur Forest Division to the west and southwest of Namdapha TR. Apart from Namdapha TR, all surveyed sites face pressure from logging. Despite the ban on hunting as per the Indian Wildlife (Protection) Act, 1972, hunting is pervasive across all these sites, albeit at different intensities.

The intensive sampling area in Namdapha TR was the Hornbill Plateau (500–700 m asl), which spreads over 15 km^2, harbouring some of the last remaining dipterocarp forests in Arunachal Pradesh. The dominant emergents in the area include *Shorea assamica*, *Terminalia myriocarpa*, *Altingia excelsa*, *Schima wallichi* and *Phoebe*. The Hornbill Plateau has never been logged, except for isolated illegal incidents at its periphery. Hornbill Plateau is, however, visited by Chakmas from nearby settlements to extract resin of *Canarium strictum* and to hunt and fish. Chakmas are a community from Bangladesh who were resettled in eastern Arunachal Pradesh in the 1960s by the Indian government. The hunters' main targets are large mammals like Sambar *Rusa unicolor*, Barking Deer (Red Muntjac) *Muntiacus muntjak*, Himalayan Serow *Capricornis thar*, Red Serow *C. rubidus*, Wild Pig *Sus scrofa*, Gaur *Bos gaurus* and primates. Smaller mammals, including small carnivores, are taken opportunistically.

The Reserved Forests experience significant logging. Turung (150–250 m asl) and Tengapani (150–250 m asl) Reserved Forests represent some of the last remaining lowland evergreen forests in Arunachal Pradesh. Unregulated logging has degraded these forests progressively and parts of Turung RF have been converted to settlements and plantations. Tengapani RF is relatively isolated and although extensively logged, only small areas have become settlements and plantations. All sampling sites lie south of the Lohit River, which is the main tributary of the River Brahmaputra. The main branch of River Brahmaputra (locally also known as the Siang) is further northwest of the sampling sites.

Methods

Direct sightings and camera-trapping detections are reported here. The sightings were opportunistic during walks mostly by day but occasionally by night, during a January 2008–March 2013 research project on hornbills (Bucerotidae). Time spent in Namdapha TR and adjoining areas totalled about 572 days: January – March 2008 (~ 20 days); November 2008 – April 2009 (~ 180 days); November 2009 – April 2010 (~ 150 days); November 2010 – March 2011 (~ 120 days); November 2011 – February 2012 (~100 days) and March 2013 (2 days). In Namdapha TR, most sightings were made near Hornbill Camp (27°32.325′N, 96°26.495′E). Variable amounts of time (November 2008 – April 2009; January 2010) were spent in Tengapani (27°43.366′N, 96°02.936′E) and Turung (27°46.264′N, 96°16.813′E) Reserved Forests and (November 2008 – April 2009, November 2009 – April 2010) in Miao (27°28.854′N, 96°13.432′E) and Rima (27°21.335′N, 96°11.661′E) Reserved Forests. Geographical coordinates and elevations were derived from a Garmin Etrex Legend (datum: WGS84).

In March 2009, in the Madhuban area of Tengapani RF, two passive infra-red Deercam-300 camera-traps were deployed from 17h00 to 05h00 along game roads and animal trails showing footprints of Leopards and other animals. Effort totalled 25 camera-trap-nights. On the Hornbill Plateau, two passive Reconyx Rapidfire RM45 camera-traps (43 trap nights, January 2012 – February 2012) were deployed throughout the day and the night. Hence, one camera-trap-night corresponded to one camera-trap deployed 12 hours in Tengapani RF but for 24 hours on the plateau.

Species accounts

Appendix 1 details the records of the 11 small carnivore species detected.

Yellow-throated Marten *Martes flavigula*

Yellow-throated Martens were encountered on at least 17 occasions. Thirteen sightings were of animals foraging, of which nine were in *Ficus* cf. *tsajhela* to forage on figs and/or lurking to nab frugivorous birds coming to the figs. Three Martens were seen chasing an adult female Red Muntjac on Hornbill Plateau. During the chase, they called incessantly, seemingly for contact between them. On first hearing their single-note whistles, an assistant plucked a fresh leaf and made a high-pitched sound: within a minute, the deer almost ran into us, followed by the Martens, which came from three different directions separated from each other by 5 m. The deer on detecting us changed direction and was followed by the Martens. Whether they caught the deer was not determined. Yellow-throated Martens have been recorded to chase Himalayan Tahr *Hemitragus jemlahicus*, Alpine Musk-deer *Moschus chrysogaster* and Himalayan Goral *Naemorhedus goral* (Sathyakumar 1999). On two other occasions, three individuals were seen in understorey trees; on detecting us, they climbed down and ran away on the forest floor. On both these occasions they called rather frequently. Another individual was seen attacking a wasp nest in a tree cavity about 1–2 m above the ground. Every time the animal was stung, it fell to the ground only to climb again and continue foraging on the wasp larvae. Another individual was seen digging into a dead tree on a sandy bank along Deban nullah on the reserve's western border. On seeing us, it scampered towards the forest. Closer inspection revealed a bee nest in the cavity under the dead log. In Turung RF, a single Yellow-throated Marten was seen inspecting an old fruit of *Gynocardia odorata* (Flacourtiaceae) on the trunk of the tree, probably for insects. Yellow-throated Martens were seen singly, in duos and in groups of three, always by day. When feeding on figs, they generally moved with great ease and speed on the different branches, often to the alarm of hornbills and small frugivores also feeding on the figs. Two Martens feeding in the same fig tree as a Binturong showed no interspecific interaction. Despite the many observations in *Ficus* cf. *tsajhela* and watches of other figs, we did not see Martens feeding on any other fig species, although on one occasion RN (during a fruit-tree watch) saw a single individual running (on the forest floor) below a fruiting *F. drupacea*. Local Lisu tribesmen believe that seeing a Yellow-throated Marten is a bad omen, so they are occasionally hunted. Smoked remains were seen in a house in Gandhigram, a village beyond Namdapha TR's western border.

Asian Small-clawed Otter *Aonyx cinereus*

A Small-clawed Otter was observed by RN, AD and others in a small forest stream next to Hornbill Camp (Fig. 1). The animal allowed approach within 1 m. It was calling incessantly (a sharp single-note whistle). It kept going upstream and then ran or swam downstream, during observation for more than 20 minutes. It dived in a small deep pool in the stream and then it called from the edge of the stream or from big rocks in the stream. Subsequently, it was seen five times by day until January 2011, in the same stream, and was filmed and photographed. Its bold and vocal behaviour was odd considering that these animals are heavily hunted in this region (Datta *et al.* 2008a). We do not know the reasons for its apparent disappearance after January 2011.

Spotted Linsang *Prionodon pardicolor*

RN and assistants saw a single Spotted Linsang barely 1.5 m

Fig. 1. Asian Small-clawed Otter *Aonyx cinereus* in a stream near Hornbill Camp, Namdapha Tiger Reserve, Arunachal Pradesh, India, 27 November 2010 (Photo: Aparajita Datta).

away, crouched in sparse undergrowth. On our approach, it crawled backwards and escaped into denser undergrowth few meters away. Mohammed Firoz Ahmed and his team camera-trapped this species in Namdapha TR in 2012 (Sarma 2012).

Large Indian Civet *Viverra zibetha*
Large Indian Civet was camera-trapped in two localities (Fig. 2). One was seen crossing the Namsai–Wakro road about 4 km from Namsai town. It was seen regularly in Namdapha TR in all winters during 2008–2012, feeding on leftovers (mostly rice) around the Hornbill camp (Fig. 3). Over a period, the animals did not get disturbed by torchlights and camera flashes, continuing to forage despite these intrusions. All sightings were on the forest floor in the night, corroborating earlier studies (Duckworth 1997 and references therein).

Small Indian Civet *Viverricula indica*
Small Indian Civet was seen and photographed on two occasions each (Fig. 4). All records were by night. This species is often said to be more common in the secondary and open forests than in closed evergreen forest (Duckworth 1997, Datta *et al.* 2008a, Than Zaw *et al.* 2008 and references therein). Notably, therefore, the camera-trap record from the Hornbill Plateau was in a large contiguous patch of primary evergreen forest at least 10 km from the nearest human settlement.

Fig. 2. Camera-trapped Large-Indian Civet *Viverra zibetha*, Tengapani Reserved Forest, Arunachal Pradesh, India, 22 March 2009 (Photo: Eastern Himalaya Program, Nature Conservation Foundation).

Fig. 3. Camp-scavenging Large Indian Civet *Viverra zibetha*, taken at 8–10 m range near Hornbill Camp, Namdapha Tiger Reserve, Arunachal Pradesh, India, 12 March 2010 (Photo: Rohit Naniwadekar).

Fig. 4. Camera-trapped Small Indian Civet *Viverricula indica*, Tengapani Reserved Forest, Arunachal Pradesh, India, 22 March 2009 (Photo: Eastern Himalaya Program, Nature Conservation Foundation).

Common Palm Civet *Paradoxurus hermaphroditus*
RN and assistants sighted a single Common Palm Civet scampering down a mid-storey tree in forest far from habitation, probably disturbed by our presence. This species is relatively common in the area, occurring both in primary and secondary forests close to habitation (Datta *et al.* 2008a).

Masked Palm Civet *Paguma larvata*
Masked Palm Civet was seen on seven occasions in three localities, and was camera-trapped under a fruiting *Prunus ceylanica* tree on four occasions within 24 hr. This species was seen feeding on fruits of an unidentified liana and of *P. ceylanica*. All sightings were of singles in the night up trees except on one occasion when two individuals were seen feeding on *P. ceylanica* fruits, indicating that the animals are nocturnal, arboreal and generally solitary and not shy, as reported earlier (e.g. Pocock 1939, Duckworth 1997). The regularity of sightings suggests that these civets may be quite common, easy to see, and potentially to study, in Namdapha TR.

Small-toothed Palm Civet *Arctogalidia trivirgata*
A single Small-toothed Palm Civet was sighted by AD, RN, Japang Pansa and Ngwayotse Yobin, using torch lights and binoculars (8×40) during a night walk to look for nocturnal mammals, near Hornbill Camp. Poor light conditions prevented our taking good pictures of the animal. It was spotted on a branch about 8 m above ground and 6 m from the trail, allowing a very clear view, and was watched for more than half an hour. The tail was bushy, thick, very long (longer than the head and body length) and unmarked. The ears were more towards the sides of the head than on Common Palm Civet and rounded, with their inner side white. The venter was lighter than the dorsum, which was uniformly dark brown or buff on the parts visible (the upper dorsum, where the species is striped, was not visible). We were unable to see if this animal had facial markings, given the blaze of the reflecting eyes. It was smaller than a Masked Palm Civet, but its tail was possibly longer. On our approach to take

pictures, it swiftly climbed onto the upper branches and was seen briefly amongst the moving branches until it was lost in the neighbouring canopy.

The observation site lies south of the Brahmaputra, and the entire Indian distribution of Small-toothed Palm Civet is reportedly south of this river, in the eastern parts of Arunachal Pradesh, upper Assam, Nagaland and Manipur (Choudhury 2003). We traced no confirmed sight records from India. It is common in at least some areas of its range (e.g. Duckworth 1997). It has not been camera-trapped in Namdapha TR, nor was it recorded in extensive recent camera-trap surveys in Myanmar, including heavy effort in areas adjacent to Namdapha TR (Than Zaw *et al*. 2008). These camera-traps were at forest-floor level, perhaps explaining non-detection of this highly arboreal species. Similarly, in northeast India relatively little effort is invested in spotlighting, which might be a better technique in detecting this species (Willcox *et al*. 2012). Local hunters/people did not appear to know of this species, suggesting that it might be rare in these forests. The two tribal people who watched the species with us had never seen one before, even though they knew all other civet species of the area. One of them (Japang Pansa) is a very knowledgeable naturalist who has observed/watched small carnivores, while most other assistants from the Lisu tribe were hunters and know all the other civets well. In addition, the Lisu have specific names for individual civet species, but seem not to have one for this species. One possible reason for this is that their main target species during hunting are mostly larger ungulate species, large cats and bears, whereas civets are hunted only when they are encountered in the forest occasionally or are trapped in snares set out in the fields.

Binturong *Arctictis binturong*

Binturong was sighted ten times on the Hornbill Plateau (Fig. 5) and once in Tengapani RF. On all occasions except one (when it was seen on the ground by AV and US) it was on fruiting fig *Ficus* trees, as has been reported previously (e.g. Nettelbeck 1997). In Namdapha TR, they were seen foraging on *Ficus* cf. *tsajhela* (the commonest strangler fig in the area) on five occasions and once each on *F. nervosa*, *F. drupacea* and an unidentified fig. AV and US saw two on the ground at 22h30 on a streambed near Hornbill Camp. The first came out of the forest and stopped at a small pool of water and drank and washed itself, quite unperturbed by the observers only a few meters away. It then walked along the stream and disappeared into the forest. The second individual followed a minute or so after the first left, and behaved similarly. Once, four Hoolocks (gibbons) *Hoolock hoolock* were seen foraging for approximately 80 minutes in the same *F. nervosa* tree as a Binturong, which was already present on the tree. Both the species were in the upper canopy but in different portions of the tree. No interaction between gibbons and Binturong was seen, in contrast to the brachiating around the Binturong, displaying and attacking observed by Nettelbeck (1998) with White-handed Gibbons *Hylobates lar*. A duo of Yellow-throated Martens foraging in the same tree as a Binturong also showed no interaction. When feeding on figs, Yellow-throated Martens ran along the branches feeding intermittently, while Binturongs remained stationary on one branch and moved only after completing feeding on that branch. Unlike other carnivores in the area, Binturongs appeared indifferent to our presence in most sightings, in keeping with local beliefs and earlier knowledge (Duckworth 1997). One assistant, a former hunter, mentioned that despite repeatedly shooting at Binturongs and missing them, the animals remained in place until they were shot. This assistant also said that Binturongs have much fat in winter, apparently making their meat tastier then.

Crab-eating Mongoose *Herpestes urva*

Of five Crab-eating Mongoose records, two were in Namdapha TR, one in Turung RF and two of freshly killed animals, in Tengapani RF. Two in Namdapha TR seen by day emerged from undergrowth and, on seeing the observers, paused less than 10 m away and tried to hide in separate bushes where their tails conspicuously stuck out. Of two found killed in Tengapani RF, one was chased and hacked to death with a stick by a local labourer (Fig. 6), while the second was killed by logging truck drivers using a catapult. Both were killed to be eaten. The gut of the first individual held unidentified aquatic insects, rice and a fish. Of the three sightings (four individuals) in the wild, one

Fig. 5. Binturong *Arctictis binturong* on *Ficus nervosa*, Hornbill Plateau, Namdapha Tiger Reserve, Arunachal Pradesh, India, 21 March 2010 (Photo: Rohit Naniwadekar).

Fig. 6. Crab-eating Mongoose *Herpestes urva* killed with a stick in Madhuban area of the Tengapani Reserved Forest, Arundachal Pradesh, India, 24 March 2009 (Photo: Rohit Naniwadekar).

was near a seasonal water course (logging trail), one was near a perennial stream, while the group of two were on the forest floor (at least 500 m away from any stream).

Small Asian Mongoose *Herpestes javanicus*
Small Asian Mongoose was seen crossing roads on several occasions in Miao and Diyun RF and surrounding unclassified forest near human settlements in 2009 and 2010. This species appears to be commensal with people and occurs in degraded forests close to human habitation. It has never been camera-trapped or otherwise detected in primary forests away from human settlements in the survey area.

Discussion

The finding of the hitherto unreported Small-toothed Palm Civet in Namdapha TR underscores the need for using a diverse array of techniques for documenting presence of small carnivores in an area. Six of the 11 species reported here were also detected outside Protected Areas, highlighting the potential value of unprotected areas in conserving small carnivore diversity.

Small carnivores face potential threats from hunting as indicated in cases of Yellow-throated Marten and Crab-eating Mongoose. Wildlife in northeast India faces severe hunting pressures, and Namdapha TR, in particular, has low densities of large carnivores and herbivores (Datta *et al.* 2008b). Small carnivores, however, continue to survive here and elsewhere in northeast India. Otters seem to be the only small carnivores here that are specifically targeted by hunters, but all continue to be hunted opportunistically. All possibly face other threats like logging and other forms of habitat degradation. Predictable foraging behaviour of civets results in their being hunted at fruiting trees in the nights according to one of our assistants, i.e. on figs and *Gynocardia odorata* (Flacourtiaceae) (see Datta & Rawat 2008). There is little information on abundance of these carnivores or on their basic ecology and functional roles in the region's ecosystems. A thorough quantitative understanding of small carnivore distributions and densities is important to identify areas for targeted conservation. Studies on their ecology and behaviour are essential to understand how such a large number of sympatric species co-exist. Until then, incidental records of occurrence and behaviour can help in understanding these elusive animals, albeit to a limited degree.

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Appendix 1. Details of records of small carnivores in and around Namdapha Tiger Reserve, India, 2008–2013.

Site	Location	Habitat (altitude)	Date	Record details	Remarks
Yellow-throated Marten *Martes flavigula*					
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	9 Mar 08	Direct sighting	Three, chasing Red Muntjac at 11h30
Namdapha TR	Hornbill (27°32.365′N, 96°26.890′E)	Primary sub-tropical evergreen forest (680 m)	9 Nov 09	Direct sighting	One, feeding in *Ficus* cf. *tsajhela* (05h47–05h51)
Namdapha TR	Hornbill (27°32.365′N, 96°26.890′E)	Primary sub-tropical evergreen forest (680 m)	15 Nov 09	Direct sighting	One,feeding in *Ficus* cf. *tsajhela* (06h05–07h00)
Namdapha TR	Hornbill (27°32.365′N, 96°26.890′E)	Primary sub-tropical evergreen forest (680 m)	19 Nov 09	Direct sighting	Two, feeding in *Ficus* cf. *tsajhela* (07h58–08h00)
Namdapha TR	Hornbill (27°32.365′N, 96°26.890′E)	Primary sub-tropical evergreen forest (680 m)	20 Nov 09	Direct sighting	Two, feeding in *Ficus* cf. *tsajhela* (06h10–06h26)
Namdapha TR	Hornbill (27°32.365′N, 96°26.890′E)	Primary sub-tropical evergreen forest (680 m)	20 Nov 09	Direct sighting	Two, feeding in *Ficus* cf. *tsajhela* (07h02–07h15)
Namdapha TR	Hornbill (27°32.318′N, 96°26.935′E)	Primary sub-tropical evergreen forest (700 m)	5 Dec 09	Direct sighting	One,feeding in *Ficus* cf. *tsajhela* (07h45–07h55)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	28 Feb 11	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (06h15)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	7 Mar 11	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (6h25)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	7 Mar 11	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (12h33)
Namdapha TR	Hornbill (27°32.552′N, 96°27.622′E)	Primary sub-tropical evergreen forest (840 m)	Jan 11	Direct sighting	Under a *Ficus drupacea* tree (in morning)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	Dec 2011 – Feb 2012	Direct sighting	Three, coming down a tree (seen twice)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	Nov 09	Direct sighting	Attacking tree-cavity wasp nest; eating larvae (morning)
Namdapha TR	Deban Nullah (27°30.472′N, 96°23.358′E)	Stream (340 m)	1 Dec 09	Direct sighting	Attacking and feeding on honey-bee hive (in afternoon)
Namdapha TR	Hornbill camp (27°32.29′N, 96°26.51′E)	Primary sub-tropical evergreen forest (640 m)	2008–2012	Direct sighting	Seen at least twice near the camp in daytime
Turung RF	Turung RF (precise location not recorded)	Degraded logged lowland forest (~ 270 m)	1 Mar 08	Direct sighting	Searching inside remains of old *Gynocardia* fruit (08h15)
Turung RF	Turung RF (precise location not recorded)	Degraded logged lowland forest (~ 270 m)	Jan 09	Direct sighting	One, crossing the Namsai–Wakro main road.
Vijaynagar USF	Yakhulo (27°15.286′N, 96°57.067′E)	lower montane forest (1380 m)	7 Apr 09	Direct sighting	07h30
Vijaynagar USF	Gandhigram (27°16.944′N, 96°54.064′E)	Village (~ 1,000 m)	24 Dec 09	Dead Animal	Smoked remains of the animal
Asian Small-clawed Otter *Aonyx cinereus*					
Namdapha TR	Hornbill camp (27°32.29′N, 96°26.51′E)	Stream (640 m)	27 Nov 10	Direct sighting	10h30; subsequently seen on five occasions (by day)

Site	Location	Habitat (altitude)	Date	Record details	Remarks
Spotted Linsang *Prionodon pardicolor*					
Namdapha TR	Hornbill camp (27°32.29′N, 96°26.51′E)	Primary sub-tropical evergreen forest (640 m)	1 Dec 10	Direct sighting	Near the camp (19h50)
Large Indian Civet *Viverra zibetha*					
Namdapha TR	Hornbill camp (27°32.29′N, 96°26.51′E)	Primary sub-tropical evergreen forest (640 m)	Many	Direct sighting	Feeding on camp leftovers by night; 1–2 individuals
Namsai RF	Namsai–Wakro Road (27°40.511′N, 95°53.832′E)	Open forest near human settlement (150 m)	Mar 09	Direct sighting	At night
Namdapha TR	Hornbill (27°32.317′N, 96°26.820′E)	Primary sub-tropical evergreen forest (670 m)	4 Feb 12	Camera-trap	00h44
Tengapani RF	Madhuban (precise location not recorded)	Logged lowland forest (~ 200 m)	22 Mar 09	Camera-trap	At night
Small Indian Civet *Viverricula indica*					
Namdapha TR	M.V. Road (27°29.795′N, 96°21.510′E)	Sub-tropical evergreen forest (410 m)	7 Mar 13	Direct sighting	At night
Namdapha TR	Hornbill (27°32.317′N, 96°26.820′E)	Primary sub-tropical evergreen forest (670 m)	3 Feb 12	Camera-trap	22h37
Digboi Town	Tinsukia–Miao Road (27°23.541′N, 95°36.839′E)	Near human settlement (150 m)	1 Mar 13	Direct sighting	At night
Tengapani RF	Madhuban (precise location not recorded)	Logged lowland forest (~ 200 m)	22 Mar 09	Camera-trap	At night (photographed)
Common Palm Civet *Paradoxurus hermaphroditus*					
Namdapha TR	Hornbill Plateau (27°31.811′N, 96°24.674′E)	Primary sub-tropical evergreen forest (580 m)	22 Nov 10	Direct sighting	~10h00
Masked Palm Civet *Paguma larvata*					
Namdapha TR	Waasi (27°34.054′N, 96°29.043′E)	Primary sub-tropical evergreen forest (1,300 m)	3 Dec 08	Direct sighting	~ 19h30
Namdapha TR	Waasi (27°34.054′N, 96°29.043′E)	Primary sub-tropical evergreen forest (1,300 m)	4 Dec 08	Direct sighting	~ 19h30
Namdapha TR	10 Mile along M.V. Road (27°30.228′N, 96°19.766′E)	Secondary evergreen forest (300 m)	22 Dec 11	Direct sighting	At night
Namdapha TR	near Hornbill camp	Primary sub-tropical evergreen forest (640 m)	16 Feb 12	Direct sighting	21–22h
Namdapha TR	near Hornbill camp	Primary sub-tropical evergreen forest (640 m)	16 Feb 12	Direct sighting	21–22h
Namdapha TR	near Hornbill camp	Primary sub-tropical evergreen forest (640 m)	29 Feb 12	Direct sighting	~ 21h
Namdapha TR	near Hornbill camp	Primary sub-tropical evergreen forest (640 m)	1 Mar 13	Direct sighting	Feeding on *Prunus ceylanica* at ~ 19h; two individuals
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	15 Feb 12	Camera-trap	18h30–00h30
Small toothed Palm Civet *Arctogalidia trivirgata*					
Namdapha TR	Hornbill (27°32.318′N, 96°26.104′E)	Primary sub-tropical evergreen forest (640 m)	5 Dec 09	Direct sighting	19h30
Binturong *Arctictis binturong*					
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	29 Feb 09	Direct sighting	On ground (22hr00); two individuals
Namdapha TR	Hornbill (27°32.365′N, 96°26.890′E)	Primary sub-tropical evergreen forest (680 m)	8 Nov 09	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (morning)
Namdapha TR	Hornbill (27°32.365′N, 96°26.890′E)	Primary sub-tropical evergreen forest (680 m)	9 Nov 09	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (06h57–07h26)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	9 Dec 09	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (06h40)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	9 Dec 09	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (07h09)
Namdapha TR	Hornbill (27°32.402′N, 96°26.802′E)	Primary sub-tropical evergreen forest (660 m)	10 Dec 09	Direct sighting	Feeding on *Ficus* cf. *tsajhela* (13h30–14h56)

Site	Location	Habitat (altitude)	Date	Record details	Remarks
Namdapha TR	Hornbill (27°31.599′N, 96°25.022′E)	Primary sub-tropical evergreen forest (590 m)	Apr 10	Direct sighting	Feeding on *Ficus nervosa* (06–11h)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	26 Nov 11	Direct sighting	07h11
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	28 Jan 11	Direct sighting	Feeding on *Ficus drupacea* (14h07)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	Mar 11	Direct sighting	Feeding on unidentified *Ficus* (in morning)
Tengapani RF	Madhuban (27°43.38′N, 96°03.65′E)	Logged lowland forest (210 m)	7 Feb 09	Direct sighting	Feeding on *Ficus altissima* (06h20)
Crab-eating Mongoose *Herpestes urva*					
Namdapha TR	Deban Nullah (27°30.472′N, 96°23.358′E)	Stream (340 m)	6 Feb 12	Direct sighting	Running along stream (09h35)
Namdapha TR	Hornbill (precise location not recorded)	Primary sub-tropical evergreen forest (~ 650 m)	24 Feb 12	Direct sighting	Forest floor (daytime); two
Tengapani RF	Madhuban (27°43.450′N, 96°3.048′E)	Logged lowland forest (~ 200 m)	24 Mar 09	Dead animal	Killed with a stick (daytime)
Tengapani RF	Madhuban (27°43.450′N, 96°3.048′E)	Logged lowland forest (~ 200 m)	26 Mar 09	Dead animal	Killed with a catapult (daytime)
Turung RF	Turung RF (27°46.186′N, 96°16.883′E)	Degraded logged lowland forest (270 m)	29 Mar 09	Direct sighting	On a logging trail, 13h20
Small Asian Mongoose *Herpestes javanica*					
Miao and Diyun RF	Precise location not recorded	Near human settlement (~ 250 m)	2009–2010	Direct sighting	Daytime, at least thrice

Small carnivore records from a threatened habitat linkage in Terengganu, Peninsular Malaysia

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Abstract

Habitat loss and fragmentation are a key threat to the survival of several small carnivore species in Southeast Asia. Enhancing habitat connectivity is therefore an important conservation strategy. In Peninsular Malaysia, the government plans to connect its fragmented forests via 17 habitat linkages to form a large contiguous forest complex known as the Central Forest Spine. Small carnivore species composition in these linkages remains poorly documented. Of the 12 species detected in and around Linkage 7, in the state of Terengganu, four are categorised as Vulnerable by *The IUCN Red List of Threatened Species*: Binturong *Arctictis binturong*, Banded Civet *Hemigalus derbyanus*, Oriental Small-clawed Otter *Aonyx cinereus* and Smooth-coated Otter *Lutrogale perspicillata*. A photograph of Crab-eating Mongoose *Herpestes urva* with young is the first record of this species from Terengganu, extending eastwards its known distribution in Peninsular Malaysia. Forests in and around this linkage are threatened by disturbance associated with an existing road, and the construction of a nearby dam. The study area's relatively high recorded small carnivore species richness, and its complement of globally threatened small carnivore species, supports its inclusion into a proposed protected area (known as the Kenyir Wildlife Corridor). Information on small carnivores in other linkages warrants publication, especially from camera-trap surveys that consciously account for microhabitat use and behavioural variation between different species. This would allow a clearer understanding of small carnivore communities in Peninsular Malaysia.

