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Pousargues's Mongoose *Dologale dybowskii* at Semliki Wildlife Reserve, Uganda (Photo: Jason Woolgar)

# A confirmed sighting of Pousargues's Mongoose *Dologale dybowskii*

Jason WOOLGAR

**Fig. 1.** Pousargues's Mongoose *Dologale dybowskii* at Semliki Wildlife Reserve, Uganda, 8 July 2013.

## Abstract

I watched at length and photographed a group of Pousargues's Mongoose *Dologale dybowskii* on 7 and 8 July 2013 at Semliki Safari Lodge (on the eastern border of Semliki Wildlife Reserve), Uganda. The animals were distinctive in appearance, given my long experience with the main potential confusion species, Common Dwarf Mongoose *Helogale parvula*. Although the species's presence was well-known to lodge staff, this is the first published confirmed record of this extremely poorly known species from anywhere in its range for several decades.

*Keywords*: foraging, locality record, reaction to people, Semliki Safari Lodge, sociality, Uganda

## Une observation confirmée de la Mangouste des savanes *Dologale dybowskii*

## Résumé

J'ai longuement observé et photographié un groupe de Mangoustes des savanes *Dologale dybowskii* les 7 et 8 juillet 2013 à Semliki Safari Lodge (sur la frontière orientale de la réserve faunique de Semliki), en Ouganda. Les animaux étaient d'apparence distinctive (compte tenu de ma longue expérience avec la principale espèce qui pourrait potentiellement créer confusion, c'est à dire la Mangouste naine commune *Helogale parvula*). Bien que la présence de l'espèce était bien connue du personnel de la loge, cet article rapporte la première observation confirmée et publiée depuis plusieurs décennies, effectuée de quelque endroit à travers l'ensemble de l'aire de répartition de cette espèce extrêmement mal connue.

Pousargues's Mongoose *Dologale dybowskii* is known from just 31 museum specimens, with no confirmed sightings of this animal for more than three decades (Aebsicher *et al*. 2013, Stuart & Stuart 2013). As far as I am aware, this, the only species in the genus *Dologale*, has never previously been photographed in the wild and has only ever been recorded in one protected area, Garamba National Park in northeastern DRC (Democratic Republic of Congo), directly on the border with South Sudan (Verschuren 1958, Stuart & Stuart 2013). The sightings took place over two days, on Sunday 7 and Monday 8 July 2013, at Semliki Safari Lodge (0°54′15″N, 30°21′13″E; about 620 m asl), Uganda, a small lodge on the eastern border of Semliki Wildlife Reserve, less than 5 km south of Lake Albert. To the west, separated by no more than 6 km, the Fort Portal road and the northern extremes of Rwenzori National Park, lies Semliki National Park and the Semliki River, which acts as a natural border between Uganda and DRC. Formerly known as the Toro Game Reserve, Semliki Wildlife Reserve is one of the oldest protected, or at least partly protected, areas in Uganda and occupies the majority of the western Great Rift Valley floor. Whilst the steep eastern slopes of the rift escarpment, which reach an elevation of around 1,900 m and protect a healthy population of Chimpanzees *Pan troglodytes*, form part of the reserve, most of Semliki sits at an elevation of between 600 m and 900 m and largely comprises open savannah and riverine forest along the Wasa River. The road from Fort Portal, the nearest major urban settlement, runs directly through the reserve to the southern extreme of Lake Albert, the most northerly of the great rift lakes and one of the few remaining localities holding Shoebill *Balaeniceps rex* in Uganda.

My first encounter with this little-known mongoose took place within a few minutes of returning from a boat trip on Lake Albert to photograph these distinctive birds, as I waited for lunch in the main dining area of the lodge. This overlooks

**Fig. 2.** Pousargues's Mongoose *Dologale dybowskii* at Semliki Wildlife Reserve, Uganda, 8 July 2013.

a section of forest. A small troop of Guerezas *Colobus guereza* had approached to within a reasonable distance for photographs and, as I turned to change the lens on my camera, I noticed that a single mongoose had entered the open dining room (roofed, but with one open side overlooking the forest, and several large doorways in the other walls, through one of which the mongoose entered). I was immediately aware that this was not a mongoose I had previously encountered, for although it bore a cursory resemblance to Common Dwarf Mongoose *Helogale parvula*, it was approximately 20–30% larger, with a far more substantial build and a longer tail than any Dwarf Mongoose I had observed in almost 25 years of travel in Africa. It was instantly recognisable as a distinct species. It was also far darker than any Dwarf Mongoose I had encountered, although of course major colour variations can occur within species across regions. Its underparts and lower limbs were conspicuously darker than the rest of the body. In addition, although Dwarf Mongoose has a wide distribution, from as far south as eastern South Africa to the northern extremes of Ethiopia, it is not thought to occur in much of Uganda and certainly not as far west as Lake Albert (Kingdon 1997). Given that small carnivores are one of my main areas of interest among mammals, I was already aware of the mongoose species that occur in Uganda and that there were only two that I had not previously seen, Jackson's Mongoose *Bdeogale jacksoni* and Pousargues's Mongoose or Savannah Mongoose, as it is also commonly known. I ruled out Jackson's Mongoose on both appearance and range and when I checked my field guides later, the only one that offered any real assistance was Jonathan Kingdon's (1997) *the Kingdon field guide to African mammals*, which appeared to confirm that I had indeed seen my first Pousargues's Mongoose. Although the mongoose I had observed was darker than Kingdon's illustration, and the "undivided upper lip" that Kingdon described was not apparent to me, the rest of the description did match the animal that I had seen, particularly the size and distinctive ruff around the neck, which Kingdon described as a "prominent reverse 'cowlick' of fur" (p. 244).

**Fig. 3.** Pousargues's Mongoose *Dologale dybowskii* at Semliki Wildlife Reserve, Uganda, 8 July 2013.

The real surprise was that the mongoose that emerged in the dining room was not alone and whilst I understand that there is some suggestion that this species is believed to be solitary (see Stuart & Stuart 2013), if my encounters are anything to go by, that is not the case, as I discovered an additional seven animals as soon as I followed the first mongoose out into the largely manicured grounds of the lodge. Unfortunately all eight animals were departing when I saw them and although I followed for as long as possible and took a few initial pictures, they quickly disappeared into the undergrowth. However, they were not at all nervous or uncomfortable in my presence and I determined that they were almost certainly regular visitors to the lodge and that I would probably have another opportunity to see them the following day. This was confirmed when I spoke to the local guides, who were all familiar with the species and immediately referred to them as 'savannah mongoose'. Happily, as I waited on the lawn in order to avoid moving and disturbing them, the next day I was able to spend around 40 minutes with what I presume were the same eight animals (Figs 1–4). They again arrived around lunchtime and on this occasion I was able to watch them interact at close quarters. My initial observation was that their foraging far more resembled the feeding patterns of Banded Mongoose *Mungos mungo*, which generally forages in fairly loose and apparently independent formations, as opposed to the slightly tighter more controlled feeding groups of Dwarf Mongoose. I subsequently discovered that this preliminary observation appears to be supported by Kingdon (1997), who noted that "Dwarf Mongooses forage as a group, with a spread of some 50–60 m" (p. 243), while "Banded Mongooses forage in a loose formation" (p. 248). Generally they pounced on insects on the ground, but at various times they all dug in the loose soil and also turned over light stones along the paths. No obvious young or sub-adults were present and although they largely fed alone, they remained in contact with a series of vocalisations reminiscent of other communal mongoose species. They did not appear to travel as a group, at least not within close proximity of each other, as two continued to feed around the lawn at least ten minutes after the first six had departed. As I followed the final two animals, I encountered another two around 50 m away, but there was no sign of the other four, perhaps again suggesting that their behaviour more resembles that of Banded Mongoose than Dwarf Mongoose. They were certainly extremely tolerant of my presence and, judging from the evidence supplied by the guides that I spoke to, at least two of whom confirmed they had been seen around the lodge for several years, these animals are likely to be common in the

**Fig. 4.** Pousargues's Mongoose *Dologale dybowskii* at Semliki Wildlife Reserve, Uganda, 8 July 2013.

area and have undoubtedly been observed by other visitors, albeit unwittingly.

The relatively remote location aside, the most likely explanation regarding the lack of recorded sightings almost certainly relates to their passing resemblance to Dwarf Mongoose (despite the fact that it does not occur in the area), as well as the fact that many tourists do not take a great deal of interest in most smaller animals. Mongooses are of course territorial and it is therefore possible that these animals are an isolated group that have lived around the lodge for a number of years. However, the guides, all of whom had a sound knowledge of the local wildlife, indicated that they are also seen within other areas of the reserve. Consequently it is far more likely that they are comparatively common there and that this is yet another example of a visitor 'discovering' an animal that local people have always known and lived with.