Keywords: Central Forest Spine, conservation, habitat linkage, Kenyir, road, selective logging

Introduction

Suitable habitats for forest-dependant small carnivores are disappearing faster in Southeast Asia than anywhere else in the world (Schipper *et al*. 2008). In fact, about 21–48% of regional populations of mammal species may be extinct by 2100, according to one alarming study (Brook *et al*. 2003). One key mammal conservation strategy for the region has been the establishment of corridors or linkages to restore ecological connectivity between fragmented habitats (e.g. Kawanishi *et al*. 2003, DWNP 2008, Clements *et al*. 2012b). Unfortunately, there is a paucity of research on the functional role of such corridors in this region (Sodhi *et al*. 2010), with almost nothing known about their small carnivore communities.

In Peninsular Malaysia, the Federal government's provisional plan to restore ecological connectivity between four fragmented forest complexes via a network of 17 habitat linkages (hereafter known as linkages; Fig. 1) is known as the Central Forest Spine Master Plan for Ecological Linkages (DTCP & DOF 2012). These linkages are threatened by anthropogenic disturbance. For example, all but two of the 17 are bisected by roads (Fig. 1; DTCP & DOF 2012), which have negative impacts on some mammal, bird and amphibian species in the tropics (Laurance *et al*. 2009).

Many linkages within the Central Forest Spine also comprise production forest reserves designated for selective timber extraction (DTCP & DOF 2012). Selectively logged and otherwise disturbed forests can have high conservation value for mammals (Wells *et al*. 2007, Berry *et al*. 2010, Foster *et al*. 2011, Giam *et al*. 2011, Gibson *et al* 2011, Schwitzer *et al.* 2011, Putz *et al*. 2012), particularly for larger mammals in Peninsular Malaysia (Rayan & Mohamad 2009, Clements *et al*. 2012a, Rayan *et al*. 2012), but the species-specific effects of commercial logging on most small carnivores are uncertain (Colón 2002, Meijaard & Sheil 2008). Several studies in logged forests have recorded a decline in some species of small carnivores (Heydon & Bulloh 1996, Colón 1999), whereas others suggest that many

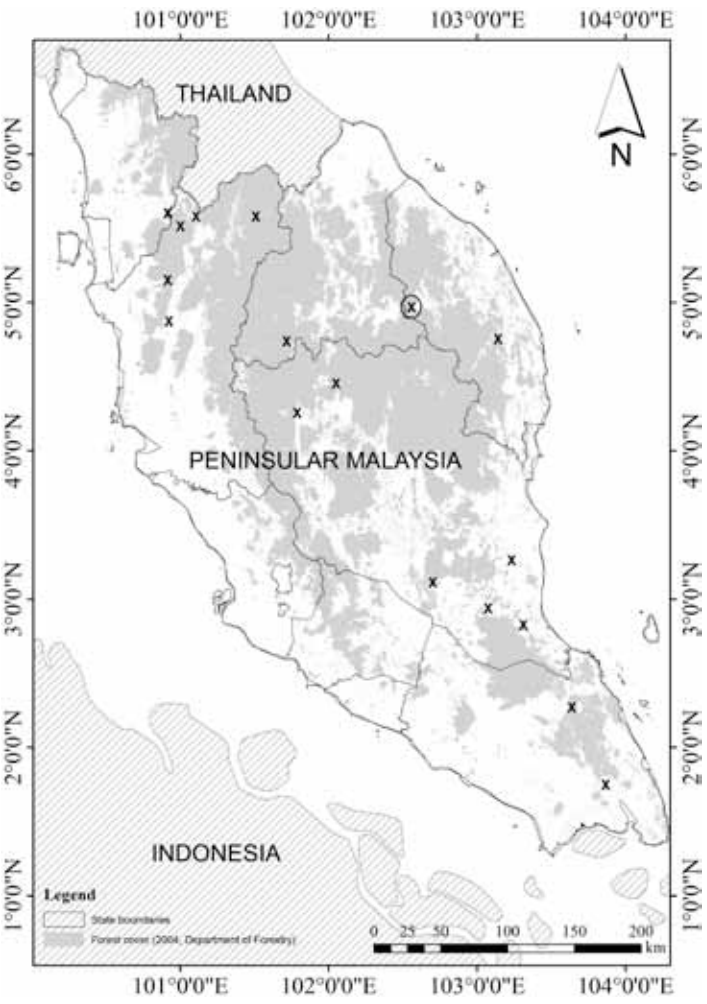

Fig. 1. Locations of 17 linkages ('×') identified by the Malaysian Federal government in the country's Central Forest Spine, including Linkage 7 (circled), subject of this study.

species persist without significant population declines (Syakirah *et al*. 2000, Meijaard & Sheil 2008, Samejima *et al*. 2012).

Twenty species of small carnivores from four families (Viverridae, Prionodontidae, Mustelidae and Herpestidae) inhabit Peninsular Malaysia (Francis 2008). In Malaysia, recent records of small carnivores come mainly from production forest reserves (e.g. Rayan & Shariff 2008, Mathai *et al*. 2010, Wilting *et al*. 2010) and protected areas (e.g. Kawanishi & Sunquist 2004, Brodie & Giordano 2011, Matsubayashi *et al*. 2011). Because the designation of linkages is relatively recent at a national policy level (DTCP & DOF 2012), very little information is available on the small carnivores within them.

This paper reports the species composition and detection rates of small carnivores in and around one of Peninsular Malaysia's 17 habitat linkages – Linkage 7, in the state of Terengganu. These are the first published data on small carnivores from a linkage in this country.

Location, materials and methods

Located in the State of Terengganu, Linkage 7 is one of 17 habitat linkages identified within the Central Forest Spine (Fig. 1). A 60-km road with 10 underpasses (i.e. elevated road structures for vehicles) cuts through this linkage (Fig. 2). The study area consists of two forest blocks totalling 158 km^2, with the lower forest block encompassing Linkage 7 (see DTCP & DOF 2012). Both forest blocks span four production forest reserves (Tembat, Petuang, Hulu Telemong and Hulu Nerus), which contain both lowland and hill dipterocarp forests. They were first selectively logged in the 1970s. No logging was conducted in either block during the present study, but forests were being clear-felled for construction of a hydro-electric dam outside the study area (over 6 km away; Fig. 2). No permanent human settlements exist in the forest blocks.

Records were derived from a camera-trapping survey to investigate habitat use by mammals in and around Linkage 7 (Clements & Laurance 2012). Camera-trapping was conducted between April 2011 and March 2012, across dry (April–September) and wet seasons (October–March). The lower and upper forest blocks were stratified into 21 and 22 cells (2 × 2 km), respectively. Within each cell, a camera-trap was deployed in the upper-left sub-cell (1 × 1 km) during the first 60-day sampling occasion, before being moved in a 'Z' - shaped manner until every sub-cell was surveyed. The lower and upper forest block respectively thereby had an array of 21 and 22 operational camera-traps during each of four sampling occasions. Within each sub-cell, camera-traps were placed close to the centre of the sub-cell, to minimise clumping, and/or on linear features known to have high detection probabilities for some large mammals (e.g. animal trail, ridge or old logging road). Camera-traps were attached to tree trunks ~50 cm above ground level and 2–5 m from the trail's centre. This survey design will have resulted in low detection rates of any small carnivore species that avoid these types of trails.

Theft, malfunction, damage from Asian Elephants *Elephas maximus*, and blockage from vegetation all prevented use of some camera-traps' data. The 158 sub-cells providing usable data lay within an elevational range of 167–732 m (Datum WGS 84, indicative elevation derived from 1 km^2-resolution digital elevation model from the Shuttle Radar Topography Mission elevation database and thus highly approximate, especially in rugged terrain). 'Day' detections occurred between 07h00 and 18h59, and 'night' detections between 19h00 and 06h59, following Kawanishi & Sunquist's (2008) study in a nearby area with similar sun-set and -rise times. No attractants were employed around the cameras. Camera-trap photos were catalogued using software Camera Base version 1.4 (http://www.atrium-biodiversity.org/tools/camerabase). To

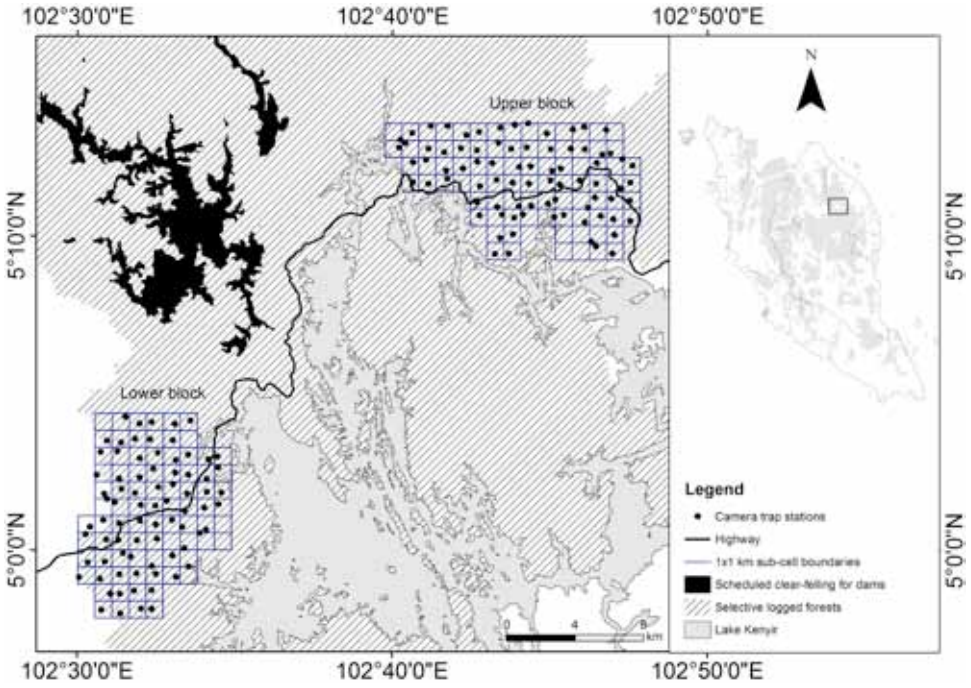

Fig. 2. Locations of 158 camera-trap stations within two forest blocks that were stratified into 1 × 1 km sub-cells in and around Linkage 7, Terengganu, Peninsular Malaysia.

facilitate comparisons with other studies, a notionally independent photograph was defined as a photograph of a species taken at least 0.5 hr after the previous photograph of the same species at the same camera-trap station.

Results and discussion

Twelve species of small carnivores were detected in and around Linkage 7, all of which are typical of lowland and hill dipterocarp forests. Nine of them were camera-trapped over 10,502 camera-trap-nights, one was camera-trapped subsequently, one was found as a roadkill and another was photographed *in situ* (Table 1, Appendix 1). Kawanishi & Sunquist (2004), in the adjacent Taman Negara National Park, with its boundary ~4 km from our nearest camera-trap, detected nine species of small carnivores from 14,054 camera-trap-nights.

In and around Linkage 7, the most frequently camera-trapped small carnivore was Banded Linsang *Prionodon linsang* (Table 1). This is surprising given its typical relative paucity of records during camera-trapping (e.g. Mathai *et al*. 2010, Wilting *et al*. 2010, Brodie & Giordano 2011), including in Peninsular Malaysia (Taman Negara, Kawanishi & Sunquist 2004; Gunong Basor Forest Reserve, Rayan 2007).

The presence of Crab-eating Mongoose *Herpestes urva*, which has been considered in Malaysia to be rare and patchily distributed (Lim 1991), represents the first record for the state of Terengganu, extending its known range south-eastwards by over 100 km from the previous eastern-most record in Peninsular Malaysia (Gunung Basor, Kelantan, 3°49′53″N, 103°35′30″E; Rayan & Shariff 2008). One image had an adult with three juveniles, three weeks after a photograph of a lone individual at the same station (Fig. 3). The approximate elevations of the species's records, within 600–700 m (Appendix 1), fall within the known range used in Malaysia (10–1,400 m; Rayan & Shariff 2008).

All five detections of Crab-eating Mongoose were during the day, but all those of Large Indian Civet *Viverra zibetha,* Masked Palm Civet *Paguma larvata* and Common Palm Civet *Paradoxurus hermaphroditus* were by night, consistent with previously documented activity patterns of these four species (e.g. Van Schaik 1996, Duckworth 1997, Grassman 1998, Azlan 2006, Francis 2008). A third of the Binturong *Arctictis binturong* photos were taken during the day, supporting the notion that they are not solely nocturnal (e.g. Nettelbeck 1997, Brodie & Giordano 2011). All adult individuals of small carnivore species were detected singly except for Yellow-throated Marten *Martes flavigula*, which was detected in duos in three out of seven photographs; others have also found them in duos or small groups (Duckworth 1997, Grassman *et al* 2005, Parr & Duckworth 2007).

Eight species of small carnivore known to occur in Peninsular Malaysia were not detected. Of four possible explanations for this, the first is inappropriate habitat. For example, the study area's dense rainforest is unlikely to support Small Asian Mongoose *Herpestes javanicus* and Small Indian Civet *Viverricula indica*, which may occur mainly in open scrub-like

Fig. 3. Camera-trapped adult Crab-eating Mongoose *Herpestes urva* with three juveniles, Linkage 7, Terengganu, Peninsular Malaysia, 27 December 2011.

Table 1. The 12 small carnivore species detected in and around Linkage 7. Terengganu, Peninsular Malaysia, 2011–2012.

Species	N	PCRI	Stations	Red List	Day	Night
Yellow-throated Marten *Martes flavigula*	7	0.07	6	LC	6	1
Oriental Small-clawed Otter *Aonyx cinereus* **	-	-	1	VU	-	-
Smooth-coated Otter *Lutrogale perspicillata* ***	-	-	1	VU	-	-
Banded Linsang *Prionodon linsang*	9	0.09	9	LC	0	9
Malay Civet *Viverra tangalunga*	2	0.02	2	LC	0	2
Large Indian Civet *Viverra zibetha*	4	0.04	4	NT	0	4
Banded Civet *Hemigalus derbyanus*	2	0.02	2	VU	0	2
Masked Palm Civet *Paguma larvata*	5	0.05	4	LC	0	5
Common Palm Civet *Paradoxurus hermaphroditus*	2	0.02	2	LC	0	2
Binturong *Arctictis binturong*	3	0.03	3	VU	1	2
Small-toothed Palm Civet *Arctogalidia trivirgata* *	-	-	-	LC	-	-
Crab-eating Mongoose *Herpestes urva*	5	0.05	2	LC	5	0

N = notionally independent detections (0.5 hr intervals); PCRI = Photographic Capture Rate Index (N/100 camera-trap-nights; based on O'Brien *et al*. 2003) over 10,502 camera-trap-nights; Stations = number of camera-traps (out of 158) that detected the species; *Red List* = *IUCN Red List of Threatened Species* category; Day = number of day detections; Night = number of night detections.

*identified from a roadkill within the study area. **daytime detection during ongoing camera-trapping survey in the study area. ***species photographed by day *in situ*.

areas (e.g. Francis 2008). In Peninsular Malaysia, Short-tailed Mongoose *Herpestes brachyurus* seems to have been detected only below 100 m (Wells 1989), although it ranges higher in Borneo (e.g. Mathai *et al*. 2010, Matsubayashi *et al*. 2011) and thus might yet be found at much higher elevations on Peninsular Malaysia. The second possible explanation is camera-trap placement. Non-detection of Hairy-nosed Otter *Lutra sumatrana* and Otter Civet *Cynogale bennettii* could reflect placement of most camera-traps away from water bodies. The non-detection of Malay Weasel *Mustela nudipes* could reflect camera-trap placement inimical to detecting this species, typically camera-trapped only rarely (Duckworth *et al* 2006, Ross *et al*. 2013). A third possible explanation is extinction: the introduced Indian Grey Mongoose *Herpestes edwardsii* is now likely to be extinct in Peninsular Malaysia (Wells 1989, Francis 2008, DWNP 2010). The fourth explanation is that the species may have never naturally occurred in this geographical area. Earlier, generalised, claims of an extensive distribution of Large-spotted Civet *Viverra megaspila* in Peninsular Malaysia (Corbett & Hill 1992, Papeş & Gaubert 2007, Francis 2008), are contested by detailed collation and evaluation of records from the country, which suggests strongly that it inhabits only the northwest of Peninsula Malaysia (Jennings & Veron 2011).

Conclusion

The species composition of small carnivores in Peninsular Malaysia's habitat linkages was hitherto little known. The 12 species detected in Linkage 7 represent one of the highest small carnivore species totals documented from a single study in Peninsular Malaysia to date. Four of these species are globally threatened (all categorised as Vulnerable) according to *The IUCN Red List of Threatened Species* (IUCN 2012), indicating high conservation importance of the linkage for small carnivores in this country. Forests surrounding this linkage continue to be subjected to various disturbances (Clements & Laurance 2012) such as the construction of hydroelectric dams and poaching (which can potentially include small carnivores; Shepherd & Shepherd 2010). Protection of forests in and around Linkage 7 should therefore be enhanced, not only to conserve the four Vulnerable species, but to maintain habitat connectivity between Taman Negara and nearby selectively logged forests. Indeed, GRC proposed that both forest blocks be included as part of a proposed larger protected area (i.e. state park) to be known as the Kenyir Wildlife Corridor (Fig. 2). Upon formal submission to the Terengganu state government, infrastructure development along the linkage was put on hold pending further assessments by environmental consultants to improve management recommendations for the area (Hance 2012).

A clearer overview of small carnivore communities within the Central Forest Spine's linkages would be helped by further publication of information on small carnivores, including records from camera-trapping studies with other objectives. Camera-trapping designs that consciously account for microhabitat and behavioural variation could enhance recording rates of species typically not well recorded by this method. Specifically, camera-traps could be deployed near small streams or pools, and employ lures or baits. Species that are either Vulnerable or Endangered, but not detected by this study (Hairy-nosed Otter, Otter Civet and, further north, Large-spotted Civet), are priority 'targets' for future small carnivore studies in the linkages.

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Appendix 1. Geographical coordinates and indicative elevation of the 12 small carnivore species recorded in and around Linkage 7, Terengganu, Peninsular Malaysia, 2011–2012.

Latitude N	Longitude E	Elevation (m)
Yellow-throated Marten *Martes flavigula*		
4°58′37.2″	102°31′04.8″	216
4°59′38.4″	102°30′54.0″	239
5°10′33.6″	102°46′58.8″	198
5°00′21.6″	102°32′31.2″	203
5°03′25.2″	102°31′22.8″	562
5°12′46.8″	102°43′48.0″	446
Oriental Small-clawed Otter *Aonyx cinereus*		
5°00′54.0″	102°31′37.2″	218
Smooth-coated Otter *Lutrogale perspicillata*		
5°03′38.0″	102°33′49.7″	160
Banded Linsang *Prionodon linsang*		
4°59′38.4″	102°30′54.0″	239
5°00′21.6″	102°32′31.2″	203
4°58′04.8″	102°30′46.8″	286
5°12′46.8″	102°42′10.8″	472
5°11′42.0″	102°47′31.2″	384
5°01′26.4″	102°34′30.0″	412
5°09′25.2″	102°43′40.8″	310
5°00′03.6″	102°33′25.2″	353
4°59′16.8″	102°31′55.2″	184
Malay Civet *Viverra tangalunga*		
4°58′37.2″	102°31′22.8″	233
5°03′00.0″	102°34′26.4″	303
Large Indian Civet *Viverra zibetha*		
4°59′09.6″	102°30′03.6″	486
5°12′50.4″	102°44′16.8″	357
5°00′18.0″	102°31′19.2″	215
5°12′46.8″	102°43′48.0″	446

Latitude N	Longitude E	Elevation (m)
Banded Civet *Hemigalus derbyanus*		
5°03′03.6″	102°33′32.4″	242
5°00′21.6″	102°32′31.2″	203
Masked Palm Civet *Paguma larvata*		
5°03′07.2″	102°30′46.8″	620
5°03′07.2″	102°31′15.6″	662
5°02′24.0″	102°30′39.6″	600
5°00′03.6″	102°33′25.2″	353
5°03′25.2″	102°30′39.6″	825
Common Palm Civet *Paradoxurus hermaphroditus*		
5°13′30.0″	102°46′04.8″	392
5°13′30.0″	102°46′04.8″	392
4°59′31.2″	102°32′24.0″	179
5°10′01.2″	102°47′02.4″	272
Binturong *Arctictis binturong*		
4°58′37.2″	102°31′22.8″	233
5°11′49.2″	102°41′45.6″	269
5°10′40.8″	102°43′30.0″	444
Small-toothed Palm Civet *Arctogalidia trivirgata*		
5°10′40.2″	102°47′48.0″	156
Crab-eating Mongoose *Herpestes urva*		
5°13′33.6″	102°43′51.6″	673
5°12′57.6″	102°43′22.8″	648

The carnivores of Mariarano forest, Madagascar: first insights

B. EVANS[1], F. RAKOTONDRAPARANY[2], L. COLE[3], S. GRAHAM[4], P. LONG[5] and R. GANDOLA[6]

Abstract

The carnivores of Mariarano forest, northwestern Madagascar, were surveyed in June–August 2012 as part of a wider biodiversity survey. Seven camera-traps provided photographs of Western Falanouc *Eupleres major* and the introduced Small Indian Civet *Viverricula indica*. Observations of tracks and faeces suggested the presence of Fosa *Cryptoprocta ferox*, although no direct sighting occurred.

Keywords: camera-trapping, *Cryptoprocta ferox*, deciduous forest, *Eupleres major*, *Viverricula indica*

Ireo biby mpihina-nofo (Karnivôra) ao anaty alan'i Mariarano: fanadihadiana voalohany

Famintinana

Natao ny fanadihadiana ny fisian'ireo karazam-biby mpihina-nofo (Karnivôra**)** mipetraka ao anaty alan'i Mariarano (any avaratra andrefan'i Madagasikara), tamin'ny volana Jiona sy Aogositra 2012, nandritra ny asa ankapobeny momba ny fanaraha maso ireo biby amin'iny faritra iny. Fakantsary fandrika fito (07) no nahitana ny fisian'ny Fanaloka Andrefana *Eupleres major* sy ilay biby vahiny Jaboady *Viverricula indica*. Ny tainy sy ny dian-tongony kosa no nahafantarana ny fisian'ny Fosa *Cryptoprocta ferox*. Hatreto izany dia tsy hita mivantana avy hatrany ireo biby ireo.

Introduction

Madagascar has been described as the world's top conservation priority (Mittermeier *et al*. 2005), containing a mammal fauna both highly diverse and highly threatened. The endemic carnivores (Eupleridae) remain so poorly studied that their conservation planning is impeded.

Mariarano classified forest (15°29′00″S, 46°41′37″E) and the adjacent Matsedroy forest fragment (15°29′23″S, 46°38′25″E) (Fig. 1) are part of an unprotected forest block in the northwest of Madagascar, 50 km northeast of Mahajanga. Hereafter, the combined forest patches are together referred to as Mariarano forest. Mariarano forest comprises 65 km^2 of western dry deciduous forest, wooded grass and bush land, a wetland complex and agricultural land (Moat & Smith 2007, Washington *et al*. 2009) and has been noted for its rich lemur populations (Andriantompohavana *et al*. 2006, Olivieri *et al*. 2006). Mariarano forest is one of the few remaining patches of unprotected western deciduous forest larger than 800 ha (Smith 1997) and is under intense anthropogenic pressure—Ackermann (2003) quantified annual deforestation rates of 3% in the forest.