## Acknowledgements

Many thanks to Jonathan Kingdon, who confirmed the species as Pousargues's Mongoose from the photographs that I provided and have reproduced for this article. Mike Evans clarified the geolocation.

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## Chris and Mathilde STUART have commented:

"Two recent records have emerged, and have been published in *Small Carnivore Conservation*, of Pousargues's Mongoose *Dologale dybowskii*. This is one of Africa's least known mongoose species and these constitute the first photographic records of living individuals.

"This mongoose was previously known from just 31 museum specimens and a number of possible but unconfirmed sightings. Aebischer *et al*. (2013) documented probable records of this mongoose from the Chinko/Mbari drainage basin in the Central African Republic (CAR), with photographs. Now, most recently, Woolgar (above) has published details of sightings with photographs taken in the Toro-Semliki Wildlife Reserve, southwest Uganda.

"Both records fall within the known range of Pousargues's Mongoose and outside the known range of the similar Common Dwarf Mongoose *Helogale parvula*. Having looked at all available photographs there is no doubt in our mind that these are Pousargues's Mongoose in both localities. One image from the CAR clearly shows the long, robust claws on the front feet, overall grizzled appearance and what could be called a "cowlick" on the lower neck. Likewise the image from Toro-Semliki is clearly not of Dwarf Mongoose. Jonathon Kingdon has also confirmed the Toro-Semliki mongoose from the images as Pousargues's.

"What is of interest is that the animals at Toro-Semliki were observed in a 'troop' but only in loose association and Woolgar was able to observe them for some time. This would seem to be the perfect location for somebody to study this population. We wish we had the time!"

# Records of ferret badgers *Melogale* from the states of Meghalaya and Arunachal Pradesh, India

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## Abstract

Ferret badger *Melogale* is recorded for the first time from the Garo Hills of Meghalaya, India. Records came through camera-trapping, field sightings and a hunted animal. Two records from Balpakram National Park and two from community forest and shifting cultivation areas close to the park are all in the South Garo Hills; and one is from the village of Upper Rongkhon in the West Garo Hills. The hunted animal confirms Burmese or Large-toothed Ferret Badger *M. personata* in the Garo Hills. Another record is from a village in Chayang Tajo Circle of East Kameng district, Arunachal Pradesh.

*Keywords*: camera-trap, East Kameng district, Garo Hills, human habitation, *jhum*, limestone, *Melogale personata*, shifting cultivation

## Introduction

Two species of ferret badger *Melogale* have a combined, extensively overlapping, range on the Asian mainland from Bangladesh (and possibly Nepal) in the west, across Bhutan and North-east India to east China and South-east Asia (Pocock 1941, Corbet & Hill 1992, Islam *et al*. 2008, Thapa 2014). These are the Large-toothed or Burmese Ferret Badger *M. personata* and the Small-toothed or Chinese Ferret Badger *M. moschata*. The two species are difficult, perhaps impossible, to distinguish using external coat and facial patterns. To establish species identity visually, present knowledge mandates examination of the skull. This is not possible for wild sightings or camera-trap photographs, so most records of *Melogale, ipso facto,* remain unconfirmed to species. Coudrat & Nanthavong (2013: 48), therefore, suggested that "throughout their range, even single records of authoritative identification remain of value". Two further complications are the naming of a third mainland species, Cuc Phuong Ferret Badger *M. cucphuongensis* Nadler *et al*., 2011 from one site in Vietnam, and indications that even some skulls (from east China) may not be unambiguously identifiable to species on visual examination (Stefen & Feiler 2004).

Globally, on *The IUCN Red List of Threatened Species M. personata* is categorised as Data Deficient and *M. moschata* as Least Concern (IUCN 2014). In India, both species are listed in Schedule II (I) of the Wildlife (Protection) Act, 1972, under which they receive a high level of protection by law.

Choudhury (2013) compiled the Indian records of both species and those that were indeterminate. In India, *Melogale* occurs only in the eight northeast Indian states (Arunachal Pradesh, Assam, Meghalaya, Mizoram, Manipur, Nagaland, Tripura and Sikkim) and in the adjoining mainland India state of West Bengal. Few ferret badger records (some museum specimens, hunting trophies and road-kills) in India are identified to species. There are at least ten records of *M. personata* from Arunachal Pradesh, Meghalaya, Nagaland, West Bengal and Tripura. The ten of *M. moschata* come from Arunachal Pradesh, Meghalaya, Nagaland and West Bengal (Thomas 1923, Choudhury 2000, 2013).

Four records of ferret badgers (a camera-trap photograph; a museum specimen; a hunted animal; and a pair of which one was killed and the other released) have been added recently from the states of Nagaland and Mizoram (Ved & Zathang in press). Their species could not be identified because skull and teeth were not examined. Camera-trap records exist only from two Indian sites so far – four from Namdapha Tiger Reserve (TR) in Arunachal Pradesh (Datta *et al*. 2008) and one from Dampa TR in Mizoram (Ved & Zathang, in press).

In this context, five *Melogale* records from the Garo Hills of Meghalaya in 2013 and 2014 warrant reporting. These records, detailed here, include the first camera-trap photograph from Meghalaya and one record identified as *M. personata* from skull characteristics. Four of the records are from in and around Balpakram National Park in the South Garo Hills district. The fifth record is from near the town of Tura in the district of West Garo Hills. A sixth record comprises a new locality for *Melogale* in Arunachal Pradesh: Chayang Tajo in East Kameng district. Geographical coordinates and altitude information for the records are summarised in Table 1, with their locations mapped on Fig. 1. Capitalised habitat types follow the classification of Champion & Seth (1968).

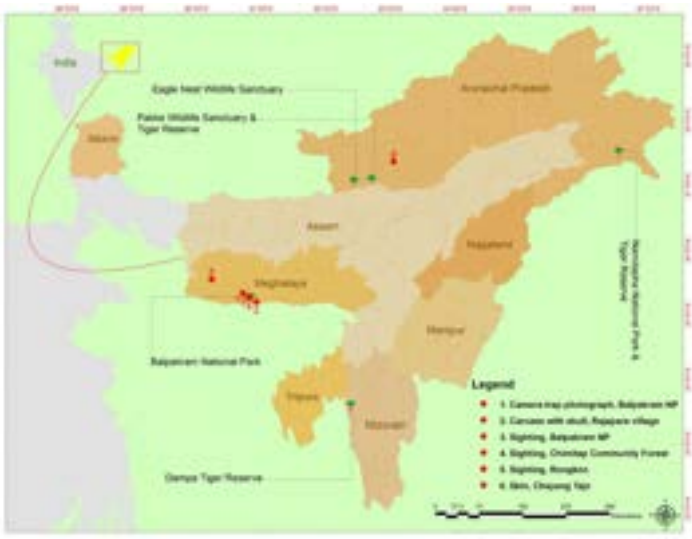


**Fig. 1.** Locations for six ferret badger *Melogale* records from Meghalaya (South and West Garo Hills districts) and Arunachal Pradesh (East Kameng district) in North-east India, 2011–2014.

**Table 1.** Ferret badger *Melogale* records from the Garo Hills (Meghalaya) and from East Kameng (Arunachal Pradesh) India, 2011–2014.

| N° | Date, time | Place | Coordinates; altitude (m)[2] | Type of evidence | Habitat[3] |
|---|---|---|---|---|---|
| **MEGHALAYA** | | | | | |
| *South Garo Hills* | | | | | |
| 1 | 25 Apr 2013, 03h02 | Balpakram NP, near village of Bana. | 25°19′56.5″N, 90°43′01.2″E; 694 | Camera-trap | Dense secondary tropical MDF |
| 2 | 8 Apr 2013, 14h55 | Village of Rajapara, Chambukung A.king[1] | 25°12′N, 90°56′E; 309 | Dead animal | 5 year *jhum* fallow, tropical MDF, secondary growth |
| 3 | 31 Mar 2014, 20h20 | Chimiseng Stream, Balpakram NP | 25°16′30.3″N, 90°48′18.9″E; 283 | Direct sighting | Dense riparian tropical MEF |
| 4 | 6 Apr 2014, 05h40 | Chimitap village community forest | 25°15′39.8″N, 90°48′44.8″E; 500 | Direct sighting | Degraded community tropical MDF |
| *West Garo Hills* | | | | | |
| 5 | 5 Oct 2013, 22h30 | Village of Upper Rongkhon | 25°32′39.0″N, 90°13′50.1″E; 390 | Direct sighting | Village, village woodlot |
| **ARUNACHAL PRADESH** | | | | | |
| *East Kameng District* | | | | | |
| 6 | May 2011 | Village near Chayang Tajo settlement[1] | *27°41′N, 93°08′E; unknown | Skin | Village near tropical SEF |

All records were unidentified to species except 2, from Rajapara, which was *M. personata*.
[1]location is site of observation of remains, not site of capture.
[2]Co-ordinates and altitudes were derived by a variety of means and, most, at least, are given under the WGS84 datum. *Within 2 km of indicated location.
[3]MDF = moist deciduous forest; MEF = moist evergreen forest; SEF = semi- evergreen forest.