Since 2009, a collaborative project has been assessing the forest's biodiversity. The partnership comprises Operation

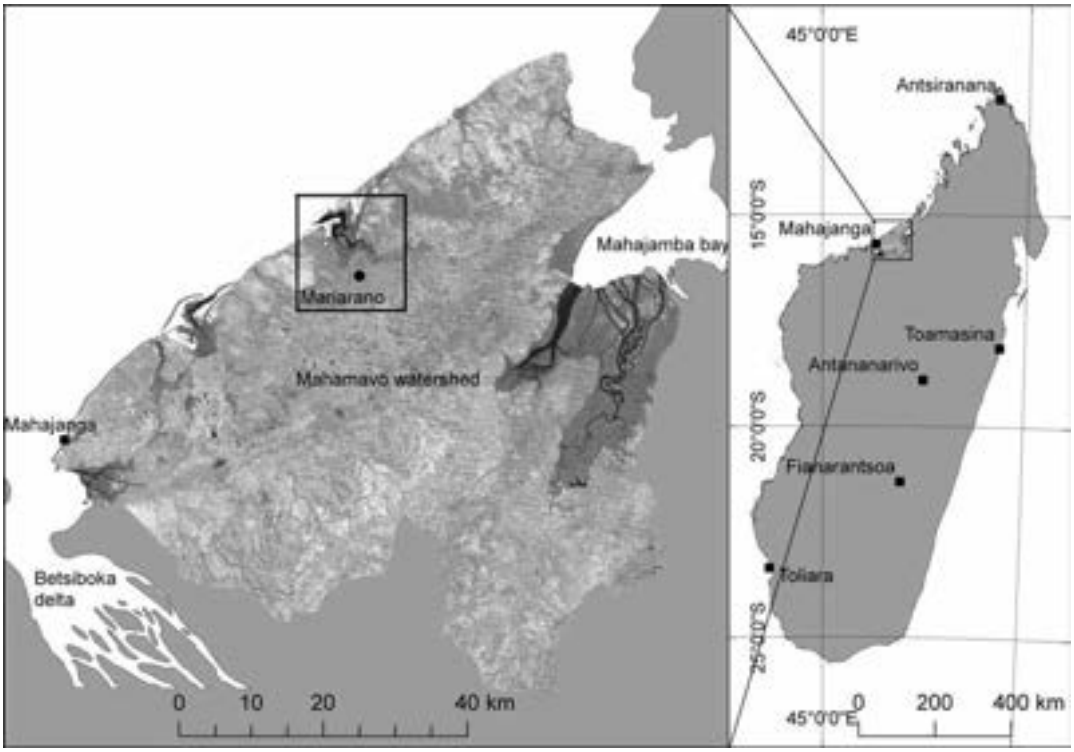

Fig. 1. Location of Mariarano Forest, Madagascar (image: P. Long).

Wallacea, an international volunteer-based NGO that supports conservation research through academic partnerships; Development and Biodiversity Action for Madagascar, a grassroots, community-based Malagasy conservation NGO; the local community forest management groups for Mariarano (*Tanteraka*) and Antanandavy; and the University of Antananarivo. The project is a landscape-scale long-term monitoring programme of multiple taxonomic groups. It aims to provide a biodiversity inventory of the area, to characterise spatial patterns and temporal trends in biodiversity, to monitor the condition of the forest habitat, to contribute revenue to local villages, and to secure further funding for environmental projects using the research results. Mariarano Forest is part of the Mahamavo catchment, a large landscape experiencing anthropogenic changes in land cover and configuration that threaten biodiversity in the area.

Biodiversity surveys and monitoring of Mariarano forest have been conducted since 2009 in each dry season between June and August. Multidisciplinary teams employ various survey techniques across a network of nine forest and six wetland sample routes, supplemented by opportunistic recording. Surveying began in the forest and mangrove system at the village of Mariarano in 2009, and extended to the Matsedroy forest fragment in 2011–2012 and has collected substantial spatial data on plants, reptiles, amphibians, lemurs, small mammals and birds (Washington *et al*. 2009, Long *et al*. 2012).

In the 2012 dry season, camera-traps were deployed to assess the area's carnivore community, supplemented by incidental observations (Fig. 2). An additional aim was to assess their efficacy as a survey tool.

Methods

From June to August, seven Bushnell Trophy HD camera-traps were deployed across the study area (Fig. 2). Five were placed using the existing network of nine survey routes of 1.6–3.6 km in length. Each survey route contained two camera-trap locations, with one camera-trap at each location for 8–14 days (Table 1). Most camera-traps were placed directly on the survey routes, apart from a few localities with higher human traffic, where they were placed on smaller trails within 30 m of the main trail. Two camera-traps were used opportunistically, being placed deliberately in areas thought likely to produce photographic records, such as lake edges. Some were baited with chicken offal (Table 1). Camera-traps were set 30 cm above the ground. The overall surveys focused on the least-encroached parcels of semi-deciduous forest, so most cameras were placed within these parcels. However, some were also placed in wooded grassland, savannah and by the edges of small lakes (Table 1). The cameras were set to take three photographs in succession from each trigger, to aid identification. Successive observations of a species at a camera-trap within an hour of the previous observation were considered to constitute the same record. Altitudes were measured using GIS (ArcView v9.0). All co-ordinates were derived from Garmin GPS 60 receiver units, recording in UTM 38L, WGS84 datum.

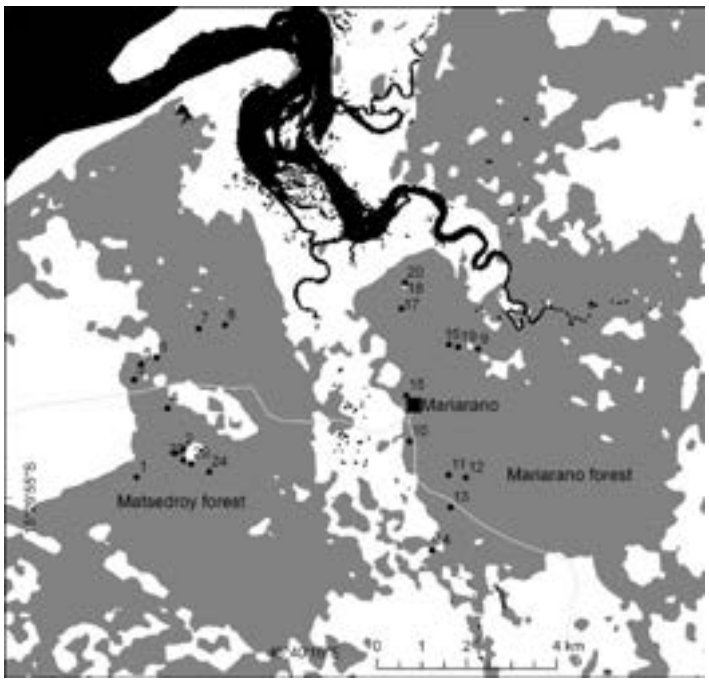

Fig. 2. Locations of camera-traps (1–24) amid forest (grey), the main settlement of Mariarano and surrounding roads (light grey).

Species accounts

In total, the camera-traps were operated for 227 nights during June–August 2012, recording 25 encounters with carnivores (Table 1).

Western Falanouc *Eupleres major*

Eupleres was photographed at three camera-trapping stations, over the course of 9–14 July. At the first station, unbaited (station 2), it was recorded singly on 9 July at 05h56 and 11 July at 05h58. At the second station, baited with chicken offal and bones and approximately 50 m from the first, photographs were taken on 11 July at 04h32, 12 July at 03h21 and 14 July at 04h25. The individual appeared to investigate the bait without taking any (Fig. 3). Both stations were on zebu trails just off the survey sample route. *Eupleres* was photographed at station 6, 2.7 km to the north, unbaited, in an open, scrubby area of the forest on 12 July at 00h51. The identification as *E. major* reflects the robustness of appearance (K. M. Helgen *in litt*. 2013) and is more consistent with this newly recognised species's known geographic range, than with that of residual Eastern Falanouc *E. goudotii* (Goodman & Helgen 2010). These records corroborate previous studies (Albignac 1974, Dollar 1999) showing a nocturnal to crepuscular activity for the genus. *Eupleres* occurs widely in Madagascar, but is apparently scarce (Garbutt 2007). There are particularly few records from the west (Goodman & Helgen 2010). The closest site to Mariarano forest where *Eupleres* has been recorded is Ankarafantsika National Park (Goodman & Helgen 2010). Mariarano forest represents an extension of known range for *Eupleres* of approximately 80 km northwest.

Fosa *Cryptoprocta ferox*

Fresh tracks provisionally identified by FR as belonging to *C. ferox* were found near the forest camp at Matsedroy on 20 and 21 July (15°29′23″S, 46°38′56″E). Faeces found on 10 July, at 15°29′24″S 46°38′52″E, were provisionally identified by FR as belonging to *C. ferox* based on the grey colour, cylindrical shape with twisted ends, and strong smell (see Garbutt 2007).

Table 1. Camera-trapping locations, effort and carnivore records, Mariarano Forest, Madagascar, in dry-season 2012.

Location	Latitude S	Longitude E	Effort[1]	Habitat[2]	Trail	Carnivores camera-trapped
1	15°29′18″	46°38′44″	13	Prim. forest	on	*C. familiaris* (2), *F. catus* (3), *V. indica* (1)
2	15°29′33″	46°38′10″	12	Prim. forest	off	*E. major* (2) *F. catus* (1)
3	15°28′48″	46°38′32″	11	Sec. forest	on	*F. catus* (1)
4	15°28′28″	46°38′07″	11	Sec. forest	on	
5	15°28′17″	46°38′13″	11	Prim. forest	on	
6	15°28′11″	46°38′24″	11	Bushland	on	*E. major* (1)
7	15°27′50″	46°38′55″	11	Prim. forest	on	
8	15°27′48″	46°39′15″	11	Sec. forest	on	*C. familiaris* (1)
9	15°28′04″	46°42′24″	9	Xero. scrub	off	
10	15°29′11″	46°41′34″	8	Sec. forest	on	*C. familiaris* (2)
11	15°29′35″	46°42′37″	8	Prim. forest	on	
12	15°29′37″	46°42′16″	8	Prim. forest	on	
13	15°29′59″	46°42′05″	8	Sec. forest	on	*C. familiaris* (1)
14	15°30′30″	46°41′51″	8	Sec. forest	on	*C. familiaris* (1)
15	15°28′38″	46°41′31″	9	Sec. forest	off	
16	15°28′01″	46°28′02″	9	Prim. forest	off	
17	15°27′35″	46°41′27″	9	Prim. forest	on	
18	15°27′16″	46°41′29″	9	Prim. forest	off	
19	15°28′02″	46°42′09″	14	Forest clearing	on	
20	15°27′16″	46°41′29″	14	Lake edge	off	*V. indica* (2)
21	15°29′21″	46°38′38″	14	Prim. forest	on	*C. familiaris* (1), *E. major* (2), *F. catus* (2)
22	15°29′26″	46°38′45″	3	Savannah	on	
23	15°29′28″	46°38′45″	5	Forest edge	on	*F. catus* (1)
24	15°29′34″	46°39′04″	12	Lake edge	off	*C. familiaris* (2)

All camera-traps were located between 0 and 120 m above sea level. All camera-traps were unbaited except for location 21.
[1]Number of days deployed. [2]Habitats: Prim. forest = primary forest; Sec. forest = secondary forest; Xero. scrub = xerophytic scrub.

Fig. 3. Western Falanouc *Eupleres major*, Mariarano forest, Madagascar, 14 July 2012 (Photo: B. J. Evans).

Fig. 4. Small Indian Civet *Viverricula indica*, Mariarano Forest, Madagascar, 26 June 2013 (Photo: B. J. Evans).

The faeces contained fur apparently of Coquerel's Sifaka *Propithecus coquereli*. Further potential *C. ferox* faeces were found on 16 July 2012 on a zebu cart trail (15°30′11.5″S 6°38′14.9″E). DNA testing of faeces has shown that visual identifications of signs are often overconfident (e.g. Janečka *et al*. 2008), so these records cannot therefore confirm the species's presence.

Small Indian Civet *Viverricula indica*
The introduced *V. indica* (Fig. 4) was camera-trapped at two stations and was observed directly once. Camera-trap records occurred at a small seasonal lake at Ambongalatsika (station 20) on 26 June at 03h26 and 30 June at 04h18, and near the forest camp at Matsedroy (station 1) on 18 July at 00h32. RG observed an individual *V. indica* in savannah (15°29′4.0″S, 46°39′28.4″E) by night (19h21) on 22 July.

Domestic Dog *Canis familiaris* and Domestic Cat *Felis catus*
Dogs and cats were camera-trapped 11 and six times respectively, and were sighted in almost all areas surveyed.

Conclusions

This initial assessment of the carnivores of Mariarano forest found *E. major*, considered by *The IUCN Red List of Threatened Species* to be part of *E. goudotii*, categorised as Near Threatened (Hawkins 2008) and, probably, *C. ferox*, categorised as Vulnerable (Hawkins & Dollar 2008). Three introduced species were also found, *V. indica*, *F. catus* and *C. familiaris*. This carnivore community is as expected for western deciduous forest, although local people also appeared familiar with the highly distinctive Ring-tailed Vontsira *Galidia elegans* (pers. obs.), which, however, is not widespread in western deciduous forest (Goodman 2012). It was considered extirpated from Anjohibe, 18 km west-south-west of Mariarano, by Samonds *et al*. (2010), based on fossils which may have dated from very different habitat conditions. This 2012 survey ran only in the dry season, with few traps and low survey effort. Increased effort, particularly during the wet season, might provide evidence of its presence. From this preliminary study, the efficacy of using camera-traps to gain multiple records of endemic carnivores in the area is proven: no other records of endemic carnivores were confirmed to species by the many hours of other survey methods.

The native carnivores in Mariarano forest face several threats. Habitat destruction through forest fires, charcoal production and logging have all been observed (Long *et al*. 2012). In Ankarafantsika, a large area of western dry deciduous forest roughly 80 km away, Barcala (2009) found that dog incidence rates related inversely to *C. ferox* incidence rates, suggesting that dogs could be extirpating *C. ferox.* Combined with the damage to ecosystems from dogs in general (Butler *et al*. 2004), their presence, in particular, is likely to be affecting the area's endemic carnivores negatively. Effects on the endemic carnivores of the other introduced carnivore species are less clear.

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Recent camera-trap records of Malay Weasel *Mustela nudipes* in Sabah, Malaysian Borneo

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Abstract

Malay Weasel *Mustela nudipes* is rarely detected in wildlife surveys, despite occupying habitats ranging from primary forest to disturbed village areas across a wide range of elevations. We report some of the few camera-trap detections of this species, including the first records from an oil palm plantation, and quantitative data showing that Malay Weasel is diurnal. A possible reason that it remains so infrequently detected by camera-trapping is that most surveys use unbaited camera-traps and place them in locations that are inefficient hunting areas for Malay Weasels, so are thus avoided by them.

Keywords: diel activity pattern, mustelid, oil palm plantation, photographic records

Rekod rekod baru Pulasan Tanah *Mustela nudipes* dari perangkap kamera di Sabah, Borneo Malaysia

Abstrak

Pulasan Tanah *Mustela nudipes* jarang dikesan semasa menjalankan pemantauan hidupan liar, walaupun spesis ini bertaburan meluas, dari hutan primer (tanpa pembalakan) hingga ke kawasan perkampungan yang terganggu, dan taburannya merentasi pelbagai ketinggian. Di sini, kami melaporkan jumlah penemuan spesis ini yang sangat kurang melalui kaedah perangkap kamera, termasuk rekod pertama spesis ini dari ladang kelapa sawit. Kami juga melaporkan corak aktiviti spesis ini sepanjang hari dengan menggunakan data kuantitatif. Pulasan Tanah aktif pada siang hari. Satu sebab mengapa spesis ini jarang ditemui dengan perangkap kamera ialah kerana kebanyakan kerja pemantauan tidak menggunakan umpan semasa memasang perangkap kamera. Selain itu, perangkap kamera diletakkan di lokasi yang tidak seiras dengan gaya pemburuan Pulasan Tanah, jadi spesis ini megelakkan lokasi lokasi sedemikian.

Introduction

Malay Weasel *Mustela nudipes* is a small carnivore found in southern Thailand, Malaysia, Brunei and western Indonesia (Sumatra and Kalimantan). Originally believed also to exist on Java, it is now thought to be absent from that island (all the few indications being either in error or, at best, inconclusive; Duckworth *et al*. 2006). Throughout its range Malay Weasel exhibits some habitat plasticity; it has been recorded from sea-level up to 1,700 m asl on Borneo (Mount Kinabalu, Sabah, Malaysia; Payne *et al*. 1998) and up to 1,300 m asl on Sumatra (Duckworth *et al*. 2006). It uses a range of natural habitats including tropical heath forest, swamp forest, montane forest and montane scrub along with lowland and hill mixed dipteropcarp forests (Duckworth *et al*. 2006). The extent to which it is forest-dependent is unclear. Records exist from a range of anthropogenically modified habitats, including exotic timber plantations (Belden *et al*. 2007), mixed rainforest–rubber plantations (Franklin & Wells 2005), highly degraded areas, villages and even suburbs (Duckworth *et al*. 2006), although it is not clear if these modified habitats can support populations, or whether, for example, these observations are of dispersing individuals. Because its relationship with forest cover and quality is uncertain, it is not known how recent and current forest loss and degradation are impacting the species. On Borneo, at least in some areas, it is reportedly used medicinally and as food, and the fur is burnt by some ethnic groups in exorcism rituals (Puri 2001). However, it does not seem to be specifically targeted by hunters across most of its range. Given these attributes, particularly the number of reports from non-forest habitats and at high elevations (where forest conversion is considerably slower than in the lowlands), and the lack of any evidence for trade-driven hunting, it is currently categorised as Least Concern by *The IUCN Red List of Threatened Species*, although its population is believed to be in decline (Duckworth & Kanchanasaka 2008).

Malay Weasel has never been studied in the wild and in most forms of modern wildlife survey it is recorded rather rarely. Despite the increasing use of camera-traps in its range, the species is rarely photographed; the first camera-trap record for this species was in 2000, obtained by Siew Te Wong during a survey of the Ulu Segama Forest Reserve, Sabah (Duckworth *et al*. 2006). Since this initial detection, Malay Weasels have been camera-trapped in at least three other areas in Sabah: Deramakot Forest Reserve (Samejima & Ong 2012), a forest fragment in an oil palm plantation adjacent to Tabin Wildlife Reserve (H. Bernard *in litt*. 2013), and in Kalabakan Forest Reserve (O. R. Wearn *in litt*. 2013). Here we detail the only other camera-trap records of Malay Weasel of which we are aware, obtained from intensive camera-trap surveys from a range of habitats within Sabah, including the first records from oil palm plantation habitat. For the first time, there are enough records to quantify the species's diel activity pattern as past statements on this topic are conflicting (Duckworth *et al*. 2006).

Survey areas and methods

As part of an investigation of Bornean cat (Felidae) ecology, nine study areas in Sabah, Malaysian Borneo, were camera-trapped between November 2006 and October 2012. This included seven

forest areas (Danum Valley Conservation Area, Ulu Segama, Malua and Kabili-Sepilok Forest Reserves, Tabin Wildlife Reserve, Lower Kinabatangan Wildlife Sanctuary and Crocker Range National Park) and two oil palm plantations (Danum Palm and Minat Teguh; Fig. 1, Table 1). Danum Palm was cleared and planted in 2000, Minat Teguh in 1995; both plantations comprised mature fruiting palms, with a largely open understory. Neither plantation retained any forest patches within the surveyed area, but both were adjacent to extensive areas of dipterocarp forest. In addition, Danum Palm contained areas of semi-natural scrub vegetation along one large river and one stream, and the southern border of Minat Teguh was fringed with mangrove.

The 497 camera-trap stations across the study areas used passive infrared digital camera-traps: Snapshot Sniper P41 (Snapshot Sniper LLC, OK, USA), Cuddeback Capture (Non Typical Inc., WI, USA), Bushnell Trophycam 2010 (Bushnell Corporation, KS, USA), Reconyx HC500 (Reconyx Inc., WI, USA) and Panthera V3 (Panthera, New York, NY, USA). Camera-trap stations were unbaited and were located approximately 1–2 km from one another in all areas except Danum Palm, where they were roughly 500 m apart. They were on animal and man-made trails (existing and freshly cut) and old logging roads in the forest areas, and on roads and existing access paths in the oil palm plantations. The passive infrared sensor was set approximately 40–50 cm above the ground. All cameras were set to operate for 24 hours each day, and recorded the time and date of each detection. All photographs of suspected Malay Weasels were meticulously inspected in order to prevent misidentification with the sometimes similarly coloured and sympatric Collared Mongoose *Herpestes semitorquatus* (Giordano & Brodie 2012, Ross *et al*. 2012). Detections were counted treating any number of photographs per calendar day per camera-trap station as one record, whereas investigation of activity pattern considered any number of detections per clock-hour, per day, per camera-trap station as a record. Elevations were measured with a Garmin GPSMap 60 CS unit, using the averaging function to increase accuracy.

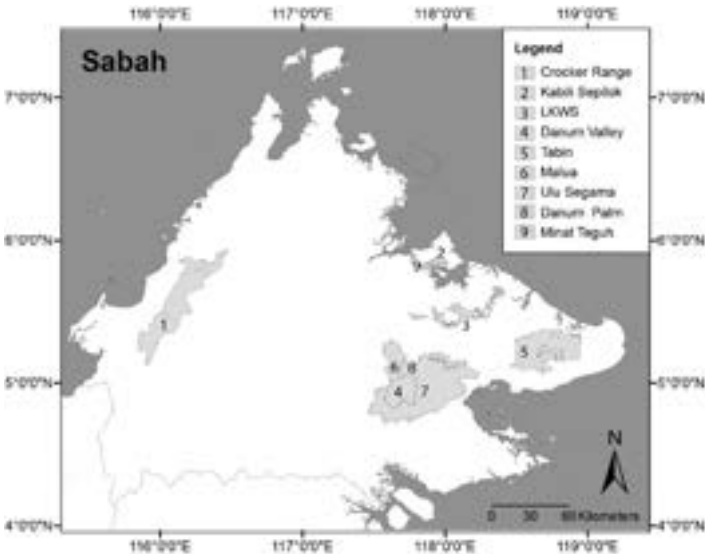

Fig. 1. Sabah, Malaysian Borneo, depicting the nine survey areas. LKWS = Lower Kinabatangan Wildlife Sanctuary.

Results

A total of 40,524 camera-trap-days resulted in over 200,000 photographs of wildlife, representing 50 identified wild mammal species. Malay Weasel was detected 28 times in total, at only four of the nine study areas, over an elevation range of 68–1,342 m (Table 1; Appendix 1). The species was detected in all months except July – September. The several records within oil palm habitat lay 200 m, 840 m and 1.5 km respectively from the nearest semi-natural vegetation. All images were of single animals. All records were obtained during the day, with a slight peak (perhaps merely a vagary of the small sample size) between 08h00 and 10h00 (Fig. 2; all sites' records pooled).

Table 1. Summary of Malay Weasel *Mustela nudipes* detections in nine study areas, Sabah, Malaysia.

Study area	Habitat	Survey period	Camera-trap-days	Camera-trap stations (mean elevation)	Malay Weasel detections* (stations)	Detection rate (detections*/100 camera-trap-days)
Danum Valley	Primary lowland dipterocarp	Oct 2006 – Jun 2007; Oct 2007 – Sep 2008; Mar 2012 – Oct 2012	6,228	157 (325 m)	0	0
Ulu Segama	Logged dipterocarp	Nov 2006 – Oct 2007	4,154	40 (254 m)	0	0
Malua	Recently logged dipterocarp	Sep 2008 – Feb 2009	3,343	36 (177 m)	1 (1)	0.030
Danum Palm	Oil palm	Mar 2009 – Jun 2009	1,941	21 (210 m)	9 (4)	0.464
Tabin	Logged dipterocarp	Aug 2009 – April 2010	6,172	72 (177 m)	1 (1)	0.016
LKWS	Logged riverine	Jul 2010 – Dec 2010	3,997	65 (34 m)	0	0
Kabili-Sepilok	Lowland mixed dipterocarp, heath forest, mangrove	Feb 2011 – May 2011	3,755	35 (66 m)	0	0
Minat Teguh	Oil palm	May 2011 – Aug 2011	1,920	35 (23 m)	0	0
Crocker Range	Primary hill dipterocarp/sub montane	Oct 2011 – Feb 2012	3,999	36 (1,032 m)	17 (9)	0.425

*A 'detection' comprises any number of photographs per calendar day per camera-trap location. LKWS = Lower Kinabatangan Wildlife Sanctuary. 'Mean elevation' refers to the elevation of the camera-trap stations.

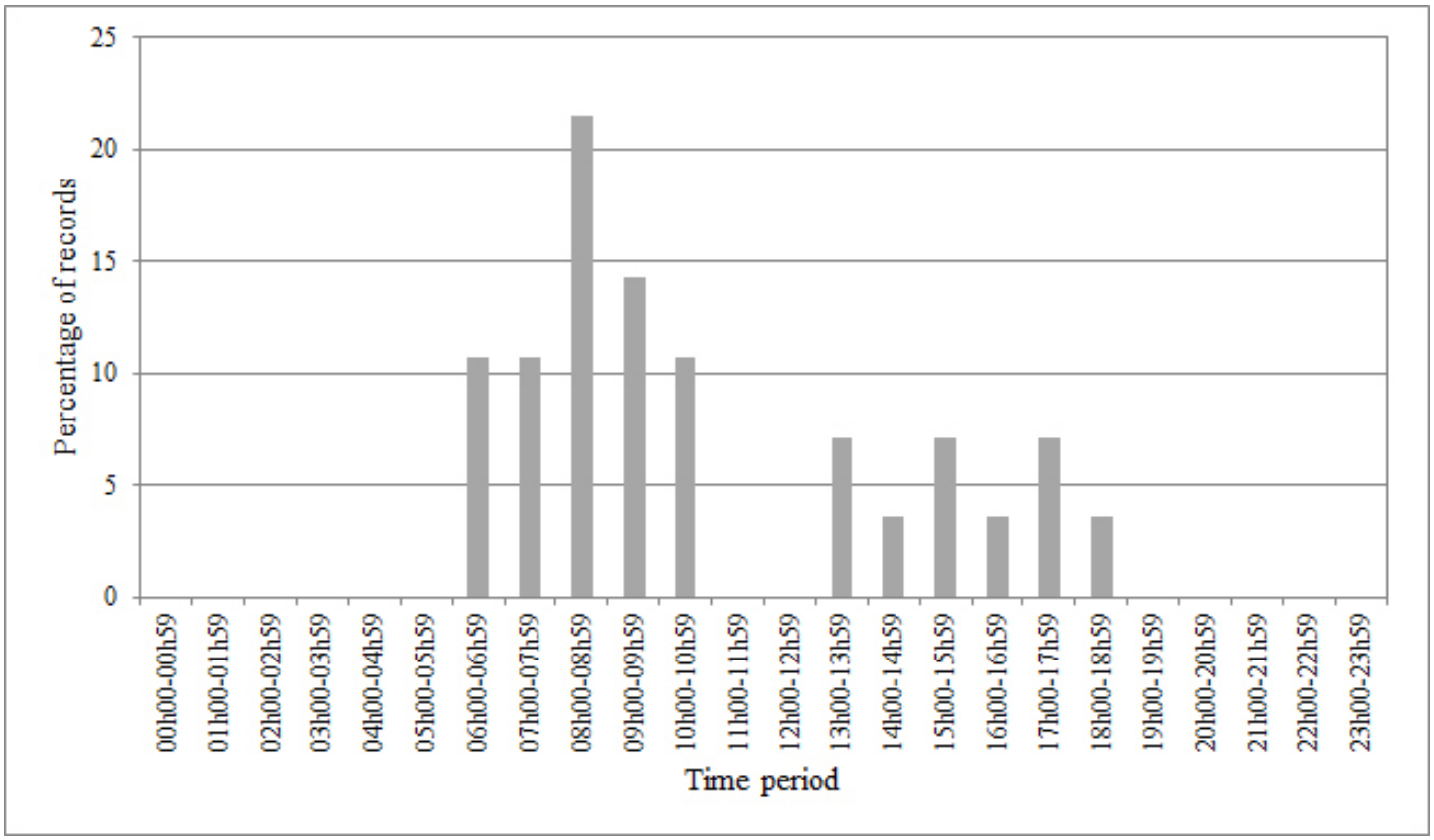

Fig. 2. Diel activity pattern of Malay Weasel *Mustela nudipes*, derived from 28 detections from pooled camera-trap data across nine study areas in Sabah, Malaysia.