## Records from the Balpakram – Baghmara Landscape, Garo Hills, Meghalaya

The Balpakram–Baghmara Landscape of approximately 600 km$^2$ is located in the South Garo Hills district of the state of Meghalaya (Fig. 2). Government-owned forests cover 68% of it. They comprise two protected areas, Balpakram National Park (NP; notified area 220 km$^2$ with 132 km$^2$ acquired but yet to be notified) and Siju Wildlife Sanctuary (WLS) (5.18 km$^2$), and two Reserve Forests (RF), Baghmara RF (43.9 km$^2$) and Rewak RF (6.47 km$^2$). The rest of the landscape is community land of the indigenous Garo tribe. Such land is mainly shifting cultivation, plantations (areca nut, cashew and rubber), small community forests and villages. The landscape's altitude ranges from 50 to 1,023 m asl at Chutmang peak. Primary and secondary stands of Tropical Moist Evergreen Forest, Tropical Semi-evergreen Forest and Tropical Moist Deciduous Forest occur here, as do grasslands, shola and riparian forests and degraded land (Kumar & Rao 1985). The terrain is hilly with deep gorges and limestone formations (Wanniang & Thiek 2007). Four *Melogale* records were obtained from this area.


**Fig. 2.** Ferret badger *Melogale* record locations in the Balpakram–Baghmara forest landscape, South Garo Hills, Meghalaya, India.

*1. Camera-trap photograph – Balpakram National Park.*
Systematic camera-trapping under a three-year project 'Assessing Mammal Presence in the Balpakram–Baghmara Landscape, Meghalaya, India' is underway. The study design uses a grid of 2 × 2 km cells in which eight camera-traps per cell are deployed for 10 consecutive days. Two to three cells are sampled per session, with each cell sampled once. Twenty-four cells were sampled during January to May 2013 and November 2013 to April 2014. One camera-trap was stolen. Data were obtained from 191 camera-trap stations over a total of 1,910 camera-trap-nights.

A ferret badger was camera-trapped on 25 April 2013 in the Bana area of Balpakram NP (Fig. 3). The camera-trap was near a ridge top, along a trail and 500–600 m from the nearest village clearance. It was fixed on a tree nine feet above the ground. The habitat was closed canopy, secondary, Tropical Moist Deciduous Forest with *Cinnamomum bejolghota* and *Macaranga indica* trees and a dense undergrowth of saplings on the slopes. Eurasian Wild Pig *Sus scrofa* and

**Fig. 3.** Ferret badger *Melogale* camera-trap record near Bana, Balpakram National Park, Meghalaya, India, 25 April 2013; (a) animal; (b) habitat at the camera-trap station.

Red Muntjac *Muntiacus muntjak* were also photographed at this station.

*2. Carcase of Large-toothed Ferret Badger – Rajapara Village, South Garo Hills*

On the afternoon of 8 April 2013 lepidopterist Sanjay Sondhi and bird-watcher Nikhil Bhopale were driving from Maheshkhola to the district headquarters of Baghmara after a butterfly and bird survey. In the Rajapara hamlet of Chambukung A.king (an a.king is land owned by a clan for cultivation and habitation; it may have more than one hamlet) they saw a middle-aged Garo tribal man walking with a ferret badger in his hand. He said that he had killed it while it was crossing a road nearby. The area was a five-year slash-and-burn cultivation (*jhum*) fallow with a freshly cleared plot in it and patches of secondary Tropical Moist Deciduous community forest with *Schima wallichii, Macaranga indica, Castonopsis hystrix, Aporosa octandra, Toona ciliata* and *Dillenia pentagyna* trees, over an undergrowth of bamboo and broom grass *Thysanolaena maxima*. They confiscated the animal, took photographs (Fig. 4a–b), and then buried it by the roadside at Mahadeo, about 5 km down the road. The skull from the putrefied carcase was retrieved by SSr on 25 May 2013, cleaned and dried. The large upper 4th pre-molars ($P^4$) and well-developed temporal crests on the skull (see Storz & Wozencraft 1999) show the specimen is *M. personata* (Fig. 4c–d).