Discussion

These records include the first known Malay Weasel records from oil palm plantation habitat. They suggest that it tolerates some degree of habitat alteration, corroborating previous records (Duckworth *et al*. 2006) and confirming the speculation of Duckworth *et al*. (2006) that it will (at least under certain circumstances) use oil palm plantations. The record furthest from semi-natural vegetation, in this case the logged forest–plantation boundary, was 1.5 km. However, because of the shape of Danum Palm Plantation (roughly triangular with semi-natural vegetation along two borders) this distance was also the furthest from more natural vegetation that was surveyed. Therefore, it remains unclear whether this highly modified habitat can support a sustainable population or whether these animals depend on adjacent forest. Malay Weasels lack finely patterned coats, hampering distinction between individuals on photographs, and rendering it unclear how many individuals were photographed in Danum Palm; the maximum distance between detections here was 2.4 km. In Crocker Range, however, one animal differed strikingly in coloration from the others (Ross *et al*. 2012: Fig. 7b) and proved that at least two individuals were detected at one camera station. The maximum distance between detections of animals with typical pelage was 13.8 km and, even with no information on home range in the species, it is likely that several individuals must have been camera-trapped in at least this area.

The highest detection rates across the nine areas were in high-elevation primary forest and lowland oil palm plantation, two very different habitats. Surveys of other primary forest and oil palm areas resulted in no detections, despite previous records of the species in some of them (Duckworth *et al*. 2006), and consistent survey methods across areas. Only four sites (470 camera-trap days) at elevations higher than 1,342 m were surveyed and so the upper limit of these records does not necessarily indicate the upper limit of Malay Weasel occurrence; it is possible that even within Crocker Range National Park Malay Weasel occurs at higher elevations than those at which we detected it. The lack of Malay Weasel detections during July – September is probably biologically uninformative: neither Crocker Range nor Danum Palm (the two areas with highest detection rates) were surveyed during these months.

Daytime activity seems typical for the species. Of the 59 records collated by Duckworth *et al*. (2006) that had temporal information, 53 (89.8%) were during daylight. While this pattern may have been strongly influenced by the timing of human activities, round-the-clock camera-traps removes this potential bias.

Malay Weasel diet is poorly known, but is thought to include rodents (Franklin & Wells 2005) and reptiles (Jentink 1898). Possibly, higher densities of some rodents (e.g. *Maxomys whiteheadi*; Rajaratnam *et al*. 2007) and/or higher hunting success in oil palm plantations might encourage movement into, or allow elevated abundances in this habitat. Indeed, this may be so for Leopard Cat *Prionailurus bengalensis* (Scott *et al*. 2004, Rajaratnam *et al*. 2007). Presence of Malay Weasel would then benefit plantation owners insofar as it preys on rodent pests. Certainly, this species is welcomed in the farmlands surrounding Kerinci Seblat National Park, Sumatra, where it is perceived to control vermin (Franklin & Wells 2005).

The increasing use of camera-traps in South-east Asia records Malay Weasel very infrequently. This rarity in camera-trapping is shared by at least some other weasels, such as Stripe-backed Weasel *M. strigidorsa* (Abramov *et al*. 2008), Least Weasel *M. nivalis* (García & Mateos 2009), Long-tailed Weasel *M. frenata* (Gompper *et al*. 2006, Ordeñana *et al*. 2010) and Yellow-bellied Weasel *M. kathiah* (Supparatvikorn *et al.* 2012). Whether this generally low camera-trapping rate is a true reflection of a low population density, or arises from behavioural traits that result in few photographic records, is unclear. Malay Weasels apparently show little fear (e.g. Franklin & Wells 2005, Duckworth *et al*. 2006). Several photographed during the present surveys seemed to be curious of the cameras; some even climbed over the unit. It is, therefore, perhaps unlikely that Malay Weasels avoid camera-traps because of fear. Inappropriate camera-trap height might reduce the likelihood of detecting this relatively small carnivore. However, this seems unlikely in at least our surveys, where detection rates were low despite the cameras being close enough to the ground to record, frequently, similar-sized mammals such as mongooses *Herpestes* and smaller ones such as small rodents. When camera-trap surveys are targeted to specific species, or even when surveys are designed for assessment of mammal communities, cameras are often placed on perceived travel routes (often logging roads and forest trails) for those species. These habitat sub-types might be avoided by Malay Weasels. Observations reported in Duckworth *et al*. (2006) detail animals hunting amongst fallen logs and entering holes. Malay Weasels might have a tendency to avoid clear forest trails and logging roads, perhaps unrelated to fear but because they are not very good foraging areas. It is possible that Malay Weasels spend a great deal of time hunting rodents in dense vegetation at which camera-traps are not usually directed. Cameras set at more typical locations might, therefore, be unlikely to detect Malay Weasels. It is also possible that Malay Weasel's movements, perhaps often fast and zigzagging (e.g. Giordano & Brodie 2012, Perrotto 2012) result in low detection probabilities in camera-trap surveys. Detections might be increased by targeting areas of dense vegetation, and the use of a suitable lure. The former, however, would result in vastly suboptimal locations for the target species of most camera-trapping surveys and so the number of Malay Weasel detections is unlikely to increase from typical camera-trap surveys in the future.

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Appendix 1. Details of Malay Weasel *Mustela nudipes* detections in nine study areas, Sabah, Malaysia.

Survey area	Location of detections	Elevation (m)	Date	Time
Malua	5°09′02″N, 117°41′29″E	184	27 Dec 2008	07h04
Danum Palm	5°04′54″N, 117°46′04″E	231	27 Mar 2009	09h31
Danum Palm	5°04′54″N, 117°46′04″E	231	29 Mar 2009	15h26
Danum Palm	5°04′54″N, 117°46′04″E	231	06 Apr 2009	10h23
Danum Palm	5°04′54″N, 117°46′04″E	231	11 Apr 2009	17h24
Danum Palm	5°04′45″N, 117°45′44″E	241	11 May 2009	08h39
Danum Palm	5°04′45″N, 117°45′44″E	241	21 May 2009	06h45
Danum Palm	5°04′45″N, 117°45′44″E	241	27 May 2009	09h15
Danum Palm	5°05′10″N, 117°46′01″E	202	21 Jun 2009	16h08
Danum Palm	5°05′29″N, 117°46′47″E	199	25 Jun 2009	08h32[a]
Tabin	5°16′16″N, 118°30′20″E	68	10 Mar 2010	08h17
Crocker Range	5°25′31″N, 115°59′24″E	1,120	11 Oct 2011	10h05
Crocker Range	5°24′18″N, 116°02′39″E	1,287	03 Nov 2011	06h03[b]
Crocker Range	5°22′13″N, 116°02′08″E	885	04 Nov 2011	07h20
Crocker Range	5°26′46″N, 116°05′30″E	789	10 Nov 2011	15h52
Crocker Range	5°23′18″N, 116°03′04″E	1,186	18 Nov 2011	07h40[c]
Crocker Range	5°26′33″N, 116°03′32″E	1,342	04 Dec 2011	08h19
Crocker Range	5°22′13″N, 116°02′08″E	885	05 Dec 2011	09h31
Crocker Range	5°22′13″N, 116°02′08″E	885	06 Dec 2011	10h28
Crocker Range	5°26′33″N, 116°03′32″E	1,342	12 Dec 2011	08h36
Crocker Range	5°22′13″N, 116°03′20″E	964	29 Dec 2011	14h44
Crocker Range	5°25′31″N, 115°59′24″E	1,120	01 Jan 2012	06h59[d]
Crocker Range	5°28′52″N, 116°00′02″E	694	05 Jan 2012	08h09
Crocker Range	5°22′13″N, 116°02′08″E	885	09 Jan 2012	09h20
Crocker Range	5°26′33″N, 116°03′32″E	1,342	01 Feb 2012	18h25
Crocker Range	5°26′33″N, 116°03′32″E	1,342	02 Feb 2012	17h26[e]
Crocker Range	5°26′34″N, 116°00′04″E	1,131	15 Feb 2012	13h42
Crocker Range	5°22′13″N, 116°02′08″E	885	21 Feb 2012	13h03
LKWS*	5°24′59″N, 118°02′05″E	18	17 Jun 2012	07h00

[a]Sequence of five images, three at 08h33 and the fifth at 08h35, all probably the same individual[#]; [b]sequence of three images of the same individual[#], all at 06h03; [c]sequence of two images of the same individual[#], both at 07h40; [d]sequence of three images of the same individual[#], all at 06h59; [e]another image at 17h50, unclear whether of the same individual.

[#]Considered to be the same individual because of the animal's position in subsequent images relative to that in the first image.

Geographical coordinates according to the WGS84 datum.

*Video record (Perrotto 2012) from Lower Kinabatangan Wildlife Sanctuary (= LKWS), the time is approximate. No Malay Weasel was camera-trapped during the survey in this area.

Recent sightings of Ruddy Mongoose *Herpestes smithii* in Eserna hill range, Jalore, Rajasthan, India: northwest extension of its known range

Sumit DOOKIA

Abstract

Three photo-documented sightings of Ruddy Mongoose *Herpestes smithii* in the Eserna hill range, in the western part of the Aravalli hills, Rajasthan, India, constitute a north-westward extension of its known range from the nearest known population, in Kumbhalgarh Wildlife Sanctuary, Rajasthan, which lies roughly 100 km to the east.

Keywords: Aravalli hills, direct sighting, habitat use, thorn forest

Introduction

Ruddy Mongoose *Herpestes smithii* is known from peninsular India, in the Western and Eastern Ghats, extending northwards up to Delhi, in the west up to at least 27°30'N in Rajasthan, and in the east to 24°N in Bihar; outside India it occurs only in Sri Lanka (Pocock 1939, Prater 1971, Corbet & Hill 1992, Hussain 1999, Menon 2003). It is listed in Schedule II of the Indian Wildlife (Protection) Act, 1972 and on Appendix III of CITES, and is classified as Least Concern in *The IUCN Red List of Threatened Species*, where its population trend is assessed as declining (Choudhury *et al*. 2008). Nationally also, it was evaluated as Least Concern during a Conservation Assessment and Management Plan workshop (Molur *et al.* 1999). This paper reports the finding of Ruddy Mongoose north-west of its known range in Rajasthan, India.

Records

Ruddy Mongoose was sighted three times in the Eserna hill range, near the village of Meda in Jalore district (Table 1). Sightings, from three closely-spaced localities, included an adult eating fresh goat skin near a temple, and three young animals repeatedly emerging from rock holes; only for one sighting was photography possible. The distinctive tail, with a 2–3-inch black tip (Fig. 1), allowed confirmation of identification as Ruddy Mongoose. The area lies in biogeographic zone 3A (Rodgers *et al.* 2000) and the vegetation type has been classified as Northern Tropical Thorn Forest (6B) and sub-type Desert Thorn Forest (6B/C1) (Champion & Seth 1968). The Eserna hill range is about 8–10 km long with its highest peak about 500 m asl. The complete hill range has good-quality thorn forest (Figs 2–3), protected by generations-old religious belief with a temple of goddess *Amba mata* in its centre. Sheep and goat are annually sacrificed by the locals, although such practices are illegal in India. The area is a multiple-use area defined by the Rajasthan

Fig. 1. Adult Ruddy Mongoose *Herpestes smithii* in thorn forest in Eserna Range, Rajasthan, India, 3 January 2010. Note black tip to tail (two views).

Table 1. Sightings of Ruddy Mongoose *Herpestes smithii* in Eserna Range, Jalore, Rajasthan, India.

Location[1]	Date	Animals seen	Altitude[1]	Habitat
Meda Uparla, near *Mata ji ka Than*, 25°15'34.80"N, 72°42'26.77"E	3 Jan 2010	2 adult, 3 young	460	Mixed thorn forest
Meda valley, near *Mamaji ka Than*, 25°15'38.17"N, 72°42'17.11"E	21 Sep 2010	2 adult, 1 young	372	Mixed thorn forest
Towards Dhawala village side, 25°16'25.20"N, 72°42'26.13"E	14 Feb 2013	2 adult	275	Dry nalah[2], amid thorn forest

[1]Geographical coordinates (WGS84) and approximate altitude, in m asl, were measured using a hand-held GPS receiver (Garmin MAP62S).
[2]A nalah is a local name for a dry rivulet. In desert areas, they hold water only briefly, remaining dry almost round the year. Their vegetation is distinct from the surrounding areas.

Fig. 2. The Eserna range, Rajasthan, India, during the monsoon season. This hill range receives relatively high rainfall for the region.

Fig. 3. A complete view of the Eserna range, Rajasthan, India, from where the new population of Ruddy Mongoose *Herpestes smithii* is reported.

state forest department as reserved forest, but now facing severe pressure from the surrounding villages and from mining activities.

Discussion

Ruddy Mongoose inhabits forests, taking 'forest' as classified by Champion & Seth (1968), including rather open, low-stature formations such as thorn forests. It is considered to occur less in areas near human disturbance (Hussain 1999) than do the related Indian Grey Mongoose *H. edwardsii* and Small Indian Mongoose *H. auropunctatus*. The Thar Desert of Rajasthan extends west from the Aravalli hill range. The range has higher rainfall than the adjacent desert: mean annual rainfall for the district is around 270–280 mm, whereas locations holding Ruddy Mongoose receive 380–400 mm. There are as yet no records of Ruddy Mongoose from the Thar desert itself. Kumbhalgarh Wildlife Sanctuary in Rajasthan and Taranga Hills in Gujarat are the locations closest to the present sightings, which is about 100 km further west of them (Fig. 4). Other recent records from north and central India are from Madhav National Park, Madhya Pradesh (Choudhury *et al*. 2008); Asola Wildlife Sanctuary,

Fig. 4. Recent sighting localities of Ruddy Mongoose *Herpestes smithii* in Rajasthan, India.

Delhi (Hussain 1999); Panna National Park (Shekhar 2008); Sariska Tiger Reserve, Rajasthan (Gupta 2011); Taranga Hills in northern Gujarat (Patel & Patel 2010, 2011) and a few protected areas in the south and central Aravalli range in Rajasthan, i.e. Sajjangarh Sanctuary (Bhatnagar *et al.* 2009), Sitamata Wildlife Sanctuary (Sharma 2001), Kumbhalgarh Wildlife Sanctuary and Phulwari-Ki-Nal Wildlife Sanctuary of Rajasthan (Anon. 2010). The Eserna hill range harbours many other threatened species (Dookia 2012), and warrant conservation.

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Feeding observations of a Binturong *Arctictis binturong* group in Namdapha National Park, Arunachal Pradesh, India

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Abstract

A group of Binturongs *Arctictis binturong* was observed feeding on fruits of the fig *Ficus drupacea* in Namdapha National Park, India, in November 2012. The group, three adults and one juvenile, was monitored for 22 hours spread over five nights to record behaviour. The Binturongs spent 50.8% (SE ± 3.33) of the total time resting, 35.8% (SE ± 2.82) of time feeding on *F. drupacea* fruits and 13.3% (SE ± 0.84) of time grooming. They were never observed to interact with Red Giant Flying Squirrels *Petaurista petaurista* or Particolored Flying Squirrels *Hylopetes alboniger*, both of which also fed in the same tree. Local hunters reported Binturongs to be a rare non-target species, killed for food whenever encountered.

Keywords: *Ficus drupacea*, fig, flying squirrels, group size, nocturnal activity

Introduction

Binturong *Arctictis binturong*, the largest arboreal civet (Viverridae), is widely distributed in forest from Sikkim to Myanmar, south-west Yunnan (China) and Indochina to Malaysia, Sumatra, Java, Borneo, Palawan and associated small islands (Corbet & Hill 1992). In India, it inhabits only the northeastern states (Menon 2003). Despite its large geographical distribution range, it remains very poorly studied. It is part of the Asian endemic subfamily of palm civets (Paradoxurinae), comprising highly frugivorous species (Estrada & Fleming 1986, Rabinowitz 1991, McKenney 2011). Binturongs are active day and night and are hypo-carnivores that eat a lot of fruit and a wide range of animal matter (Prater 1971, Lambert 1990, Menon 2003, McKenney 2011, Nettelbeck 1997, Shrestha *et al.* 2011). They might be effective seed dispersal agents for some plants (Colon & Campos-Arceiz 2013). Binturongs are declining through forest destruction and degradation, and through hunting for their fur, meat and scent gland, so are categorised as Vulnerable by *The IUCN Red List of Threatened Species* (Widmann *et al*. 2008).

A group of Binturongs located by chance in Namdapha National Park, India, was followed over several nights to document their behaviour until relocation of the survey camp forestalled future watching of them. The observations are documented here.

Observation area

Namdapha National Park (Namdapha NP; 27°23′30″–27°39′40″N, 96°15′02″–96°58′33″E) covers 1,985 km^2 in the eastern Himalayan region of Arunachal Pradesh and harbours some of the northernmost tropical rainforests in the world (Proctor *et al.* 1998). Its high habitat heterogeneity, stemming from vast altitudinal range (200–4,571 m asl), allows a rich mammal fauna (Proctor *et al.* 1998, Datta *et al*. 2003). Hunting in the park is prohibited by law but continues at levels sufficient to threaten several species' survival there. Namdapha NP's floral and faunal diversity was detailed by Ghosh (1987) and Nath *et al*. (2005).

Methods

During a long-term survey of flying squirrels *Petaurista* and *Hylopetes* in Namdapha NP, we chanced upon a group of Binturongs between Hornbill Camp and Bulbulia Camp at 27°32′06.2″N, 96°27′14.5″E (datum WGS84; about 625 m asl) in November 2012. The group was monitored for 22 hours on five nights from 16–24 November 2012. Animals were located by scanning the canopy with red lights. Two spotlights (6 V, solar powered) and National Geographic 5× night-vision binoculars were used to observe the animals found. Heights of Binturongs above ground were measured with a Bosch laser distance measurer. Behavioural observations were recorded using scan sampling (see Altmann 1974), which started after sunset at 18h30 and lasted until 00h30 at the latest (because the solar-charged spotlight batteries had then discharged), with scans every 30 minutes. Behaviour was categorised as resting, feeding and grooming. 'Feeding' comprised time in consumption and in walking in order to forage. 'Resting' comprised time spent stationary. 'Grooming' included activities such as complete body shaking, body licking and scratching. At each scan, the behaviour of the first-sighted animal was recorded. Forest guards and experienced hunters in villages surrounding Namdapha NP were interviewed informally and opportunistically about Binturongs.

Results

A group of Binturongs first encountered, by chance, on 16 November 2012 in a fig *Ficus drupacea* tree was observed and relocated for further observations on four alternate nights. The group when found comprised three adults and one juvenile, but on subsequent nights fewer individuals were sighted (Table 1). Animals were difficult to sex under prevailing low visibility. During the 22 hours of observation (44 scans), the Binturongs were always in the same tree. They fed exclusively on ripe *F. drupacea* fruits, which were bigger and brighter, darker red than unripe fruits (Figs 1–2). Feeding height ranged between 12 and 25 m above ground; the feeding tree was 30.6 m high. The juvenile, seen only on the first night, was observed to follow a single adult and often remained out of view behind thick foliage during spotlight observations. The adults did not seem disturbed by the spotlight, exhibiting no apparently abnormal behaviour. Their activities comprised feeding (35.8%; SE ± 2.82), resting (50.8%; SE ± 3.33) and auto-grooming (13.3%; SE ± 0.84) (Fig. 3). No interactions were obvious between members of the group. The adults often maintained a distance of 5–10 m from each other. Mostly, they fed in the up-

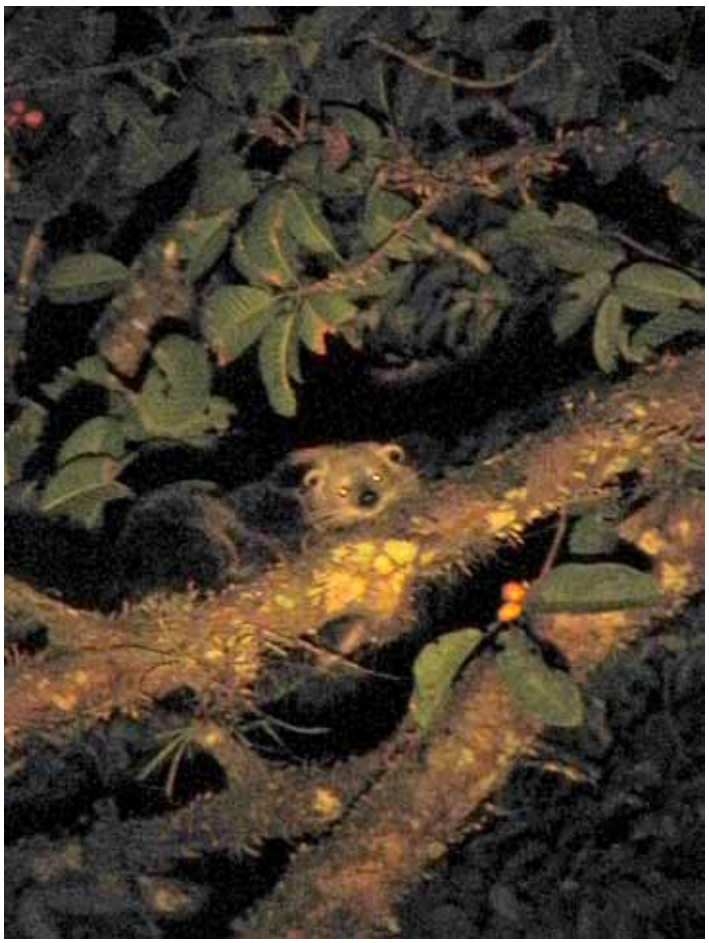

Fig. 1. Binturong *Arctictis binturong* resting in a fig *Ficus drupacea* tree, Namdapha National Park, India, 16 November 2012.

Fig. 2. Leaves and ripe fruit of the fig *Ficus drupacea*, Namdapha National Park, India.

per canopy (20 m and above) while they rested by lying down over the large horizontal branches in the middle canopy (10–20 m above ground). They moved into the terminal branches only rarely. Two feeding tactics were observed: plucking fruit directly by the mouth, and grabbing fruit and/or fruit-bearing branches with the front limbs to steer it into the mouth.

Table 1. Date, time and number of individual Binturongs *Arctictis binturong* observed in Namdapha National Park, India, in November 2012.

Date	Observation time	Individuals observed
16 Nov	18h30–22h30	3 adults, 1 juvenile
18 Nov	18h30–22h30	2 adults
20 Nov	18h30–22h30	3 adults
22 Nov	18h30–22h30	2 adults
24 Nov	18h30–00h30	2 adults

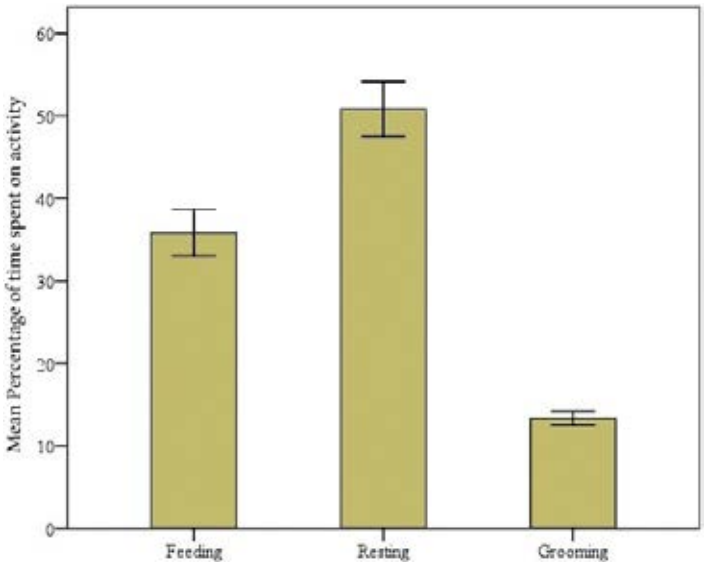

Fig. 3. Percentage of time (mean ± SE) spent in various activities by wild Binturongs *Arctictis binturong* in a fruiting fig *Ficus drupacea*, Namdapha National Park, India; first half of night only.

The same tree held Red Giant Flying Squirrels *Petaurista petaurista* and Particolored Flying Squirrels *Hylopetes alboniger*. Binturongs fed immediately after dusk (18h30) until 20h00, but not seemingly after (although there were no observations in the second half of the night), whereas flying squirrels fed in the upper canopy when the Binturongs were resting in middle canopy after their feeding peak. Particolored Flying Squirrel *Hylopetes alboniger* appeared in the tree much earlier than did Red Giant Flying Squirrel *P. petaurista*, but both species could feed in proximity to each other, even on the same branch (Krishna *et al.* 2013). Flying squirrels maintained a typical distance of 8–10 m horizontally and vertically from the Binturongs. No aggression was recorded between flying squirrels and the Binturongs.

Out of 11 experienced hunters and forest guards interviewed, four (36.4%) considered Binturong to be 'rare', two (18.2%; both were forest guards) had camera-trapped the species on several occasions, and the remaining five (45.4%) did not apparently know of the species's existence. According to Kabuk Lego, a forest official belonging to the Adi tribe, Binturong is known as 'situm peya' in the Adi language, meaning 'not bear', although this remains to be validated by direct physical observation shared by speakers of both languages.

Discussion

Binturong has often been stated to be solitary (Menon 2003) and indeed many sightings are of singles (e.g. Nettelbeck 1997),

although small groups of adults with immature offspring were noted by Medway (l978). Binturongs are well known to eat figs (e.g. Lambert 1990, Rozhnov 1994). Arivazhagen & Thiyagesan (2001) recorded that 63.7% of active time of Binturongs (captive old male and old female, averaged) was spent in resting, while in the present study they spent 50.8%. Conversely, the average time spent feeding by the captives (6.1%) was much lower than in the present study (35.8%). These differences presumably stem from the captive animals' easy access to food but may also reflect the restriction of the present observations to the first half of the night, whereas the zoo animals were watched round the clock (Arivazhagen & Thiyagesan 2001). All grooming observed was auto-grooming. Typically, Binturongs licked their fur, then scratched and, often, shook their body. Rozhnov (1994) suggested that body-shaking was the preferred maintenance activity, followed by licking and scratching.

Binturongs and flying squirrels fed in the same tree, albeit at different heights and at different times of the night. They were never seen to interact, in contrast to the aggressive encounters between gibbons *Hylobates* and Binturongs documented by Nettelbeck (1997).

Local people around Namdapha NP said that they find Binturongs occasionally or not at all. In nearly 110 hours of spotlighting over several nights in other parts of Namdapha NP we never encountered the species. Binturongs are apparently killed as a source of food whenever chanced upon, but were not stated to be a hunters' target, perhaps because they are so rarely encountered.

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Observations of Crab-eating Mongoose *Herpestes urva* in eastern Nepal

Sanjan THAPA

Abstract

Crab-eating Mongoose *Herpestes urva* has been reported from within and outside protected areas of Nepal. However, specific localities are poorly documented. Three individuals were observed (of which one was photographed) in agricultural land at Madi Rambeni-Ward n° 2 and 3, Sankhuwasabha district, eastern Nepal. These are the first detailed records with exact locality of the species in Nepal published since 1925, and the first from eastern Nepal.

Keywords: agricultural habitat, distribution, new locality record, Sankhuwasabha district

पुर्वी नेपालको संखुवासभा जिल्लाको मादीमा गँगटे न्याउरीमुसाको अवलोकन

सारांश:

नेपालको संरक्षित क्षेत्र भित्र र बाहिर गँगटे न्याउरीमुसा पाइन्छ। तर तिनीहरुको वितरण भएको स्पष्ट ठाउँ उल्लेखित कमै मात्र जानकारीमा छ। पुर्वी नेपालको संखुवासभा जिल्लाको मादी राम्बेनी वडा नं. २ र ३ मा तीन वटा गँगटे न्याउरीमुसाहरु खेतमा अवलोकन गरीएको छ (जसमध्ये एउटा न्याउरीमुसोको तस्वीर खिचीएको छ)। सन् १९२५ पश्चात नेपालमा र पुर्वी नेपालमा यस जनावर पाइएको निश्चित स्थान उल्लेख गरीएको यो पहिलो अभिलेख हो।

Background

Crab-eating Mongoose *Herpestes urva* was first reported, under the name *Gulo urva*, in Nepal in 1836 from the country's central and northern regions (Hodgson 1836). Hodgson presented several specimens to the natural history section of the British Museum (BMNH), including skulls and a drawing of an adult with details of hind feet (Gray 1846, 1863). Checklists and other publications about Nepal's wildlife (Frick 1969, Mitchell 1975, Suwal & Verheugt 1995, Shrestha 1997, Majupuria & Kumar (Majupuria) 2006, Baral & Shah 2008, Jnawali *et al*. 2011) typically include Crab-eating Mongoose. However, only Fry (1925) published records of specific localities, reporting specimens of single females each from Gorkha, central Nepal; Chengli (perhaps today's Chyangli Village Development Committee in Gorkha district); and Boitari, in Gorkha district. More recently, it has been listed as occurring in the Annapurna Conservation Area, Chitwan National Park, Bardia National Park, Suklaphanta Wildlife Reserve and Ilam (Suwal & Verheugt 1995, Majupuria & Kumar (Majupuria) 2006), and in Koshi Tappu and Parsa Wildlife Reserves (Jnawali *et al*. 2011). According to Jnawali *et al*. (2011), it occurs in Nepal between 100 m and 1,300 m and is fairly common in the lowland forests in the country's east (in Dharan Forests and Mai Valley forests). None of these modern locations seems to be associated with details of any specific records.

Crab-eating Mongoose's conservation status has been assessed nationally as Vulnerable C2a(i) with a population size guesstimated at fewer than 1,000 individuals (Jnawali *et al*. 2011). However, it is not legally protected in Nepal.

Observations

In 2013, three individual Crab-eating Mongooses were sighted, of which one was photographed, at Madi Rambeni-Ward n° 2 and 3, Sankhuwasabha district, eastern Nepal (Fig. 1). Madi Rambeni is in a sub-tropical bioclimatic zone (Bajracharya 1996). Rice is a major crop during the monsoon season and

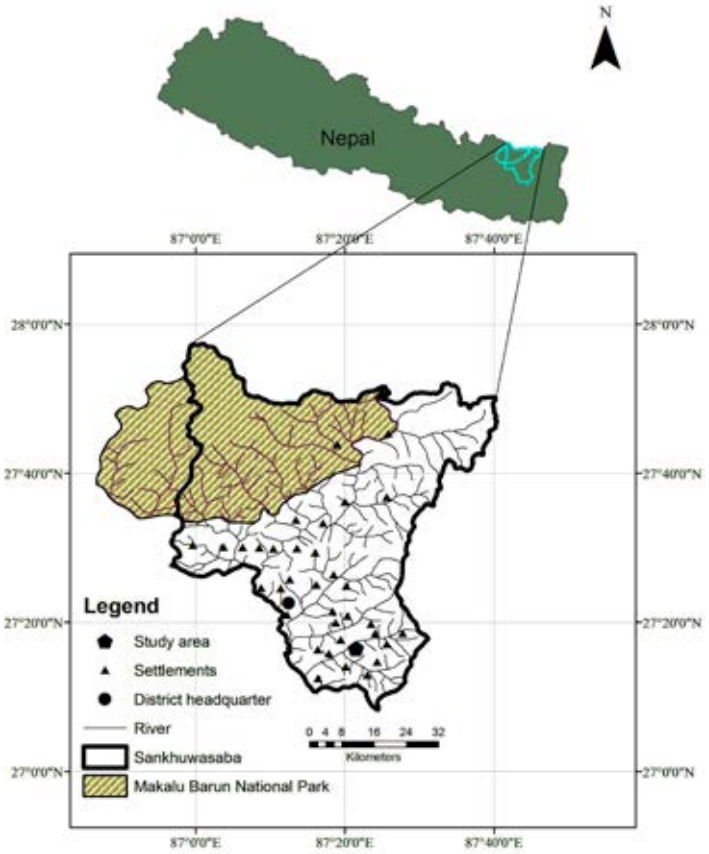

Fig. 1. Area of Crab-eating Mongoose *Herpestes urva* sightings, Madi Rambeni-Ward n° 2 and 3, Sankhuwasabha district, eastern Nepal.

Fig. 2. Crab-eating Mongoose *Herpestes urva* (two views). Kantar, Madi-Rambeni-3, Nepal, 2 February 2013.

is harvested during November–December. The fields remain dry and muddy, near water sources, after the harvest until the end of March. Geographical co-ordinates and elevations were measured using a Garmin Etrex GPS. The former use the WGS84 datum and the latter are approximate.

One Crab-eating Mongoose was observed on 4 January 2013 at 14h55 in Dhunge (27°16′29.2″N, 87°21′30.3″E) at a recorded elevation of 1,264 m. Running through a harvested rice terrace, it stopped and stared for about 30 seconds then crossed a stream and entered a stand of bamboo, alder *Alnus nepalensis* and cardamom cultivation. Its body was brownish-grey with a reddish tinge at the back. The tail was also brownish-grey with a reddish tinge. The brownish-grey head had a distinct white band running from below the ear backward across the neck to terminate just above the foreleg. The animal was seen just for about a minute.

After searching for nine days, in the hope of photographic proof of the species, another individual sighted on 2 February at 16h17 in Kantar, Madi-Rambeni-3 (27°16′34.3″N, 87°21′31.6″E) at a recorded elevation of 1,201 m was immediately photographed (Fig. 2). It was inserting its mouth in the mud, probably searching for food in a harvested rice terrace filled with water (sim, in Nepali) along the Jamuna stream. For closer photography, I approached it, but it fled into bamboo along the stream. The animal was observed for 2–3 minutes. Its body was dark grey with white hair tips. Its nose was distinctly red. Its tail was bushy with the distal part brownish in appearance while the basal part was concolorous with the body.

One more individual was sighted on 26 March 2013 at 16h30 in Patidhara (27°16′31.2″N, 87°21′24.3″E) at a recorded elevation of 1,198 m. It was observed for about 3–4 minutes, apparently seeking food in the sim along the stream. The animal was pale grey in colour, differing from the first two sightings by the absence of any reddish hue.

The local people in this area called Crab-eating Mongoose '*dumsi ko mulya*', literally meaning a hybrid of porcupine *Hystrix brachyura* and marten *Martes*. They said that it was seen singly, in duos, or in groups of up to eight individuals, feeding on frogs, tadpoles and insects in waterlogged harvested terrace, particularly around sunset. They reported that these animals live in burrows near rocks, and run here and there in the fields in the afternoon. When disturbed they immediately flee. They reported that an individual once attacked a chicken near a house amid rice fields, but failed to kill it.

Discussion

The present observations seem to be the first specific Crab-eating Mongoose records published for Nepal since Fry (1925), and the first for eastern Nepal. However, there are several other undocumented locality records from Ilam District, and the species is not uncommon in certain patches of Dharan Forests IBA, Sunsari District, east Nepal (H. S. Baral *in litt*. 2013). These three records from Sankhuwasabha district fall within the narrow altitudinal range of 1,198–1,264 m. However, local people reported observing the species at lower elevations and up to 1,800 m. This range needs to be confirmed, as does the statement in Majupuria & Kumar (Majupuria) (2006: 122) that it "presumably" ranges up to 2,500 m.

This is a commonly seen mongoose in much of mainland Southeast Asia (e.g. Duckworth 1997, Than Zaw *et al*. 2008), but not in Nepal. The fundamental reason for its apparent rarity in the country remains unclear, making it noteworthy that individuals can be, apparently, frequently encountered in Sankhuwasabha district. These records fall within the elevation range stated for Nepal. The locations lie outside the distribution as mapped by Jnawali *et al*. (2011), but between the latter and the species's main range in Southeast Asia.

Many Southeast Asian records of Crab-eating Mongoose come from evergreen forest (including degraded areas), often near water, with some from deciduous forest in Thailand, Cambodia and southern Viet Nam, and from lowland wet evergreen forests, secondary forest and around industrial areas (oil refineries) in India (Duckworth 1997, Van Rompaey 2001, Duckworth & Timmins 2008, Than Zaw *et al*. 2008). Additionally, there are records from rice fields and other agricultural areas, and even near human settlements (Duckworth & Timmins 2008). In Nepal, this species is said to inhabit tropical and subtropical evergreen and moist deciduous forests (Jnawali *et al.* 2011), but the Sankhuwasabha observations come from agricultural terraces near streams, amid fragmented vegetation and human settlements. Local people indicated burrows amid the farmland that they attributed to this species. However, the sites lie only about 1–2 km from forest, so it cannot be excluded that these animals using farmland depend on adjacent forest in some way. These sightings in Nepal were by daylight,

as is typical in Southeast Asia (Than Zaw *et al*. 2008 and references therein).

Poaching for fur, habitat loss and degradation from wetland drainage, unmanaged pollution of waterways, and clearing of forests for livestock and agriculture have been assessed as the major threats to the species in Nepal (Jnawali *et al.* 2011). I found no evidence of poaching, but given the agricultural nature of the habitat, pollution of agricultural fields and the water channels by excessive use of fertilisers and pesticides certainly comprise possible threats for this species in this area.

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Recent records of Ruddy Mongoose *Herpestes smithii* and Brown Mongoose *H. fuscus* from Kerala, southern Western Ghats, India

R. SREEHARI[1], C. T. FREDY[1], R. ANAND[1], C. R. ANEESH[1,2] and P. O. NAMEER[1]

Abstract

Camera-trapping and direct observation recorded Ruddy Mongoose *Herpestes smithii* in Parambikulam Tiger Reserve and Chinnar Wildlife Sanctuary, and Brown Mongoose *H. fuscus* in Parambikulam Tiger Reserve and Eravikulam National Park. All sites lie in the state of Kerala, in which there is apparently only one previously published record of each species. The Brown Mongoose records expand its reported altitudinal range to 492–2,032 m.

Keywords: Anamalai Hills, camera-trapping, Chinnar Wildlife Sanctuary, Eravikulam National Park, Herpestidae, Parambikulam Tiger Reserve

ചുണയൻ കീരിയുടെയും തവിടൻ കീരിയുടേയും കേരളത്തിൽ നിന്നുമുള്ള പുതിയ ചില റിപ്പോർട്ടുകൾ

സംഗ്രഹം

പറമ്പിക്കുളം കടുവാസങ്കേതം, ചിന്നാർ വന്യജീവി സങ്കേതം, ഇരവികുളം ദേശീയോദ്യാനം എന്നിവടങ്ങളിൽ 2011-12കളിൽ നടത്തിയ പഠനങ്ങളിൽ ചുണയൻകീരിയെ (Ruddy Mongoose) ചിന്നാറിൽ നിന്നും, പറമ്പിക്കുളത്തു നിന്നും നിരീക്ഷണ ക്യാമറ ഉപയോഗിച്ച് കണ്ടെത്തുകയുണ്ടായി. കൂടാതെ തവിടൻ കീരിയെ (Brown Mongoose) പറമ്പിക്കുളത്ത് നേരിൽ കാണുകയും ഇരവികുളത്തു നിന്ന് നിരീക്ഷണ ക്യാമറയിൽ ചിത്രമെടുക്കുകയും ചെയ്തു.

Introduction

India has seven species of mongoose, all in the subfamily Herpestinae of family Herpestidae. Four are known from Kerala, one of India's southernmost states: Indian (Common) Grey Mongoose *H. edwardsii*, Brown Mongoose *H. fuscus*, Ruddy Mongoose *H. smithii* and Stripe-necked Mongoose *H. vitticollis* (Nameer 2000, Menon 2003). Of these four, Indian Grey Mongoose is the most widespread, seen near human habitation and along forest edges, as well as in the forest interior (e.g. Shekhar 2003, D. Mudappa *in litt*. 2013). While Stripe-necked Mongoose is seen in most forested areas of the Western Ghats (Mudappa 2013), Brown Mongoose and Ruddy Mongoose have more restricted reported distributions, with apparently only a single published record of each species from the State (see below). Recent (2011–2012) small carnivore surveys in various protected areas in the Anamalai region (Fig. 1) of the Western Ghats recorded all four species: the records of Brown and Ruddy Mongooses are presented here (detailed in Table 1). Locations and altitudes were recorded using a Garmin 72 GPS receiver. The former used the WGS84 datum, and the latter are approximate.

Ruddy Mongoose

Ruddy Mongoose is distributed in peninsular India, from the state of Rajasthan in the west to Bihar to the east, and in Sri Lanka (Phillips 1984, Dookia 2013, Mudappa 2013). In Parambikulam Tiger Reserve, a duo of Ruddy Mongooses was photographed by a Bushnell Infrared camera-trap (Trophy^{CAM} STC-TGl4M) installed near a stream running through a moist deciduous forest, and one was sighted near the tunnel entry of the Parambikulam reservoir (Table 1). In Chinnar Wildlife Sanctuary, three independent camera-trap images of Ruddy Mongoose were obtained from a scrub jungle near the Kootar region (Table 1, Fig. 2). Ruddy Mongoose looks similar to Indian Grey Mongoose, but can be distinguished by a brown pelage with a rufous tinge, darker feet and black tip to the tail, which is usually curved upwards (Mudappa 2013). All five records of Ruddy Mongoose were within altitudes recorded as 440 to 575 m. All records were by day, consistent with previous reports that the species is largely diurnal. The single previously published report of Ruddy Mongoose from Kerala (Pillay 2009) is from Chinnar Wildlife Sanctuary.

Table 1. The survey's records of Ruddy Mongoose *Herpestes smithii* and Brown Mongoose *H. fuscus*, Kerala, India.

Date	Location	Time	Record	Alt. (m)	Forest type
Ruddy Mongoose					
4 Jan 2012	Tunnel Entry, Parambikulam TR, 10°24′58.0″N, 76°47′52.8″E	15h20	Direct sighting	541	mdf
13 Mar 2012	Vengoli,Parambikulam TR, 10°24′22.5″N, 76°47′56.1″E	10h26	Camera-trapped	574	mdf
30 Sep 2012	Kootar, Chinnar WLS, 10°21′05.4″N, 77°13′42.6″E	07h15	Camera-trapped	442	Scrub jungle
3 Oct 2012	Kootar, Chinnar WLS, 10°21′01.6″N, 77°14′11.8″E	13h48	Camera-trapped	439	Scrub jungle
5 Oct 2012	Kootar, Chinnar WLS, 10°21′05.4″N, 77°13′42.6″E	06h53	Camera-trapped	442	Scrub jungle
Brown Mongoose					
21 Sep 2011	Orukomban, Parambikulam TR, 10°24′0.2″N, 76°41′38.2″E	07h50	Direct sighting	492	Evergreen forest
9 Dec 2012	Eravikulam NP, 10°13′24.3″N, 77°04′59.7″E	21h27	Camera-trapped	2,032	Shola*

*montane evergreen forest; mdf = moist deciduous forest

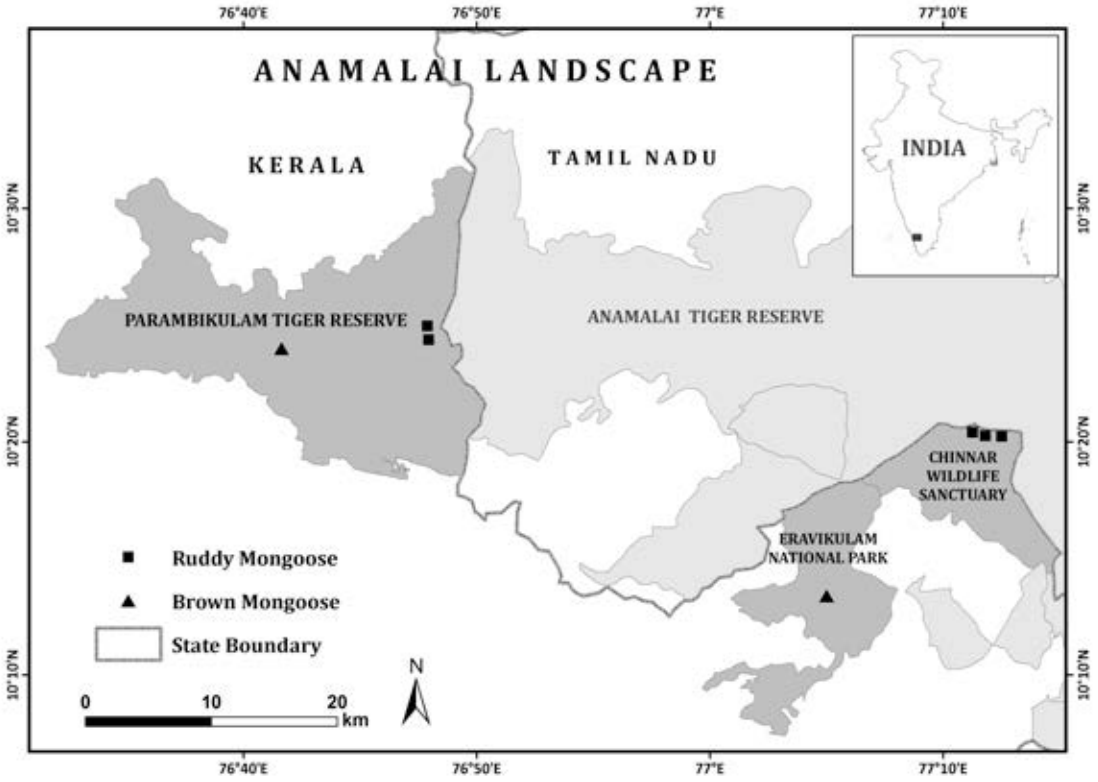

Fig. 1. Locations of the survey's Ruddy Mongoose *Herpestes smithii* and Brown Mongoose *H. fuscus* records in the Anamalai landscape, southern Western Ghats, India.

Fig. 2. Camera-trapped Ruddy Mongoose *Herpestes smithii* from Chinnar Wildlife Sanctuary, Kerala, India, 3 October 2012.

Fig. 3. Camera-trapped Brown Mongoose *Herpestes fuscus* from Eravikulam National Park, Kerala, India, 9 December 2012.

Brown Mongoose

Brown Mongoose inhabits forests in the south Indian hill ranges at 700–1,850 m asl (Mudappa *et al*. 2008, Mudappa 2013) and in Sri Lanka (Phillips 1984). Apparently the only previous record from Kerala is from Peeramedu, Idukki district (Mudappa *et al*. 2008). A Brown Mongoose was sighted in Parambikulam Tiger Reserve, on a forest road; it disappeared as soon as it was sighted (Table 1). A Brown Mongoose camera-trapped near the Eravikulam Hut, Eravikulam National Park, was on a *Rhododendron arboreum* tree, hardly one meter from the ground level (Table 1, Fig. 3). The species is clearly identifiable by its mostly uniform dark coloration and thick, conical tail. These records extend the known altitudinal limit of Brown Mongoose in the Western Ghats. The sighting in Parambikulam Tiger Reserve, at a recorded altitude of 492 m, is about 200 m lower than the lowest elevation given in Mudappa *et al*. (2008), while the Eravikulam National Park record, at 2,032 m, is about 200 m higher than the highest elevation given by Mudappa (2013).

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Photographic documentation of Brown Palm Civet *Paradoxurus jerdoni* in Maharashtra, India, north of its known range

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Abstract

Brown Palm Civet *Paradoxurus jerdoni* is a small carnivore endemic to the Western Ghats, India. It occurs throughout the southern Western Ghats, from Achankovil Reserved Forest (Kerala) to the Bhagwan Mahaveer Wildlife Sanctuary (Goa), but until now was not recorded in the northern Western Ghats, north of the state of Goa. Two records from the state of Maharashtra extend its known range north by about 200 km: a photograph near Amboli, and a sighting even further north in Chandoli National Park. The forest of Amboli is structurally connected to the Bhagwan Mahaveer Wildlife Sanctuary in Goa, but connectivity with Chandoli National Park is now severely limited for this forest-dwelling small carnivore (see p. 39 for a record from 75 km further north).

Keywords: Amboli, Chandoli National Park, extension of known range, northernmost records

ब्राउन पाम सिवेट *Paradoxurus jerdoni* याचा माहितीक्षेत्राच्या उत्तरेकडील महाराष्ट्र, भारत येथील छायाचित्रित दस्तऐवज

सारांश

ब्राउन पाम सिवेट *Paradoxurus jerdoni* हा छोटा मांसभक्षक पश्चिम घाटामधील स्थानिक रहिवाशी आहे. हा प्राणी संपूर्ण दक्षिण पश्चिम घाटात सापडतो. केरळ मधिल आचनकोविल आरक्षित वनापासून गोव्यमधील भगवान महावीर अभयारण्यापर्यन्त याची नोंद आहे, परंतु या आधी उत्तर पश्चिम घाटामध्ये नोंद नव्हती. त्याच्या वसतीभागाच्या 200 कि. मी. उत्तर भागापर्यंत आढळल्याच्या दोन नवीन नोंदी महाराष्ट्रात केल्या जात आहेत. या प्राण्याचे अंबोली मध्ये छायाचित्रीकरण केले गेले व चांदोली राष्ट्रीय उद्यानामध्ये देखील हा प्राणी आढळला. या मांसभक्षकासाठी अंबोलीचे वन क्षेत्र भगवान महावीर अभयारण्याला हालचालीसाठी संलग्न आहे, परंतु या वनभागाची संलग्नता चांदोली राष्ट्रीय उद्यानाशी कमी झाली आहे.

Brown Palm Civet *Paradoxurus jerdoni* is a small carnivore endemic to the Western Ghats of India, distributed almost continuously from Achankovil Reserved Forest, Kerala, in the south, to Dhud Sagar, Bhagwan Mahaveer Wildlife Sanctuary, Goa, in the north (Rajamani *et al.* 2002). Most records are at altitudes of 500–1,300 m, and it is reportedly more common in higher altitudes (Mudappa 1998). Despite its relatively small range, the population of the species seems to be under no severe threat, so it is listed as Least Concern in *The IUCN Red list of Threatened Species* (Mudappa & Choudhury 2008).

Brown Palm Civet is largely arboreal, nocturnal and frugivorous, feeding on over 50 native tree and liana fruit species, as well as on four non-native plant species (Mudappa *et al.* 2010). It supplements its diet with invertebrates and smaller vertebrates (Pocock 1939, Mudappa *et al.* 2010). It is most commonly found in evergreen rainforest (Rajamani *et al.* 2002). It has also been reported in coffee plantations (Ryley 1913, Pocock 1939, Ashraf *et al.* 1993). Mudappa *et al.* (2007) found occurrence to be higher in medium-sized forest fragments contiguous with coffee plantations, than in isolated forest fragments. Its distribution may depend more on the structure of forests and fruit-tree distribution (Rajamani *et al.* 2002, Mudappa *et al.* 2007, 2010) than other factors.