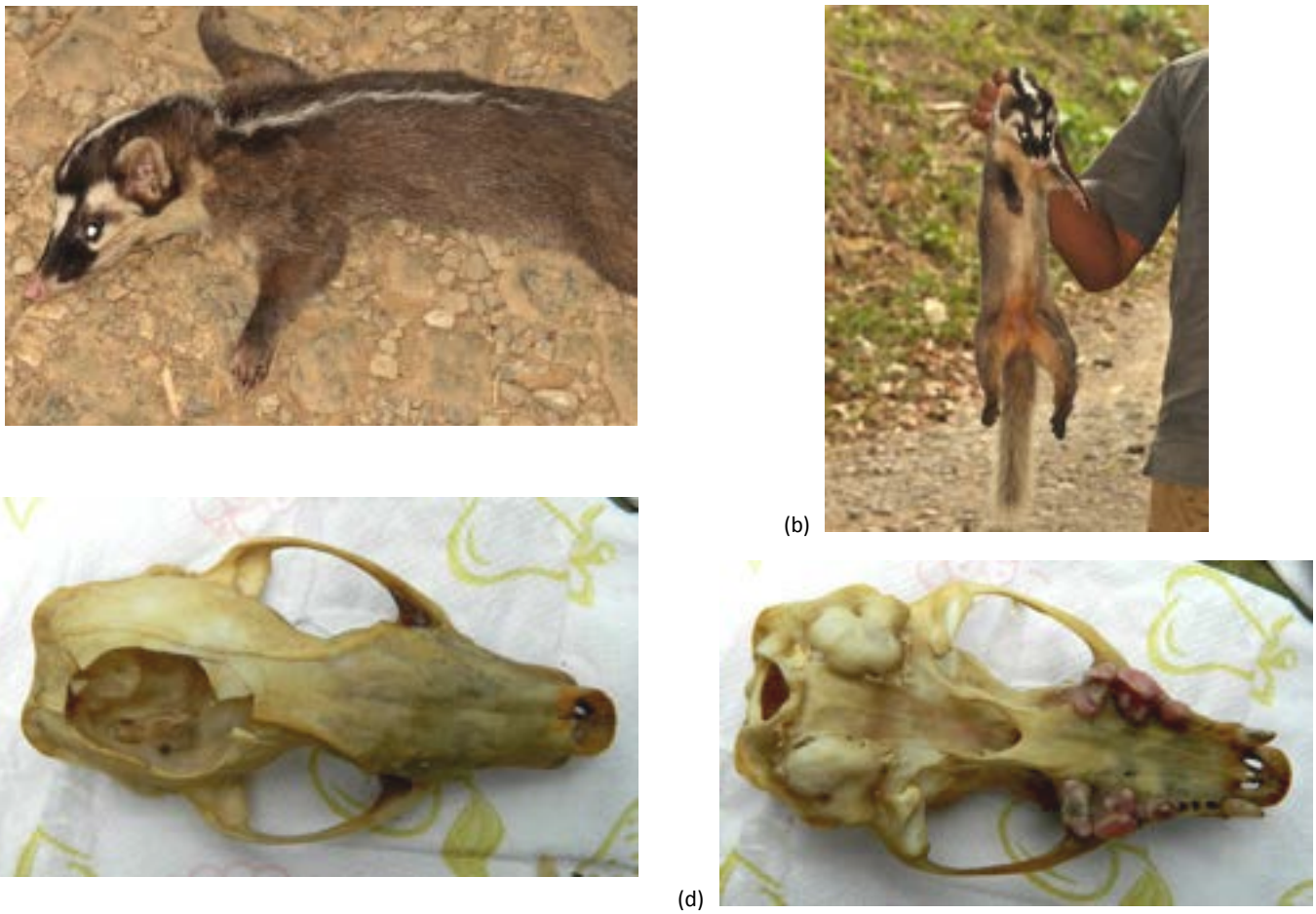

**Fig. 4.** Large-toothed Ferret Badger *Melogale personata*, village of Rajapara, South Garo Hills**,** Meghalaya, India; (a, b) fresh carcase, 8 April 2013; (c, d) skull.