Amboli (15°57′N, 73°59′E) is a popular hill town in the Sindhudurg district, while Chandoli National Park (17°10′N, 73°47′E) is located at the junction of four districts (Satara, Sangli, Ratanagiri and Kolhapur); both are in the state of Maharashtra. Vegetation around Amboli comprises semi-evergreen and moist deciduous forest, intermixed with some evergreen forest patches. Dominant trees include *Memecylon umbellatum*, *Actinodaphne*, *Syzygium cumini*, *Mangifera indica*, *Nothapodytes nimmoniana* and *Ficus*; moist deciduous forests merge into semi-evergreen and scrub forests along an altitudinal gradient (Jog 2009). Vegetation in Chandoli National Park is similar, dominated by the *Memecylon–Syzigium–Olea* floristic series (Kanade *et al.* 2008).

A Brown Palm Civet was sighted by GAP in Chandoli National Park in December 2010 (17°08′38.00″N, 73°43′29.27″E, datum WGS 84; recorded approximate elevation 818 m), but was not photographed. The animal was seen clearly for over two minutes at a distance of less than ten feet, foraging on the ground, near a stream during the night, in an evergreen patch of forest. In pelage it differed distinctly from Small Indian Civet *Viverricula indica* and Common Palm Civet *Paradoxurus hermaphroditus*. On 7 January 2013, at around 22h30 on a trail to Mahadev Gadh (15°57′59.87″N, 73°59′27.92″E, WGS84, recorded approximate elevation 749 m) at Amboli, a civet was sighted on a tree along the road. It was photographed and later identified as a Brown Palm Civet by the distinct darker pelage around the head, neck, shoulder, and fore- and hind-legs (as noted in Menon 2003) (Fig. 1).

This animal, with its lighter underbelly and markings along the face (Fig. 1), contrasts starkly with the more uniformly dark brown typical in the southern Western Ghats. This pattern in pelage colouration may be a regional variation in Brown Palm Civets of the northern Western Ghats. Another

Fig. 1. Brown Palm Civet *Paradoxurus jerdoni* photographed in Amboli, Maharashtra, India, on 7 January 2013; a) showing frontal view, b) showing the lighter underbelly and markings on the face. (Photos: Harshal Bhosale).

photograph, taken by HSB in November 2011, about 150 km south of Amboli in Sharavathi Wildlife Sanctuary, Karnataka (14°5′48″N, 74°41′12″E, datum WGS 84, recorded approximate elevation 278 m), and near the northern edge of the species's previously accepted range (Mudappa & Choudhury 2008), shows a similar pelage (Fig. 2). This could be a form of disruptive colouration (see Caro 2009), perhaps based on forest structure in the northern Western Ghats, but this is mere speculation. The forest type in Sharavathi is mostly evergreen. This sighting at a lower elevation supports the suggestion by Rajamani *et al.* (2002) that the civet's distribution may not be restricted to medium and high altitudes.

Brown Palm Civet is as an important seed disperser in its tropical forests (Mudappa *et al.* 2010). These records extend the known distribution about 200 km further north along the Western Ghats, into the state of Maharashtra. We are aware of no previous records of the species from the northern Western Ghats, but photographs of Small Indian (four) and Common Palm Civets (one) were obtained in a preliminary camera-trap survey (317 trap-nights) in Sindhudurg district, Maharashtra (V. Athreya verbally 2013). The forest area of Amboli is connected to that of Bhagwan Mahaveer Wildlife Sanctuary in Goa, but forest contiguity to Chandoli National Park has severely declined. Overall, information on small carnivore status, distribution and conservation needs in the northern Western Ghats remains limited.

Fig. 2. Brown Palm Civet *Paradoxurus jerdoni* photographed in Sharavathi Wildlife Sanctuary, Karnataka, India, in November 2011, with pelage colour similar to that in Fig. 1. (Photo:Harshal Bhosale).

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Note added at proof stage: Brown Palm Civet was camera-trapped on two separate nights (07 and 12 December 2013) in the Wai region of the northern Western Ghats (approximate location: 18°01′08″N, 73°40′28″E). Both records were of a single animal at the same camera-trap station (picture below). The camera-traps were set by Shrikar Ashtaputre and Sunil Kale with the help of Maharashtra State Forest Department and Vidya Athreya, Wildlife Conservation Society - India. This extends the known range of the species by another 75 km further north of Chandoli Nation Park.

The first records of Nilgiri Marten *Martes gwatkinsii* from Parambikulam Tiger Reserve, southern Western Ghats, India

R. SREEHARI and P. O. NAMEER

Abstract

Nilgiri Marten *Martes gwatkinsii* is a globally threatened mustelid endemic to the Western Ghats, southern India. It was camera-trapped once and sighted thrice in Parambikulam Tiger Reserve, Kerala, in the Anamalai Hill sub-region of the southern Western Ghats, in 2011–2012. These are the first records for this area, which lies within the known geographic range.

Keywords: Anamalai Hills, camera-trap, distribution, endemic, Mustelidae, Kerala

മരനായയുടെ പറമ്പിക്കുളം കടുവാസങ്കേതത്തിൽ നിന്നുമുള്ള പ്രാഥമിക റിപ്പോർട്ട്

സംഗ്രഹം

പശ്ചിമഘട്ടത്തിൽ മാത്രം കണ്ടുവരുന്ന മസ്റ്റിലിഡെ കുടുംബത്തിൽപ്പെട്ട മരനായകൾ ആഗോളതലത്തിൽ വംശനാശഭീഷണി നേരിടുന്ന സസ്തനിയാണ്. 2011-2012കളിൽ പറമ്പിക്കുളം കടുവാസങ്കേതത്തിൽ നിരീക്ഷണ ക്യാമറ ഉപയോഗിച്ച് നടത്തിയ പഠനത്തിൽ ഇവയുടെ ചിത്രം ഒരു തവണ പകർത്തുവാനും, മൂന്ന് തവണ നേരിൽ കാണുകയും ചെയ്തിട്ടുണ്ട്. പറമ്പിക്കുളത്തു നിന്ന് ആദ്യമായാണ് മരനായ റിപ്പോർട്ട് ചെയ്യുന്നത്.

Nilgiri Marten *Martes gwatkinsii* is a poorly known small carnivore endemic to the Western Ghats, southern India (Wirth & Van Rompaey 1991, Nameer 2000, Johnsingh & Nameer 2013, Mudappa 2013). *The IUCN Red List of Threatened Species* categorises it as Vulnerable (Choudhury *et al*. 2008). There are 22 published locality records, confined to the states of Karnataka, Tamil Nadu and Kerala (Table 1, Fig. 1). Apart from those by Kinloch (1923) and Hutton (1949), all other records were during the last few decades. This paper reports the first records of Nilgiri Marten from Parambikulam Tiger Reserve, Kerala.

Parambikulam Tiger Reserve (Parambikulam TR), the second Tiger Reserve of Kerala, is situated in the Palghat district, within the Anamalai hills of Western Ghats. Its 643.66 km^2 are located within 10°20–26′N, 76°35–50′E, at 300–1,438 m asl

Table 1. Localities with records of Nilgiri Marten *Martes gwatkinsii* from the Western Ghats, southern India (its entire world range).

Map #	Location	Reference
1	Bisale Reserved Forest, Karnataka, 12°46′N, 75°44′E	Krishna & Karnad 2010
2	Sampaje, Karnataka, 12°29′N, 75°33′E	Karanth 1986
3	Thalakaveri Wildlife Sanctuary, Karnataka, 12°11′N, 75°48′E	Kumara & Singh 2007, Krishna & Karnad 2010
4	Virajpet, Coorg, Karnataka, 12°01′N, 75°52′E	Pocock 1941, Schreiber *et al*. 1989
5	Brahmagiris, Karnataka, 11°59′N, 75°07′E	Schreiber *et al*. 1989
6	Sandynallah, Nilgiris, Tamil Nadu, 11°32′N, 76°24′E	Krishna & Karnad 2010
7	Mukkurthi Nationl Park, Tamil Nadu, 11°26′N, 76°38′E	Yoganand & Kumar 1995
8	Nilambur Reserved Forest, Kerala, 11°18′N, 76°33′E	Balakrishnan 2005
9	Upper Bhavani, Tamil Nadu, 11°13′N, 76°31′E	Gokula & Ramachandran 1996
10	Silent Valley National Park, Kerala, 11°09′N, 76°26′E	Christopher & Jayson 1996, Balakrishnan 2005
11	Muthikkulam Reserved Forest, Kerala, 10°56′N, 76°38′E	Balakrishnan 2005
12	Nelliampathy Reserved Forest, Kerala, 10°33′N, 76°41′E	Kinloch 1923, Krishna & Karnad 2010
13	Parambikulam Tiger Reserve, Kerala, 10°29′N, 76°47′E	Present study
14	Topslip, Tamil Nadu, 10°24′N, 76°51′E	Krishna & Karnad 2010
15	Grass Hills National Park, Tamil Nadu, 10°20′N, 77°55′E	Krishna & Karnad 2010
16	Indira Gandhi Wildlife Sanctuary, Tamil Nadu, 10°20′N, 76°01′E	Krishna & Karnad 2010, Sridhar *et al*. 2008
17	Pambadum shola National Park, Kerala, 10°14′N, 77°08′E	Krishna & Karnad 2010
18	Eravikulam National Park, Kerala, 10°12′N, 77°04′E	Madhusudan 1995
19	Palni Hills, Tamil Nadu, 10°10′N, 77°23′E	Krishna & Karnad 2010
20	High Wavy Mountains, Tamil Nadu, 9°42′N, 77°24′E	Hutton 1944, 1949
21	Periyar Tiger Reserve, 9°30′N, 76°17′E	Kurup & Joseph 2001
22	Peppara Wildlife Sanctuary, Kerala, 8°40′N, 77°08′E	Christopher & Jayson 1996
23	Kalakkad-Mundunthurai Tiger Reserve, Tamil Nadu, 8°32′N, 77°23′E	Mudappa 2002

Some additional records, particularly those not formally published, from within or near these sites are not shown.

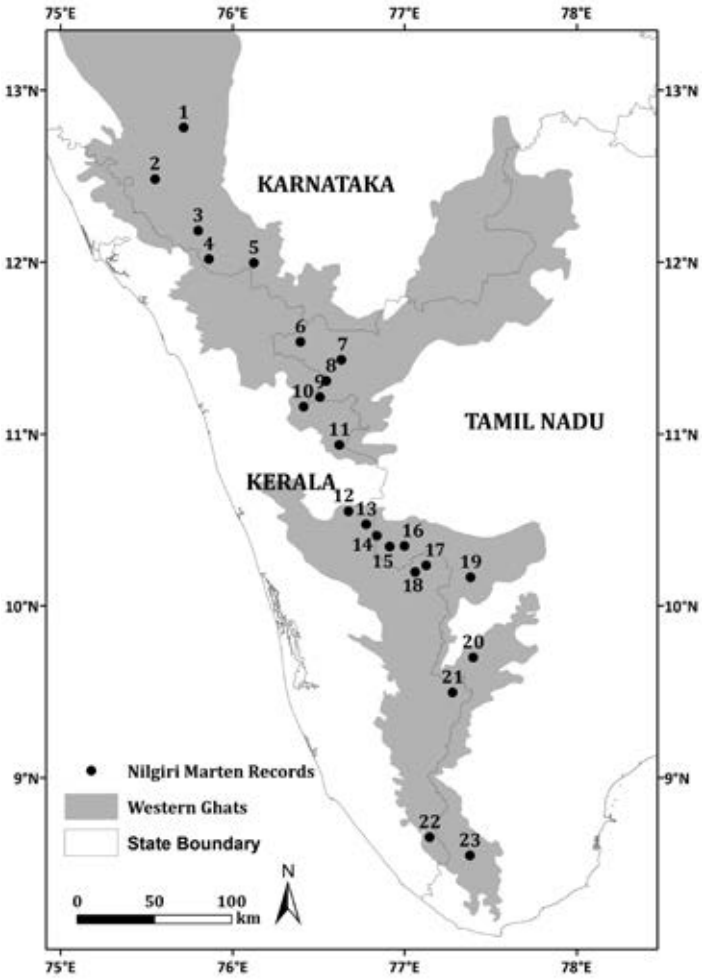

Fig. 1. Localities with Nilgiri Marten *Martes gwatkinsii* records from the Western Ghats, southern India.

Fig. 2. Nilgiri Marten *Martes gwatkinsii* camera-trapped in Parambikulam Tiger Reserve, Kerala, India, on 27 July 2011.

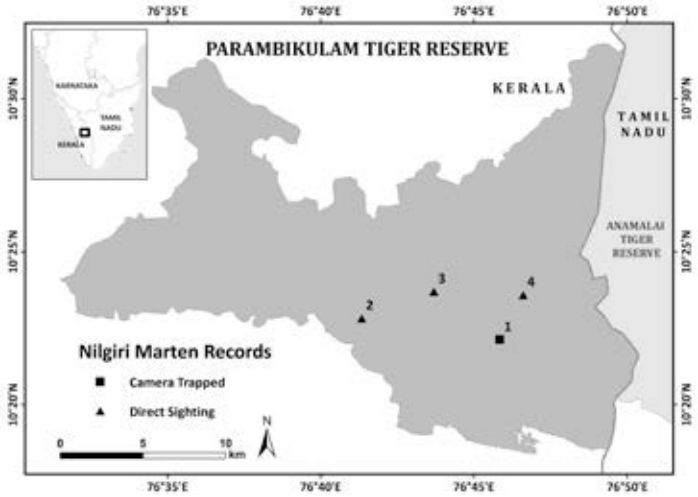

Fig. 3. Nilgiri Marten *Martes gwatkinsii* records from Parambikulam Tiger Reserve, Kerala, India.

(Kaler 2011). A small carnivore survey at Parambikulam TR from April 2011 to March 2012 deployed Bushnell TrophyCam infrared camera-traps with a digital scouting camera, without lures or baits, in various habitats, mostly along existing forest trails and near streams.

One Nilgiri Marten was camera-trapped (Fig. 2), at Karimalagopuram. Three direct sightings were also made: two from Kothala and the other one near to the Fifth Colony (a tribal settlement). All four records (Table 2, Fig. 3) were of apparently solitary individuals, with two each from semi-evergreen and from the adjoining moist deciduous forests. The directly sighted animals were all in the crowns of trees at heights of 10–20 m above ground, during daylight.

In spite of an effort of 1,349 camera-trap-nights in all representative habitats, across the altitudinal range of Parambikulam TR, Nilgiri Marten was camera-trapped only once. Moreover, in 242 km of day transect and 344 km of night vehicle transect surveys, over a period of one year, the animal was sighted only thrice. These records suggest that Nilgiri Marten is an uncommon animal at Parambikulam TR. Given that all three direct sightings were of animals in trees, camera-trapping may not be a very efficient search method for the species, at least as typically employed (using unbaited, ground-level camera-traps). The present survey is the first camera-trap-based survey of small carnivores at Parambikulam TR. Thus, the present sighting of this species from the Parambikulam

Table 2. Records of Nilgiri Marten *Martes gwatkinsii* from Parambikulam Tiger Reserve, India.

Date	Time	Location	Latitude	Longitude	Altitude	Habitat**
27 July 2011*	17h01	Karimalagopuram	10°22′N	76°45′E	708 m	SEG
14 Sept 2011	11h30	Kothala	10°22′N	76°41′E	543 m	SEG
22 Sept 2011	10h00	Kothala	10°23′N	76°43′E	526 m	MDF
11 Feb 2012	15h20	Fifth Colony	10°23′N	76°46′E	580 m	MDF

**SEG: semi-evergreen forest; MDF: moist deciduous forest. All altitudes are approximate; they were measured using a Garmin 72 GPS.
All records involved single individuals. All were direct field sightings except one camera-trap record*

TR, which lies within the known geographic range, could be a case of Nilgiri Marten being overlooked in the past from here, rather than the species increasing in abundance.

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Historical and recent records of Greater Grison *Galictis vittata* in Paraguay, with nomenclatural comments

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Abstract

Paraguay generally has been omitted from the published distribution of Greater Grison *Galictis vittata*, despite historical mentions of the species there including a specimen collected in 1930. Historical mentions of *G. vittata* in Paraguay are reviewed here, and previous nomenclatural confusion is reviewed and clarified. Two recent records, a specimen and an observation, add respectively a second documented locality to the Atlantic Forest ecoregion of eastern Paraguay, and extend the known Paraguayan distribution approximately 675 km north-westwards into the Dry Chaco. The species is probably widespread at low density across much of the country.

Keywords: Atlantic Forest, Chaco, *Galictis allamandi*, *Galictis cuja*, *Grisonella huronax*, Lesser Grison

Registros históricos y recientes del Grisón Mayor *Galictis vittata* en Paraguay, con comentarios sobre su nomenclatura

Resumen

Con algunas excepciones, el Paraguay ha sido excluido de las distribuciones publicadas de *Galictis vittata*, a pesar de anotaciones históricas de la especie en Paraguay, y un espécimen colectado en 1930. Se revisaron menciones históricas de *G. vittata* en Paraguay, y la confusión anterior sobre la nomenclatura fue revisada y aclarada. Reportamos dos registros adicionales recientes, un espécimen colectado y una observación en vida silvestre. Con estos nuevos registros se agrega una segunda localidad para la ecorregión del Bosque Atlántico en la Región Oriental del Paraguay, y se extiende la distribución paraguaya conocida a 675 km aproximadamente al noroeste hasta la ecorregión del Chaco Seco. Probablemente la especie se extiende en baja densidad en la mayoría del territorio paraguayo.

Palabras claves: Bosque Atlántico, Chaco, *Galictis allamandi*, *Galictis cuja*, *Grisonella huronax*, Grisón Menor

Introduction

Greater Grison *Galictis vittata* is a widespread, medium-sized, lowland mustelid occurring as four subspecies from southern Mexico to northern Argentina (Yensen & Tarifa 2003a). Despite its diurnal habits, broad range of habitats used, and its extensive distribution, the species is surprisingly poorly studied; it seems to occur at low density throughout its range (Arita *et al.* 1990, Canevari & Vaccaro 2007).

The presence of the species in Paraguay has been subject to dispute. Excepting Bornholdt *et al*. (2013), the country was omitted from modern treatments of the species's distribution (Yensen & Tarifa 2003a, Canevari & Vaccaro 2007). It does occur in southern Santa Cruz Department, Bolivia (Anderson 1997, Tarifa *et al.* 2010), and in a few localities in Provincia Misiones, Argentina (Díaz & Lucherini 2006, Massoia *et al*. 2006), but the Rio Paraná has long been known to be a dispersal barrier for certain mammal species (Bertoni 1914). Consequently, the mapped range of the species often forms a wide arc around northern and eastern Paraguay, but omitting the country entirely (Yensen & Tarifa 2003a, Canevari & Vaccaro 2007). In fact, Bornholdt *et al*. (2013), citing a specimen collected in 1930, provided the first specimen-based record for the country.

This paper reports historical mentions of *G. vittata* in Paraguay, clarifies nomenclatural confusion in early literature, and confirms the species's continued occurrence in Paraguay by reporting two recent records. These suggest a wide distribution across the country, and extend the known habitat associations to the Dry Chaco.

Nomenclature

As currently understood the genus *Galictis* Bell, 1826 contains two extant species, the larger Greater Grison *G. vittata* (Schreber, 1776) and the smaller Lesser Grison *G. cuja* (Molina, 1782). The larger species has a mainly tropical distribution in Central and South America, the smaller species a temperate distribution in the Southern Cone; there is a poorly understood region of sympatry in central South America (Yensen & Tarifa 2003a, 2003b, Bornholdt *et al*. 2013).

Confusion over the type of *Viverra vittata* Schreber, 1776 and *Galictis allamandi* Bell, 1837 (actually paintings by different artists of the same specimen) led many influential turn-of-the-century zoologists, including Ihering (1911), to use *G. allamandi* for the larger species and *G. vittata* for the smaller (Husson 1978), a situation still occurring at least until Krumbiegel (1942).

Modern treatments (e.g. Yensen & Tarifa 2003a, Wozencraft 2005, Paglia *et al*. 2012) synonymise *G. allamandi* under *G. vittata* (the name now used for the larger species). However, references to *G. vittata* in older literature, including Rengger (1830), typically apply instead to *G. cuja* as currently recognised (Cabrera 1958, Yensen & Tarifa 2003a, 2003b).

Historical records

Bertoni (1914) listed both *Grison allamandi* (Bell.) and *Grison vittatus* (Schreber) in the first systematic catalogues of Paraguayan mammals, giving both the Guaraní name "Dyaguapé". Unfortunately he provided no more than a locality, Puerto Bertoni (Fig. 1, locality 4), for both species; an asterisk next to *G. allamandi* indicates that he was reporting it for Paraguay for the first time. In an update of the same catalogue, Bertoni (1939) listed *Grison allamandi* (Bell.) and *Grisonella huronax* Thomas, this time providing the additional locality Itá (Fig. 1, locality 5) for the former and giving the common names of "Yaguapé" for *G. allamandi* and "Yaguá kambé, (or) Yaguapé" for *G. huronax*.

Bertoni's general failure to provide details or literature references has led many modern Paraguayan biologists to consider his more unlikely records to be equivocal or hypothetical. A lack of modern Paraguayan records of *G. vittata* thus led to a general consensus that the widespread and common Lesser Grison *G. cuja* is the only species of the genus in Paraguay.

However between these two publications Bertoni (1932) published a short, apparently overlooked, note on these species where he claimed to have been able to compare the 'common' *huronax* with the 'robust' and 'much larger' *Grison allamandi*. The text becomes somewhat confusing as he alluded to differences between *G. allamandi* and "*G. vittatus*" (= *cuja* as currently recognised), and then stated that these large individuals presented all the 'exact colours of *crassidens*' (= *vittatus* as currently recognised), leaving it unclear as to which name he suggested was applicable. Although he alluded to a whiter coloration and robust form in his *G. allamandi* than in his *G. huronax*, the brief description of the coloration in the larger specimens is non-diagnostic by itself.

Interpreting the confusing nomenclature in the context of current knowledge, it is apparent that known synonyms of modern *G. vittata* are being used solely to describe this larger taxon and synonyms of *G. cuja* are being used solely to describe the smaller taxon. Furthermore peculiarities in the nomenclature used in Bertoni (1914) make it clear that Ihering (1910) is the principal taxonomic source for many of his carnivore families, including the Mustelidae. Ihering (1910) provided detailed descriptions of both species that allow his *G. allamandi* to be conclusively identified as modern *G. vittatus* and his *G. vittatus* to be definitely associated with modern *G. cuja*. Thus Bertoni, in following Ihering (1910), is certainly referring to two different species.

In 1930, a specimen was collected by Emil Kaempfer in Colonia Independencia (Departamento Guairá), Paraguay (Fig. 1, locality 1), at the western limit of the Atlantic Forest ecoregion. Bertoni (1932, 1939) made no mention of, and presumably was unaware of, this specimen. The specimen, AMNH 77695 (skull only) was first reported by Bornholdt *et al*. (2013). It seems to have been the only specimen of *G. vittata* for Paraguay until another was collected in 2010.

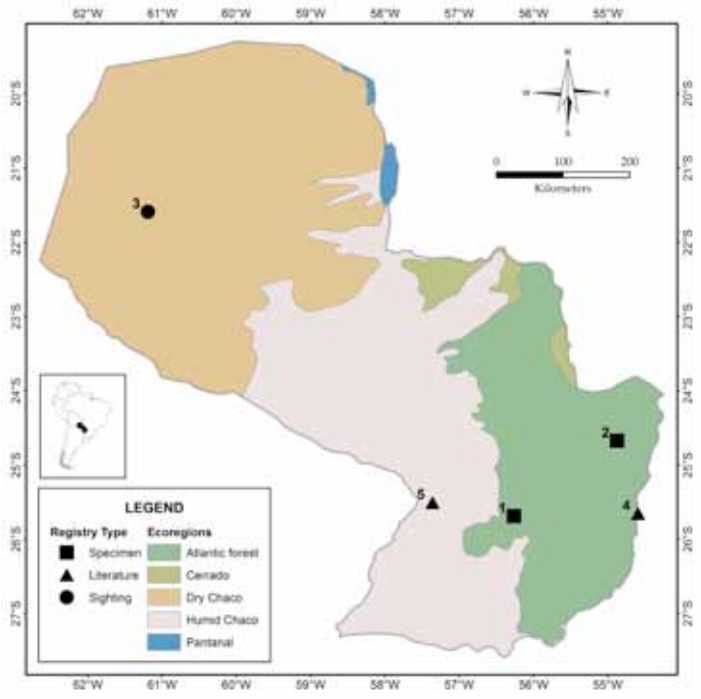

Fig. 1. Paraguay, indicating localities for Greater Grison *Galictis vittata*. Specimen localities (squares): 1, Colonia Independencia, Departamento Guairá, 25°41′S, 56°16′W (AMNH 77695); 2, Super Carretera Itaipú, Departamento Alto Paraná, 24°40′30.3″S, 54°52′19.3″W (CBMI 284). Sight locality (circle): 3, Departamento Boquerón, 21°35′39.5″S, 61°11′21.7″W. Literature localities (triangles): 4, Puerto Bertoni, Departamento Alto Paraná, 25°39′S, 54°36′W (Bertoni 1914); 5, Itá, Departamento Central, 25°30′S, 57°22′W (Bertoni 1939). Datum WGS84.

Modern records

A decomposing and bloated road-kill specimen was found on 17 September 2010 by PS and HDC (accompanied by Robert and Ulrike Wylands) on the Super Carretera Itaipú, Departamento Alto Paraná (Fig. 1, locality 2). The specimen was photographed *in situ* (Fig. 2; additional photographs are available at http://www.faunaparaguay.com/galictisvittata.html). The off-white head stripe and tips of the dorsal hairs suggest that this specimen is attributable to *G. v. brasiliensis* (Thunberg, 1820). Although heavily altered, the natural vegetation here is Atlantic Forest, with the immediate area being characterised by islands of disturbed forest, pasture land and isolated human dwellings. The specimen, an adult male (Figs. 2–3) was deposited at the nearby Museo Itaipú Binacional, where it is catalogued as CBMI 284, skull and skeleton. Bornholdt *et al*. (2013) made no reference to this specimen and presumably did not know of its existence.

Measurements for CBMI 284, compared with means and ranges reported by Yensen & Tarifa (2003a), are listed in Table 1. For all equivalent measurements, CBMI 284 falls within or above the range listed for *G. vittata* by Tarifa & Yensen (2003a). In addition, the specimen exhibits clearly the m1 metaconid mentioned by Bornholdt *et al*. (2013) as diagnostic for *G. vittata* (Fig. 3, lower).

Two adults were observed on 10 February 2012 by PS, Keith Millar, Kevin Guest and Richard Koepsel at approximately 10h00 (with good ambient light) at Km 603 of the Ruta Trans Chaco, Departamento Boquerón (Fig. 1, locality 3). This was in an area of arid Chaco vegetation, heavily modified for cattle ranching. Both animals were observed from a vehicle through 10 × 40 binoculars. They emerged from roadside vegetation, crossed the road and then walked along the roadside

Fig. 2. Greater Grison *Galictis vittata* encountered dead on 17 September 2010, in Departamento Alto Paraná, Paraguay (Museo Itaipú Binacional catalogue number CBMI 284). Ventrolateral view (upper); dorsolateral view (lower).

Fig. 3. Same individual Greater Grison *G. vittata* as in Fig. 2. Ventral view of cranium showing fully erupted teeth, fused sphenopalatine suture (upper); Lingual view of left mandible, showing m1 and m2, with m1 metaconid diagnostic for *G. vittata* (lower; see Bornholdt *et al*. 2013, Fig. 1).

Table 1. External and cranial measurements of Paraguayan grison specimen CBMI 284 (Fig. 1, locality 2), and measurements (mean and range) for Greater Grison *Galictis vittata* in Yensen & Tarifa (2003a).

Character	CBMI 284	Yensen & Tarifa
Weight (g)	**4400**	**2348 (1475–3800)**
External characters (mm)		
Total length	600	676.2 (600–760)
Tail length	170	157.4 (135–195)
Head + body length	430	518.8 (450–600)
Hind foot length	93	82.8 (66–97)
Ear length	34	25.8 (20–32)
Craniodental characters (mm)		
Greatest length of skull	95.2	
Basilar length		80.15 (71.5–96.5)
Condylobasilar length	91.6	88.17 (80.3–97.9)
Palatal length	46.0	
Postpalatal length		39.29 (37.1–42.8)
Length of nasals	26.4	
Maxillary toothrow length	28.6	28.04 (23.1–32.5)
Maxillary molariform toothrow length	23.1	
Zygomatic breadth	58.1	50.98 (45.4–56.2)
Mastoid breadth	55.8	47.87 (42.9–54.4)
Squamosal breadth		40.79 (37.8–43.0)

Character	CBMI 284	Yensen & Tarifa
Postorbital breadth	21.8	19.79 (17.8–22.2)
Least interorbital breadth		20.41 (16.5–23.2)
Postdental breadth		11.04 (9.7–11.9)
Width across upper canines	22.2	20.04 (17.1–23.3)
Maximum breadth of toothrow		30.15 (28.1–33.2)
Length of auditory bulla		23.49 (21.4–25.2)
Width of auditory bulla		11.19 (8.1–13.4)
Angular length of mandible	58.2	53.43 (47.1–59.2)
Mandibular ramus height	11.1	
Mandibular toothrow length	34.3	
Mandibular molariform toothrow length	27.6	

Total length (and therefore, head + body length) of CBMI 284 were measured in *rigor mortis* condition, so are underestimates. Where uncertainty exists regarding equivalency of the two sets of measurements, they are listed separately.

towards the observers before disappearing again into vegetation at a distance of about 3 m. The large size of these animals compared with *G. cuja* was obvious even at the greatest observed distance (20 m), but even more diagnostic was the heavy, waddling gait (reminiscent of Wolverine *Gulo gulo*) and quite different from the sliding, weasel-like movements of the smaller species, with which PS is familiar.

This record extends the known Paraguayan distribution of *G. vittata* approximately 675 km north-westwards, well into the Dry Chaco. Characteristics necessary for subspecific designation were not observed. The populations nearest to this locality, in Bolivia, are referred to *G. v. andina* Thomas, 1903, so the subspecific identity of Chaco *G. vittata* cannot be assumed to be the same as those east of the Rio Paraguay.

These records suggest that *G. vittata* is uncommon but widespread in Paraguay and may have been overlooked because of a wide-ranging assumption that all Paraguayan *Galictis* are *G. cuja*. The presence of *G. vittata* in both the Dry Chaco and the Atlantic Forest ecoregions means that it probably occurs throughout much of the country, thus expanding the known areas of sympatry with *G. cuja*. Additional records to confirm the continuing presence of *G. vittata* in other regions in Paraguay will be necessary to clarify the southern limits of the species's range, as well as the geographic limits of two of the four currently recognised subspecies (*G. v. andina* and *G. v. brasiliensis*) (Yensen & Tarifa 2003a).

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A confirmed record of Large-toothed Ferret Badger *Melogale personata* from central Laos suggesting syntopy with Small-toothed Ferret Badger *M. moschata*

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Abstract

Large-toothed Ferret Badger *Melogale personata* and Small-toothed Ferret Badger *M. moschata* overlap in distribution over much of their range. Precise distributions are little known because visual distinction of the two species seems possible only through clear inspection of their skull and dentition. Thus, large parts of their joint range lack authenticated records for one or both species. A skull photographed in a poacher camp in July 2011 is the first record of *M. personata* from Nakai–Nam Theun NPA (and only the second precise locality record for Laos). A recent *M. moschata* record from similar altitude and habitat only 12 km away strongly suggests syntopy of the two species.

Keywords: Burmese Ferret Badger, Chinese Ferret Badger, Lao PDR, Mustelidae, Nakai–Nam Theun National Protected Area

ບັນທຶກການໄດ້ຮັບການຢັ້ງຢືນ ຂອງ ໝາລຶ່ງແຂ້ວໃຫ່ຽ *Melogale personata* ພາກກາງຂອງລາວ ທີ່ບອກເຖິງພູມສັນຖານທີ່ຄ້າຍຄືກັນ ກັບ ໝາລຶ່ງແຂ້ວນ້ອຍ *M. moschata*.

ບົດຄັດຫຍໍ້

ໝາລຶ່ງແຂ້ວໃຫ່ຽ *Melogale personata* ແລະ ໝາລຶ່ງແຂ້ວນ້ອຍ *M. moschata* ຂອບເຂດການກະຈາຍຂອງພວກເຂົາທີ່ທັບຊ້ອນກັນຫຼາຍທີ່ສຸດ. ການກະຈາຍທີ່ຊັດເຈນ ແມ່ນທີ່ເປັນທີ່ຮູ້ຈັກກັນເລັກໆນ້ອຍໆ ເພາະວ່າ ຄວາມແຕກຕ່າງທີ່ສັງເກດຈາກທັງສອງຊະນິດ ຄ້າຍຄືກັບວ່າເປັນໄປໄດ້ພຽງແຕ່ຜ່ານການກວດສອບຢ່າງຊັດເຈນຂອງກະໂຫຼກຫົວ ແລະ ແຂ້ວຂອງພວກເຂົາ. ດັ່ງນັ້ນ ການບັນທຶກສ່ວນໃຫ່ຽ ຂອງຂອບເຂດທີ່ຮ່ວມກັນຂອງພວກເຂົາຈຶ່ງຂາດ ຫຼື ຮັບຮອງຄວາມຖືກຕ້ອງຢ່າງໃດຢ່າງໜຶ່ງ ຂອງທັງສອງຊະນິດ. ຮູບທີ່ຖ່າຍກະໂຫຼກຫົວ ທີ່ຢູ່ໃນຕຸບຂອງພວກລ່າສັດ ໃນເດືອນ ກໍລະກົດ 2011 ແມ່ນການບັນທຶກທຳອິດ ຂອງ *M. personata* ຈາກພະນັກງານ ປ່ສສະຫງວນແຫ່ງຊາດ ນາກາຍ-ນ້ຳເທີນ (ເປັນຄັ້ງທີສອງ ທີ່ມີການບັນທຶກສະຖານທີ່ທີ່ແນ່ນອນ ສຳຫຼັບປະເທດລາວ). ການບັນທຶກລ່າສຸດຈາກພື້ນທີ່ນີ້ ຂອງ *M. moschata* ຫ່າງຈາກກັນພຽງ 12 ກິໂລແມັດ ແລະ ຈາກຖິ່ນທີ່ຢູ່ອາໄສ ແລະ ຄວາມສູງທີ່ຄ້າຍຄືກັນ, ສະແດງໃຫ້ເຫັນຢ່າງຊັດເຈນວ່າ ທັງສອງຊະນິດແມ່ນຢູ່ໃນພູມສັນຖານຄ້າຍຄືກັນ.

Ferret badgers *Melogale* are endemic to Southeast Asia and neighbouring parts of China and South Asia. They remain poorly known in terms of their distribution, conservation status, taxonomy and ecology. In mainland Southeast Asia, two species are conventionally accepted to occur: Large-toothed Ferret Badger *M. personata* and Small-toothed Ferret Badger *M. moschata*. A third was recently described in Vietnam, *M. cucphuongensis* Nadler *et al*., 2011. Because of the difficulty of distinguishing the two species from field sightings or camera-trap photographs, and the reduction in specimen collecting, recent records are few. Most of the validated records (where skulls were examined) are of museum specimens. Over much of their range these date from the first half of the twentieth century and at least in some parts of Southeast Asia, these typically lack precise information on location, let alone habitat or altitude, having been bought in markets or brought to collecting expeditions by local people (e.g. Osgood 1932, Legendre 1936). Thus, each species's geographic distribution remains coarsely known, with habitat and altitudinal distribution even less well understood. Although they are clearly widely sympatric, the extent of syntopy (i.e. co-occurrence in similar habitat and altitude within the broad geographic range) is unknown. As far as is presently known, morphologically the two can be confidently distinguished only by their skull and dentition (Schank *et al*. 2009). This means that many modern sources of records for other small carnivores, such as camera-trap photographs and direct sightings, cannot provide species-level identifications. In addition, widespread under-appreciation of the difficulty of visual identification results in many potential records (e.g. road-kills not salvaged as specimens) being examined and photographed without reference to the teeth (J. W. Duckworth *in litt*. 2013). Throughout their range, even single records of authoritative identification remain of value.

Melogale personata is classified as Data Deficient in the *IUCN Red List of Threatened Species* because of this paucity of recent confirmed records (Duckworth *et al*. 2008). Historical records came from India, Myanmar, Thailand, southern China, Laos and Vietnam (O'Donel 1917, Hinton & Fry 1923, Osgood 1932, Pocock 1941, Lekagul & McNeely 1977) with few to no recent confirmed records from each of these countries (Duckworth *et al*. 2008). The species was recently discovered in Bangladesh (Islam *et al*. 2008) and Cambodia (Schank *et al.* 2009), underlining how poorly its distribution is known.

In Laos, the only confirmed record of *M. personata* in

its natural habitat, with an exact locality, comes from Phou Hinpoun National Protected Area (NPA) at 17°30′40″N, 104°50′15″E, 200 m asl (Robinson & Webber 1998). In addition, two historical collecting expeditions procured many specimens on the Bolaven plateau (Osgood 1932, Legendre 1936, Robichaud 2010). On 28 July 2011, a poacher camp in the Thong Xet/Thong Khouang area in Nakai–Nam Theun National Protected Area, central eastern Laos, at 17°46′33.474″N, 105°30′09.317″E, approximately 870 m asl (Garmin GPS 60, datum Indian Thailand) (Fig. 1) was found to hold an incomplete skull of *Melogale.* The skull was photographed once (Fig. 2) but left behind given the logistical challenges of specimen preparation and transport during this particular wildlife survey. A. V. Abramov (*in litt*. 2013) confirmed the species as *M. personata* based on (i) the large size of upper premolar 4; (ii) the premolar 3 relatively larger than premolar 2; and (iii) the relatively small infra-orbital foramen. The very short nasal bone of the snout may also be typical of *M. personata*, differing from the more elongated one of *M. moschata* and *M. cucphuongensis* (Nadler *et al*. 2011). Other dental characteristics rule out *M. cucphuongensis* from the identification, according to characters as given in its original description (Nadler *et al*. 2011).

During a large-scale camera-trap survey in Nakai–Nam Theun NPA from 2006 to 2011, many photographs of *Melogale*

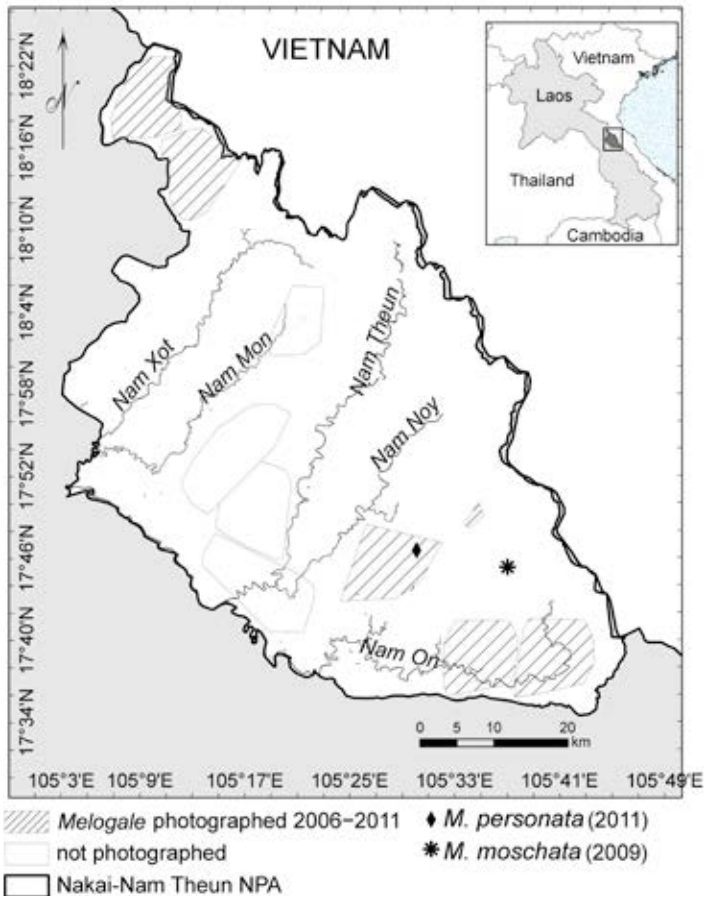

Fig. 1. Localities of ferret badger *Melogale* records in Nakai–Nam Theun National Protected Area, central eastern Laos. Skull-based Large-toothed Ferret Badger *M. personata* in 2011 and Small-toothed Ferret Badger *M. moschata* in 2009 (after Robichaud 2010). Camera-trap survey blocks from 2006–2011 indicate where *Melogale* (unidentified to species) was photographed and where it was not.

Fig. 2. Incomplete skull of Large-toothed Ferret Badger *Melogale personata*, Nakai–Nam Theun National Protected Area, central eastern Laos, 28 July 2011 (Photo: C. Nanthavong).

were taken. There were clear variations in fur coloration, from brownish-orange to light or dark grey, in the 101 notionally independent photographs of *Melogale* from that survey (Coudrat *et al*. in press). The taxonomic significance of this variation, if any, is unclear; it is currently believed that coloration varies within a single species of ferret badger (e.g. Schank *et al*. 2009, Nadler *et al*. 2011, Wong *et al*. 2011). The genus was photographed from about 580 to about 1,675 m asl (taken with Garmin GPS60 or Garmin 12 units) principally from the southern and northern areas of Nakai–Nam Theun NPA (Coudrat *et al*. in press). *Melogale* was photographed at two camera-trap locations near the record presented here (Fig. 1): within 5 and 3½ km away, at about 850 and about 900 m asl, respectively (all animals photographed at these two camera-trap locations were of a grey coloration). However, there remain too few data on morphological variation to identify species of ferret badgers from camera-trap photographs alone.

Although the skull was in a hunters' camp and could in theory have been carried in from another area, this is unlikely. Nakai–Nam Theun NPA is heavily hunted for the wildlife-meat and -part trades (Robichaud *et al*. 2009, Coudrat 2013) and teams of hunters, who are in the forest for many days at a time, consume in the field some of the animals they catch. The damage to the skull seemed to indicate that the animal had been butchered. The camp was along a small stream, but not along a trail. It had been abandoned a few hours earlier, based on a still fuming fire and fresh dog tracks in the stream. A load of yet unused wire snares were left behind on the roof top of the camp, suggesting this camp served as a base for the hunting season and hunters had the intention to visit the camp regularly. This area was intensively snared at the time of survey, coinciding with the rainy season when illegal hunting increases. It is thus highly implausible that the animal was trapped more than a few kilometers away from this hunters' camp. The altitude and habitat type in which the skull originated may be more open to question; altitude within a radius of 3 km of the record ranges from ~700 to 1,000 m asl (based on a 1:50,000 topographical map).

So far, among the ferret badgers, only *M. moschata* had been confirmed to occur in Nakai–Nam Theun NPA, from a skull found in a hunters' snare amid natural habitat, in 2009

(17°45′20″N, 105°37′05″E, 980 m asl; Robichaud 2010) (Fig. 1). The two records in Nakai–Nam Theun NPA of *M. personata* and *M. moschata* were found 12 km apart, at about 870 m asl and about 980 m asl, respectively, and suggest within broad sympatry of both species, the likelihood of some level of syntopy. The potential ecological niche separation between the two species remains unknown. Many more records will be necessary to comprehend the distribution range of both species in mainland Southeast Asia. On current knowledge, this will require skull examination or genetic identification. As well as records from mainstream collection-based surveys, the present record is just one of a number of recent significant ferret badger records showing the values of opportunistic salvage collection or even just photography (e.g. Islam *et al.* 2008, Schank *et al.* 2009, Robichaud 2010). The common and widespread hunting practice in Laos and Vietnam with long lines of snares (Nooren & Claridge 2001, Coudrat 2013), provides wildlife surveyors or patrolling rangers the opportunity of photographing, collecting and/or later examining remains of trapped animals. Such hunting is illegal and is increasingly being reduced by effective management in some protected areas, including parts of Nakai–Nam Theun NPA (NT2 WMPA 2012, SWG 2013). In the interim, any encounter with ferret badger skulls in such traps should systematically be recorded in detail.

Acknowledgements

Permission to survey Nakai–Nam Theun National Protected Area was obtained from the Department of Agriculture and Forestry of the Government of the Lao P.D.R. and the Nam Theun 2 – Watershed Management and Protection Authority. Villagers from Nakai–Nam Theun NPA assisted during the wildlife surveys. A. V. Abramov examined the picture of the skull, confirmed it as belonging to *M. personata*, and encouraged publication of the record. J. W. Duckworth commented on an earlier draft, which substantially improved this manuscript. Two reviewers provided valuable comments for improvement.

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A sighting of Nilgiri Marten *Martes gwatkinsii* in Peppara Wildlife Sanctuary, southern Western Ghats, India

ANOOP Raj. P. N.

Abstract

A Nilgiri Marten *Martes gwatkinsii* was observed for 45 minutes, photographed and filmed, at Bonacadu in Peppara Wildlife Sanctuary, Kerala, India, on 5 January 2013. It was sighted in a tea plantation located around 400 m from the nearest forest patch.

Keywords: Agasthyamalai Biosphere Reserve, locality record, tea plantation, vocalisation

ഇന്ത്യയിലെ, ദക്ഷിണ പശ്ചിമഘട്ട മലനിരയിലെ പേപ്പാറ വന്യജീവി സങ്കേതത്തില് നിന്നും നീലഗിരി മാര്ട്ടിനെ *Martes gwatkinsii* കണ്ടെത്തിയതിനെക്കുറിച്ചുള്ള ലേഖനം

സഹ്യപർവതനിരകളിൽ മാത്രം കണ്ടു വരുന്ന അപൂർവ ഇനം ജീവി വർഗമാണ് നീലഗിരി മാർട്ടിൻ *Martes gwatkinsii*. 2013 ജനുവരി 5നു നീലഗിരി മാർട്ടിനെ അഗസ്ത്യമല ബയോസ്ഫിയർ റിസേർവിലെ പേപ്പാറ വന്യജീവി സങ്കേതത്തിൽ ബോണകാട് എന്ന പ്രദേശത്ത് വച്ച് കാണുകയുണ്ടായി. കാട്ടിൽ നിന്നും വിട്ടുമാറി ഏകദേശം 400 മീറ്റർ അകലെ ഉള്ള തേയില തോട്ടത്തിൽ നിന്നുമാണ് നീലഗിരിമാർട്ടിനെ കണ്ടത്. 45നിമിഷത്തിലെ നിരീക്ഷണത്തിൽ ഇവയുടെ ചിത്രങ്ങളും ലോകത്തിലെ തന്നെ ആദ്യത്തെ ചലനച്ചിത്രവും ലഭ്യമായി

Nilgiri Marten *Martes gwatkinsii* is the rarest and least-known species of marten. It is endemic to the Western Ghats of southern India (Wirth & Van Rompaey 1991). It is listed in *The IUCN Red List of Threatened Species* as Vulnerable (Choudhury *et al*. 2008). Its preferred habitats seem to be evergreen and montane forest (sholas), but it has been reported even from moist deciduous forests and plantations adjoining evergreen forests (Madhusudhan 1995, Gokula & Ramachandran 1996, Kumar & Yoganand 1999, Mudappa 2002, 2013, Balakrishnan 2005). It is reported from an altitudinal range of 350–2,200 m (Krishna & Karnad 2010, Mudappa 2013). It is mostly carnivorous, including birds, reptiles and small and medium-sized mammals in its diet, but it also eats fruit, invertebrates and honey raided from bee-hives (Hutton 1944, Christopher & Jayson 1996, Kurup & Joseph 2001, Mudappa 2002, Balakrishnan 2005, Kumara & Singh 2007).

Peppara Wildlife Sanctuary is a part of Agasthyamalai Biosphere Reserve, in the southern Western Ghats of Kerala. On the evening of 5 January 2013, my tracker and I were walking back to the base camp along a road built across a tea plantation in Bonacadu, which lies within the Peppara Wildlife Sanctuary. All of a sudden, what looked like a Indian Giant Squirrel *Ratufa indica* ran across the plantation. It is unusual for a giant squirrel to run for any extended length on the ground, so I photographed the animal and when I zoomed in on the photograph, to my surprise and elation, I saw that it was a Nilgiri Marten. I took six photographs (Fig. 1) and a 31-second video of the animal, using a Canon SX 40 HS. The sighting occurred at 17h15 at a distance of 22 m from where I stood. The animal was at 8°40′26″N, 77°10′10″E (datum WGS84), at an altitude somewhere within 700–800 m. A temporary stream lay 10 m from the animal. The clear evening sky offered good light to observe the animal with the naked eye.

I observed the animal for 45 minutes. The plantation was covered with creepers and grass, with scattered self-sown trees (of an unknown species). The Marten was running across the rocks, but when it spotted us, it stopped moving and stared at us for about 5–10 minutes. It seemed quite calm and unruffled. It then started running between the shrubs and rocks, and climbed to the top of a rock from where it started calling with a quiet '*creeeek creeeek...*' sound. It always stretched its neck while calling. This lasted for about 7 minutes. Then it ran back to the plantation and started digging under the trees, as if searching for something. It sniffed in and around the rock cervices for more than 30 minutes, finally sprinting into the nearest natural forest patch. This forest patch, a part of Agasthyamalai Biosphere Reserve, is 200 m from the plantation and about 300–400 m from the original location of the Marten.

There is a previous report of Nilgiri Marten from Peppara Wildlife Sanctuary (Christopher & Jayson 1996). During another recent sighting of the species, in Mukurthi National Park, Tamil Nadu (about 11°16′N, 76°28.5′E) on 21 June 2012 (Iyer 2012), the animals were also surprisingly confiding: the photographer, R. Prakash, noted that "we clicked pictures for quite some time and it was surprising that they [a presumed pair] lingered on".

Many carnivore species in the Western Ghats such as cats (Felidae), Nilgiri Marten and civets (Viverridae) are poorly known (Johnsingh 1986, Nowell & Jackson 1996, Mudappa 1998). This is a major drawback in their conservation (Kumar & Yoganand 1999). Among them, Martens seem always to have been seen only rarely, and such long observations of Nilgiri Marten are very rare. Accumulating the details of such sightings would surely provide more clues about the conservation needs of this enigmatic species of marten.

Fig. 1. Nilgiri Marten *Martes gwatkinsii*, Bonacadu, Peppara Wildlife Sanctuary, Kerala, India, 5 January 2013 (two views).

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Observations of sympatric small carnivores in Mudumalai Tiger Reserve, Western Ghats, India

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Abstract

Small carnivores were camera-trapped intensively in three major forest types in Mudumalai Tiger Reserve, India, in 2010 and 2011. Direct sightings, opportunistic drives, interviews of local people and forest officials also provided information. Small Indian Civet *Viverricula indica* and Stripe-necked Mongoose *Herpestes vitticollis* had higher encounter rates in deciduous and semi-evergreen forests than in thorn forest, within which the mongoose was recorded only very rarely. Common Palm Civet *Paradoxurus hermaphroditus* encounter rates seemed similar in thorn forest and deciduous forest, but it was never recorded in semi-evergreen forest, whereas Brown Palm Civet *P. jerdoni* was recorded only in semi-evergreen forest. Ruddy Mongoose *H. smithii* and Indian Grey Mongoose *H. edwardsii* were recorded more frequently in thorn forest than in deciduous forest but only exceptionally, or not (respectively) in semi-evergreen forest. Smooth-coated Otter *Lutrogale perspicillata* and Brown Mongoose *H. fuscus* were not camera-trapped, but the former was sighted opportunistically, while the latter was perhaps reported outside the reserve by locals. Conservation priorities for small carnivores in Mudumalai Tiger Reserve and the surrounding landscape involve protection of critical habitats such as riparian and semi-evergreen forests, better control over anthropogenic activities, and reducing local trade in small carnivores if it is confirmed to exist. Extensive surveys should be well designed for naturally rare and/or difficult-to-detect species, which may include other species, not so far recorded in the reserve, to ascertain their status, threat levels and, if any, conservation needs.

Keywords: camera-trapping, encounter rates, forest types, Herpestidae, Mustelidae, South India, Viverridae

Introduction

Many small carnivores are difficult to study being elusive, small, (semi-) arboreal, and crepuscular or nocturnal. Low research interest in them across India reflects their lower popularity and charisma than of larger mammals, and limited perceived use as flagship species. Extensive camera-trapping of carnivores across India has provided little published information on small carnivores, with few systematic surveys specifically for them (Gupta 2011). Variation in small carnivore communities with habitat remains little documented. Recent camera-trapping surveys gathered important ecological data on some species (Datta *et al*. 2008, Nixon *et al*. 2010, Gupta 2011, Prakash *et al*. 2012).