*3. Sighting – Balpakram National Park*
At 20h20 on 31 March 2014, KK and forest guard Santosh Sangma had a 10-second sighting of a ferret badger at their temporary camp by the Chimiseng stream in Balpakram NP. The camp was at the headwaters of the stream in a limestone belt, with very large boulders and a narrow but continuous stream of water. The habitat was dense undisturbed Tropical Moist Evergreen Forest, at least 1 km from any cleared area. There were *Polyalthia simiarum* and *Castanopsis* trees about 25 m tall and an undergrowth of tree saplings (Fig. 5). The observers, sitting just above the stream by a camp-fire, heard scurrying from near the kitchen waste pit next to the stream, about 10 m below. KK's torch revealed blue-white eyeshine. The small animal stood on a low, flat rock by the water with its nose twitching, then turned and left. KK had a clear view of its mask, body and a fluffed pale tail that looked almost white. It is possible the animal was attracted by the smell of kitchen waste (rice, fruit and vegetable peelings, egg shells). A camera-trap at the spot that and the following two nights did not photograph the animal.

*4. Sighting – Chimitap Community Forest*
While on a survey for hornbills, RN saw two ferret badgers on the Chimitap–Rongcheng trail in the Chimitap community forest, about 380 m outside the Balpakram NP boundary, on 6 April 2014 at 05h40. It was after sunrise and light conditions were good. The location was in an open patch to the east of the trail where tree logs were being worked into planks by Chimitap villagers, near Ringringot. Vegetation on either side of the trail was degraded Tropical Moist Deciduous Forest on limestone, with a few trees of *Tetrameles nudiflora.* RN and his guide heard the animals from a flat area atop a slope about 8 m west of the trail. Some 10 seconds later, RN's clear view of the two animals approaching showed conical snouts and bushy tails approximately half the body length (itself slightly exceeding a foot). On the head, the area around the eye was white, with black around the forehead and ears. A white dorsal line extended from head to back, but RN could not be sure if it extended to the base of the tail. One animal was chasing the other; they left the trail about 6 m behind the observers.

## Record from West Garo Hills, Meghalaya

*5. Sighting – the village of Rongkhon, West Garo Hills, Meghalaya*
At 22h30 on 5 October 2013, PS received a call from his mother Keroni A. Sangma about an animal cornered by their four dogs in her house's toilet in the village of Upper Rongkhon of Me.gongre (Rongkhon) A.king, near Bosco Mount. PS arrived there, found the animal to be a ferret badger, then took a few photographs (Fig. 6). After the dogs were led away, the animal walked out slowly sniffing the ground and headed for a firewood log in the courtyard, where it seemed to forage for insects. It then went towards a patch of forest near the house. The village and forest patch are at the foothill of the small Kramcheng Peak. This is connected to the Tura Range of hills. The area was forest until 1986. Subsequent conversion to cultivation has left some patches of forest, interspersed with plantations of jackfruit, mango, lychee, tamarind, banana and betel.

## Record from East Kameng District, Arunachal Pradesh

*6. Skin – village in Chayang Tajo Circle*
In May 2011, during a state-wide Tiger *Panthera tigris* occupancy survey in Arunachal Pradesh, DS saw a fresh *Melogale* skin hung out to dry outside a house in a small village in the Chayang Tajo Circle of East Kameng district, about 2 km from the main settlement of Chayang Tajo (Fig. 7). The Nyishi tribal house-owner said that the animal had been caught 3–4 days earlier in a trap in a nearby forest. Another villager said that he was not familiar with the animal. The skull had not been preserved. The adjacent forest was sub-tropical semi-evergreen forest. Chayang Tajo and its nearby villages are an old settlement area where *jhum* cultivation is practiced.

## Discussion

*Identification to species*
Ferret badgers are among the lesser known carnivores in India. Although believed to be widespread across northeast India, there are few specific records from the wild. Of the six

**Fig. 5.** Location of ferret badger *Melogale* sighting at Chimiseng stream, Balpakram National Park, Meghalaya, India (below the tent), 31 March 2014.