In southern India, the Nilgiri Biosphere Reserve (Nilgiri BR) offers a wide range of habitats from lowland scrub forests to rainforests at high elevations, supporting many species of small carnivores (Yoganand & Kumar 1995). The Western Ghats, within which Nilgiri BR lies, is under serious threat from development activities like human settlements, industries, hydroelectric projects, irrigation dams, mining, and commercial monoculture plantations of Teak *Tectona grandis*, tea, coffee and spices. The small carnivores of Mudumalai Tiger Reserve (Mudumalai TR), part of the Nilgiri BR, have been reported by rapid surveys, opportunistic sightings, sign surveys, live-trapping and radio-telemetry (Kumar & Umapathy 1999, Kumar & Yoganand 1999, Kumara & Singh 2007, Baskaran & Boominathan 2010). However, these studies were restricted in spatial and seasonal coverage, and were mostly not intensive and/or systematic. Furthermore, Ashraf et al. (1993) stated that the Brown Palm Civet, which is endemic to South India, is unlikely to be present in Mudumlalai TR.

This study reports small carnivores from intensive camera-trap surveys in Mudumalai TR in wet- and dry seasons of 2010 and 2011, supplemented by opportunistic observations and interviews with local people and forest officials.

Study site

Mudumalai Tiger Reserve (11°32–43′N, 76°22–45′E; Fig. 1), in the state of Tamil Nadu, spans 321 km^2 and is bounded by Wayanad Wildlife Sanctuary on the west, Bandipur Tiger Reserve in the north and Nilgiri North Forest Division in the south. The protected areas total 3,300 km^2 of contiguous habitat. Vegetation in Mudumalai TR comprises Southern Tropical Dry Thorn Forest, Southern Tropical Dry Deciduous Forest, Southern Tropical Moist Deciduous Forest, Southern Tropical Semi-evergreen Forest, Moist Bamboo Brakes and Riparian Fringe Forest (see Champion & Seth 1968). Rainfall peaks during May (140–160 mm) and November (180 mm). Terrain is undulating hills interspersed with valleys, ravines, water courses and swamps. Elevation ranges from 854 m to 1,266 m. The mean maximum daily temperature ranged from 22.9 °C to 32.6 °C in the dry season, 24.5 °C to 30 °C in the first wet season, and 22.6 °C to 26.6 °C in the second wet season (Centre for Ecological Sciences, Indian Institute of Science), during the study period.

Cattle grazing, cultivation, pesticide use, settlements, collection of fuel wood and non-timber forest products, fishing, use of domestic dogs for hunting wildlife, illegal resorts and weekend homes, illegal hunting in privately owned plantations fringing the forests (tea, coffee and spices) and annual forest fires (anthropogenic) are believed to be significant threats to Mudumalai TR and its wildlife. The Moundadan Chettie tribe convert natural swamps (locally called '*vayal*') into paddy fields. Kurumba, Kattu Naicker and Irula tribes steal carnivore kills, perhaps depleting resources for smaller scavengers like mongooses. Invasive plants such as *Lantana camara*, *Eupatorium odoratum*, *Parthenium hysterophorus* and *Opuntia*

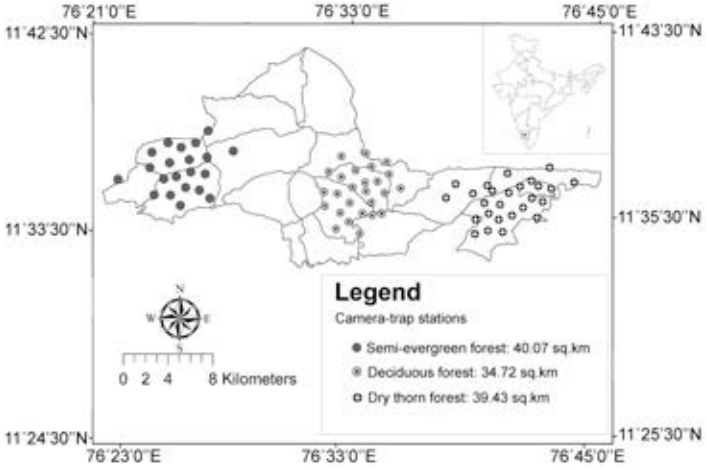

Fig. 1. Locations of camera-trap stations in Mudumalai Tiger Reserve, India (2010 and 2011). Outer perimeter shows the reserve's boundary.

dillenii are proliferating.

Methods

Field survey

An area of 114 km^2 within the altitudinal range of 920–1,003 m had three intensive camera-trapping zones, in deciduous (35 km^2), semi-evergreen (40 km^2) and dry thorn forest (39 km^2), during 2010 and 2011 (Fig. 1). Deciduous and dry thorn forests were surveyed in both dry and wet seasons, while semi-evergreen forest was sampled only in the former (Table 1), reflecting inaccessibility and logistical constraints in the wet season. Thorough preliminary survey identified sites with evidence such as tracks, faeces and civetries. Paired camera-traps were set in a grid of 1×1 km. This design centred on identifying individual animals, where possible, in a mark–recapture framework and investigating seasonal habitat use by presence/absence modelling (results to be reported elsewhere). Each year there were 25 pairs of camera-traps in deciduous forest, 21 in semi-evergreen forest and 26 in dry thorn forest, for 30 days in each forest type (Table 1). The same stations were used in each survey. Each station had two independently operating passive-infrared cameras (Deercam DC300; Stealthcam; and Moultrie Game Spy D-40) mounted opposite each other on trails, dirt roads, stream beds, underpasses; near fruiting trees, termite mounds and fresh animal carcases; 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 1 minute and sensitivity was set to high. Camera-traps were set approximately 25 cm above ground, except a pair on a Mango *Mangifera indica* branch, over-hanging a stream (targeting civets). A pair of skilled Kurumba trackers (former hunters) suggested camera-trap locations for civets, based on vegetation, terrain and their recent sightings. All camera-traps were checked, on average, every three days. Camera ID, film roll ID or 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 came from sign surveys, interviews with locals and forest officials, and opportunistic drives during day and night using a four-wheeler at a speed of 15 km/hr to look for small carnivores.

Data analysis

Each photograph recorded its date and time. A photographic event, whether by both camera-traps at a single camera station or at one, was considered notionally independent if it was at least 10 minutes after the species's preceding image at that station. Detections involving more than one individual part of the same social unit, e.g. mother and young, were counted as single events. Encounter rates were derived by dividing the number of notionally independent events by the camera-trap-nights $\times$ 100.

Results

Ten species of small carnivores, including small cats (Felidae), were found. Totally, 7,380 trap-nights yielded 439 notionally independent photographs of nine species: small cats (89, including Jungle Cat *Felis chaus*, Leopard Cat *Prionailurus bengalensis* and Rusty-spotted Cat *P. rubiginosus*), Small Indian Civet *Viverricula indica* (87 notionally independent photographs), Common Palm Civet (36), Brown Palm Civet (20), Stripe-necked Mongoose *Herpestes vitticollis* (61), Ruddy Mongoose *H. smithii* (95) and Indian Grey Mongoose *H. edwardsii* (51). Smooth-coated Otter *Lutrogale perspicillata* and Brown Mongoose *H. fuscus* were not camera-trapped, but the former was sighted opportunistically, while the latter was perhaps reported by locals outside the reserve. Mean encounter rates of small carnivores (excluding small cats) across both years ranged from 0.13 captures per 100 trap-nights to 2.56 captures per

Table 1. Camera-trapping effort in three major forest types in dry and wet seasons in Mudumalai Tiger Reserve, Western Ghats, India (2010 and 2011).

Year	Season	Habitat types	Number of camera-trap stations	Number of camera-trap-nights
2010	Dry	Deciduous forest	25	750
	Dry	Dry thorn forest	26	780
	Dry	Semi-evergreen forest	21	630
	Wet	Deciduous forest	25	750
	Wet	Dry thorn forest	26	780
2011	Dry	Deciduous forest	25	750
	Dry	Dry thorn forest	26	780
	Dry	Semi-evergreen forest	21	630
	Wet	Deciduous forest	25	750
	Wet	Dry thorn forest	26	780

Table 2. Number of camera-trap stations with records (CS), notionally independent photo-captures (NIPC) and encounter rates (ER) (NIPC/100 trap-nights) of small carnivores in Mudumalai Tiger Reserve, India (2010 and 2011).

		Deciduous#						**Dry thorn***						**Semi-evergreen^**		
		Dry			**Wet**			**Dry**			**Wet**			**Dry**		
Species	Year	CS	NIPC	ER	CS	NIPC	ER	CS	NIPC	ER	CS	NIPC	ER	CS	NIPC	ER
Small Indian Civet	2010	4	7	0.93	4	5	0.67	5	9	1.15	3	6	0.77	4	4	0.63
	2011	9	16	2.13	4	7	0.93	2	3	0.38	9	15	1.92	6	15	2.38
	Mean			1.53			0.80			0.76			1.34			1.50
Common Palm Civet	2010	2	2	0.40	1	1	0.13	3	8	1.02	2	4	0.51	0	0	0
	2011	3	4	0.53	3	6	0.80	4	5	0.64	4	6	0.77	0	0	0
	Mean			0.93			0.46			0.83			0.64			
Brown Palm Civet	2010	0	0	0	0	0	0	0	0	0	0	0	0	5	8	1.27
	2011	0	0	0	0	0	0	0	0	0	0	0	0	6	12	1.90
	Mean															1.58
Stripe-necked Mongoose	2010	7	14	1.87	4	20	2.66	1	1	0.13	0	0	0	1	1	0.16
	2011	5	10	1.33	2	6	0.80	0	0	0	0	0	0	7	9	1.43
	Mean			1.53			1.73			0.065						0.79
Ruddy Mongoose	2010	5	14	1.87	4	5	0.67	6	23	2.95	5	9	1.15	0	0	0
	2011	3	4	0.53	3	12	1.60	10	17	2.18	6	11	1.41	0	0	0
	Mean			1.2			1.13			2.56			1.28	0	0	0
Indian Grey Mongoose	2010	1	1	0.13	1	1	0.13	5	17	2.18	3	8	1.03	0	0	0
	2011	1	2	0.26	1	1	0.13	7	15	1.92	6	6	0.77	0	0	0
	Mean			0.19			0.13			2.05			0.90			

= 3000 camera-trap-nights, * = 3120 camera-trap-nights, ^ = 1260 camera-trap-nights.
'Notionally independent photo-captures' and 'encounter rate' are calculated as given in the text. No camera-trapping was carried out in the semi-evergreen forest during the wet season.

100 trap-nights (Table 2).

Species accounts

Accounts are given for all species of Mustelidae, Viverridae and Herpestidae detected, but small cats are not considered further, being covered in Kalle *et al*. (2013).

Smooth-coated Otter *Lutrogale perspicillata*

Otters were recorded only by opportunistic sightings and ancillary evidence. Camera-traps were rarely set in localities (near streams and rivers) likely to record otters. In 2010, we sighted a group of seven otters at around 07h00, for 10 minutes, in the eastern part of the reserve along the Moyar river, within thorn forest (Fig. 2). In 2011, we sighted a duo at 09h00 along a shallow bamboo-lined stream (Video 1), towards the southern portion of the reserve, 2–3 km from highway NH-67. Tracks, specifically in moist mud, and spraints were often observed. The spraints consisted of crushed crabs, shells and fish remains, deposited over rocks along the banks of perennial water bodies (large and small), and sometimes along forest trails close to these water bodies. Images of footprints and faeces suggest the signs are at least mostly of the Smooth-coated Otters (S. A. Hussain verbally 2011). Otters are quite familiar to the local tribes and anti-poaching watchers. Based on their verbal descriptions of morphology, otters were called '*neer nai*' in Tamil, which means 'water dog'. Based on their own observations and after examining the photographs in Menon (2003), tribes claim to have seen two kinds/species of otters. There is no species-specific local name for either, yet they are aware that one is larger than the other. Local tribes stated that they often noticed otters capturing fish in shallow waters, usually during 06h00–07h00. We found no evidence of otter hunting.

Small Indian Civet *Viverricula indica*

Small Indian Civet was camera-trapped more often than were palm civets, perhaps reflecting its more ground-dwelling nature. It was the most widely found species, recorded at 55.5% of all camera-trap locations in all three forest types. During night drives, it was sighted twice in deciduous forest and once in thorn forest. In semi-evergreen forest, it was also photographed near understorey-coffee shade, *c.* 300 m from a village. In 2010's peak dry season it was photographed repeatedly near a human-made water hole in dry deciduous forest. All images showed only one animal. The species seems not to be camera-trap-shy: some individuals (identified by spot patterns along the neck and flank) were camera-trapped repeatedly. It is strictly nocturnal, with all photographs obtained during darkness (18h00–06h00). On seeing camera-trap photos of Small Indian Civet, the locals referred to it as '*palm seeri*' where '*palm*' is the English word and '*seeri*' is in the language (other than Tamil) spoken by Kurumba tribes. Its etymology is unclear. Locals reported frequent observations of the species visiting settlements by night to prey on domestic fowl. These results fit with past views that it is a habitat generalist. Kumar & Umapathy (1999) reported low live-trapping success rates for it in the Nilgiri BR. In Karnataka, sightings came from habitats varying from crop fields in the drier plains to evergreen forests (Kumara & Singh 2007). It was more frequently record-

Fig. 2. A group of Smooth-coated Otters *Lutrogale perspicillata* near moist bamboo brakes in the Moyar range of Mudumalai Tiger Reserve, India, 21 March 2010 (Photo credit: R. Kalle).

ed in rainforest fragments than in the relatively undisturbed, large, contiguous rainforest tracts of Kalakad-Mundanthurai Tiger Reserve (Mudappa *et al*. 2007, Ramesh *et al*. 2012).

Common Palm Civet *Paradoxurus hermaphroditus*

Common Palm Civet was recorded at 23.3% of camera-trap locations, but may have been under-recorded because of its semi-arboreal habit (see Su Su & Sale 2007). Encounter rates were similar in thorn forest and deciduous forest in the dry season, but none was recorded in semi-evergreen forest (Table 2). Most records were close to water, near riparian vegetation and dried stream beds, possibly because frequent canopy breaks force animals to ground level to cross them. A kitten was photographed in dry deciduous forest on 31 March 2011. During a night drive, an animal was observed on the trunk of an *Anoigessus latifolia* tree 3 m above ground; local tribes reported them using this species and *Grewia tiliifolia*. All photographs showed only one animal. The species does not appear to be camera-trap-shy: some were photographed repeatedly. It was photographed only in the dark hours (18h00–05h00). On seeing camera-trap photographs, tribes referred to Common Palm Civet in Tamil as '*maranai*' ('tree dog' or 'wood dog'), stating that in lateral view it resembles a dog. The local tribes stated that they used to hunt them for meat, many years back; each animal was reportedly removed from its resting site (tree cavity) by pulling its tail. Earlier studies in southern India camera-trapped many Common Palm Civets in drier deciduous forests at lower elevations (< 800 m), with no observations in the rainforests (Mudappa *et al*. 2007), and in Kerala and Karnataka, it was recorded almost entirely in deciduous forests and plantations (Kumara & Singh 2007, Nixon *et al*. 2010).

Brown Palm Civet *Paradoxurus jerdoni*

Brown Palm Civet was photographed only in semi-evergreen forest, being recorded in 76.2% of camera-trap locations there (Table 2); thus within its preferred habitat it seems quite generally distributed. It was camera-trapped amid natural vegetation and near understorey-coffee shade. During a night drive in semi-evergreen forest, an animal was observed on the ground. All photographs showed only one animal. A few individuals had yellow markings near the tail tip (Fig. 3) but most did not. All photographs were obtained by night (23h00–03h45). In Tamil, the species is seemingly locally called '*maranai*', as is Common Palm Civet (see above). Sometimes it might be referred to as '*palam panni*' in Tamil, where '*palam*' means 'fruit' while '*panni*' means 'pig'. Both names were assigned based on verbal descriptions of animals by tribes; no photographic corroboration was made. To the locals, the frugivorous diet and frontal facial appearance resemble a pig. Locals stated that such animals are often sighted in tea and coffee estates during the peak coffee-berry season. A coffee estate owner near the Nellakotai Range found two kittens, about five weeks old, in coffee plantations on 25 February 2010 (Fig. 4). No evidence of hunting was found. Brown Palm Civet has been recorded only in evergreen biomes, occurring in both little-disturbed, large contiguous forests as well as fragments surrounded by tea plantations and/

Fig. 3. Brown Palm Civet *Paradoxurus jerdoni* camera-trapped in semi-evergreen forest of Mudumalai Tiger Reserve, India, 18 February 2011 (Photo credit: Wildlife Institute of India).

Fig. 4. Two young Brown Palm Civets *Paradoxurus jerdoni* found locally in a coffee plantation outside Mudumalai Tiger Reserve, India, 25 February 2010 (Photo credit: R. Kalle).

or human habitations (Mudappa 2001, Rajamani *et al*. 2002).

Stripe-necked Mongoose *Herpestes vitticollis*

Stripe-necked Mongoose was photographed most often in moist regions, especially along stream beds and close to water sources (Video 2), amounting to 36.1% of all camera-trap stations. Encounter rates were highest in deciduous forest followed by semi-evergreen forest, and very low in thorn forest (Table 2). It was photo-captured and sighted directly in duos and apparently singly. Tracks identified as this species were observed along stream beds especially in the dry season, when dead tadpoles, fish and molluscs (all potential food) are found in receded or stagnant water. Close to these tracks, frequent small holes in the soil perhaps indicated searches for sub-soil prey; once a duo was watched searching thus, walking along stream beds. A camera-trap placed near a dead male Gaur *Bos gaurus*, over a dried stream bed of the Kakanullah river, photographed a duo in the late evening. The next day at around 20h00 (when dark) a duo was observed feeding on the carcase. Most records come by day, but one was photographed at 21h06 in semi-evergreen forest (Fig. 5). Seeing camera-trap photographs, the Kurumba tribes referred to the species as '*berki*' in a local language; the etymology was not explained. The animal has been reported in wet, semi-evergreen and dry deciduous forests especially near water bodies in the Nilgiri BR (Van Rompaey & Jayakumar 2003, Choudhury *et al*. 2008), suggesting that the present survey's lower encounter rates in the thorn forest than in other forest types reflect association with moist regions.

Brown Mongoose *Herpestes fuscus*

Brown Mongoose was neither camera-trapped nor sighted. On seeing photographs of the species in Menon (2003), some locals (tribes and tea/coffee estate employees) called this species '*karpu keeri*' in Tamil, where '*karpu*' means 'black' and '*keeri*' is a name used for other mongoose species (see below). Perhaps Brown Mongoose exists around the reserve: locals report observing '*karpu keeri*' (whether this name is used only for this species is unclear) by night, amidst tea and coffee estates along roads next to the Nellakotai range of the reserve.

Ruddy Mongoose *Herpestes smithii*

Ruddy Mongoose was camera-trapped widely (41.7% of all camera locations), but not in semi-evergreen forest (Table 2). One was, however, seen in this habitat, about 2 km from the nearest moist deciduous forest. All photographs showed only one animal (e.g. Fig. 6), yet direct observations confirm that they may sometimes travel in duos. Four late-evening encounters of the species scavenging over large mammal carcases involved Asian Elephant *Elephas maximus* (once a duo, once a singleton) and Chital *Axis axis* (two singletons, once in a *vayal* and the other in thorn forest). A duo was observed on a Teak branch, a meter above ground, in moist deciduous forest. Faeces of one sighted defecating held rings of millipede (some, pill millipedes) exoskeleton, and termite and beetle mouth-parts and wings. In the dry season, it was photographed repeatedly for three days at a human-made water hole, sometimes drinking. One evening (in low light) it was observed feeding along a tar road (Video 3A). It was sighted several times along forest roads by day (Video 3B & C). It seems to be largely diurnal, being photo-captured mostly by day but also occasionally in the early part of the night (18h00–20h30). Seeing camera-trap images, the tribes called this animal '*keeri*' in Tamil, apparently lacking a unique local name for it. In Karnataka, Kumara & Singh (2007) often sighted the species in dry forests or rocky areas. By contrast, in Someshwara Wildlife Sanctuary Nixon *et al*. (2010) camera-trapped it frequently in evergreen/semi-evergreen forests; survey effort was too low in deciduous forest and plantations to assess status there but it was sighted in deciduous forests of Biligiri Rangan Temple Wildlife Sanctuary, as well as semi-evergreen forests in Someshwara Wildlife Sanctuary, Karnataka (A. M. A. Nixon verbally 2013).

Indian Grey Mongoose *Herpestes edwardsii*

Indian Grey Mongoose was camera-trapped most often near termite mounds and in open habitats of deciduous and thorn forests amounting to 30.6% of all camera sites. None was re-

Fig. 5. Stripe-necked Mongoose *Herpestes vitticollis* camera-trapped in semi-evergreen forest, Mudumalai Tiger Reserve, India, 15 February 2011 (Photo credit: Wildlife Institute of India).

Fig. 6. Ruddy Mongoose *Herpestes smithii* camera-trapped in dry deciduous forest, Mudumalai Tiger Reserve, India, 7 November 2010.

corded by any method in semi-evergreen forest. It was sighted easily in open vegetation (Video 4A & B) and along forest roads and narrow trails during day drives, including a grassy area in the reserve's tea estate. Although images were all of singletons, on 21 February 2010 a group of four was sighted around 17h00, and on 4 March 2010 a duo was sighted. It is a regular visitor at the Peacock dormitory in the Kargudi Range of the reserve, where it comes to feed on kitchen refuse (pers. obs.). Most were photo-captured by day, but some thorn forest records were between 18h00 and 03h24, and one in deciduous forest was at 18h40. According to verbal descriptions of morphology by tribes and on their seeing camera-trap images, the species is locally called '*keeri*' in Tamil, like Ruddy Mongoose. Tribes reported observing *keeri* (Indian Grey and/or Ruddy Mongoose) frequently entering backyard pens to prey on domestic fowl, in the late afternoon and evening, and predating Grey Junglefowl *Gallus sonneratii*. Elsewhere, it has generally been recorded in disturbed areas, in dry secondary forests, in thorn forests, and near human settlements (Choudhury *et al.* 2011). By contrast, in Someshwara Wildlife Sanctuary, almost all camera-trap images came from evergreen/semi-evergreen forests, but survey effort was too low in deciduous forest and plantations to assess status there. A few Grey Mongooses were sighted in deciduous forests of Kerala (Nilambur region) but never camera-trapped (Nixon *et al*. 2010, A. M. A. Nixon verbally 2013).

General discussion

Mudumalai's three main forest types apparently hold somewhat different compositions of small carnivores (Table 2). However, photographic encounter rate is an index of the animal's prevalence on the images. Without exhaustive additional investigation to estimate detection probability, it cannot be used as a surrogate for abundance because many factors other than animal density affect how frequently any species is camera-trapped.

This survey recorded most small carnivore species known (Yoganand & Kumar 1995, Kumar & Umapathy 1999, Kumar & Yoganand 1999, Baskaran & Boominathan 2010) or likely (Ashraf *et al*. 1993, Nameer *et al*. 2001) to occur in Mudumalai TR. The records of Brown Palm civet may be the first for the reserve and contrast with earlier speculations that it might not occur there (Ashraf et al. 1993). Whether these are absent from Mudumalai TR or were present but overlooked is unclear. Future camera-trap placement should use knowledge of their ecology to target such species. Local tribes' knowledge may increase survey effectiveness through improved camera-trap placement, and allow larger area coverage, particularly in deeper, denser, less accessible regions.

Anthropogenic forest conversion and degradation threaten forest-dwelling species like Brown Palm Civet and Stripe-necked Mongoose (Kodandapani *et al*. 2004). Camera-traps also recorded locals with fishing gear, firewood, domestic dogs and cattle, particularly in the reserve's southeast. Local tribes and/or villagers hunting in Mudumalai TR usually bring domestic dogs and target large ungulates or carnivore kills, especially Chital, Sambar *Rusa unicolor* and sometimes even Black-naped Hare *Lepus nigricollis*. Small carnivores might feature as opportunistic catch. Baseline surveys to assess levels of offtake and trade and, the status of small carnivores in the surrounding landscape matrix outside protected areas, are needed. Threats to otters might come from water pollution and overfishing (Meena 2002, Nawab & Hussain 2012); threats in Mudumalai TR warrant investigation.

The priority research topics for small carnivores in Mudumalai TR and surrounding landscape include those which inform protection of critical habitats like riparian areas. Field research on semi-aquatic mammals like otters (heavily threatened in tropical Asia; e.g. Shepherd & Tansom 2013) should include better search efforts in an occupancy framework such that camera-trap placement and sign surveys are inclined towards riparian habitats (see Prakash *et al*. 2012). Understanding the status of generally rarely recorded, so perhaps vulnerable, species like Brown Mongoose and Nilgiri Marten demands focussing survey efforts in habitats believed to support them: rainforests/rainforest fragments, tea/coffee estates, mid-elevation tropical forests and montane shola grasslands.

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Electronic supplementary material

Videos filmed during the study in Mudumalai Tiger Reserve, India (Videos by R. Kalle).

1. Smooth-coated Otter *Lutrogale perspicillata*
<http://www.youtube.com/watch?v=InPmYXgxJFM>
2. Stripe-necked Mongoose *Herpestes vitticollis*
<http://www.youtube.com/watch?v=TSfAltgcNek>
3. Ruddy Mongoose *Herpestes smithii*
A) <http://www.youtube.com/watch?v=ydQFANxUpnw>
B) <http://www.youtube.com/watch?v=ujX-f7p-zBg>
C) < http://www.youtube.com/watch?v=ecBHkSSGEr8>
4. Indian Grey Mongoose *Herpestes edwardsii*
A) <http://www.youtube.com/watch?v=scvx7soy5Lc>
B) <http://www.youtube.com/watch?v=Wg3TkpWzz-8>

Nilgiri Marten *Martes gwatkinsii* in the Western Ghats, India (Photo: Ramakrishnan Prakash)

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