**Fig. 6.** Ferret Badger *Melogale* in Upper Rongkhon, West Garo Hills, Meghalaya, India, 5 October 2013.

**Fig. 7.** Ferret badger *Melogale* skin at a village in Chayang Tajo Circle, East Kameng district, Arunachal Pradesh, India, May 2011.

records detailed here, only one was identified to species: it was *M. personata*. There remain only a handful of Indian ferret badger records identified to species. When possible, it is worth photographing both pelt and skull of any ferret badger encountered: skins associated with skulls (and thus of known species) might assist in development of identification criteria for records where skulls cannot be checked, such as camera-trap photographs. On living animals and mounted specimens, teeth on both jaws should be clearly photographed, with a scale in the image, to assist species identification and permit independent examination of the characteristics from photographs. However, even teeth characteristics alone may not allow identification (Stefen & Feiler 2004), at least in east China.

*Activity pattern*

Ferret badgers are said to be mainly nocturnal (e.g. Wang & Fuller 2003, Than Zaw *et al*. 2008, Chen *et al*. 2009), with dawn and dusk activity peaks in *M. moschata* (Sheng 1982). In Meghalaya, three of the four live animal records were at night, the fourth at dawn. All four records of Datta *et al*. (2008) were also at night. On the other hand, RN's sighting was in the early morning, and 14+ sightings by A. U. Choudhury (*in litt*. 2014) in Innerline and Dhansiri RFs (Assam) were between 06h00 and 11h20, indicating daylight activity to some extent.

*Habitat use*

These northeast Indian records are variously from *jhum* (slash-and-burn shifting agriculture), both degraded and closed-canopy moist deciduous forest, and relatively undisturbed moist evergreen forest. Some were within dense forest up to 1 km from any cleared area, but ferret badgers are clearly not limited to such habitat. Four of the six records presented here were in and around villages, disturbed forest and shifting cultivation. In the nearby state of Manipur, they were reported from tropical moist deciduous, tropical wet evergreen and subtropical pine forest at 1,200–1,500 m asl, and *jhum* areas (Ramakantha 1992). Ved & Zathang (in press) report two ferret badgers from an urban garden in Aizawl city, Mizoram. A radio-telemetry field study of *M. moschata* in southeastern China conducted in a village found that in addition to rodent dens, it used firewood stacks and rock piles around houses as day beds (Wang & Fuller 2003). Islam *et al.* (2008) recorded a *M. personata* captured on a tea estate in Bangladesh: the nearest forest was about 20 km away (Md. Anwarul Islam *in litt*. 2014). A. U. Choudhury (*in litt*. 2014) reports 3–4 sightings of ferret badgers crossing clearings within both degraded and good forest in the Innerline Reserve Forest, Hailakandi district, Assam. He also had 10+ sightings of them crossing a railway line dividing degraded forest from good forest in the Dhansiri Reserve Forest, Karbi Anglong district, Assam.

*Abundance and distribution*

The Garo Hills of Meghalaya are not represented well among India's existing ferret badger records and reports. Previous *M. personata* specimens, as well as the only *M. moschata* specimen from Meghalaya, are all from the Khasi Hills (Choudhury 2013), east of and adjacent to the Garo Hills. In an interview survey, 3% and 34% of 334 respondents in the Garo Hills, including hunters, reported (based around guide-book plates) *M. personata* and *M. moschata* respectively within their a.king in the preceding five years (Ved & Sangma 2007). The interviewers found no Garo or Atong names for either species. Whilst the identifications to species must be discounted, these responses suggest that ferret badgers use habitation and cultivation in villages (plausible, given the six new records presented here) and might not be uncommon in the Garo Hills.

The Garo Hills are only the third site in India, after Namdapha TR and Dampa TR, where *Melogale* has been camera-trapped. In Balpakram NP, 1,910 camera-trap-nights were needed to record one photograph of *Melogale*. This suggests a much lower encounter rate, so perhaps abundance, than in Namdapha TR where only 384 camera-trap-days were required per ferret badger photograph (Datta *et al.* 2008) during a total of 1,537 camera-trap-days. No ferret badgers were recorded in over 3,000 camera-trap-days in the Assam Valley Tropical Wet Evergreen forests at 100–400 m asl of the Jeypore–Dehing Landscape of Eastern Assam (Kakati 2010), in habitat similar to lowland Namdapha TR, less than 50 km along the same forest belt. Schank *et al*. (2009) suggested that the typically low camera-trap encounter rates of ferret badgers in much of South-east Asia might reflect relative rarity, presence of threats, natural variation in local abundance patterns and/or inadequacy of the camera-trap method in detecting the genus. But the genus has been readily camera-trapped in southern China, Vietnam and some of eastern Lao PDR (Lau *et al*. 2010, Willcox *et al*. 2014: Table SOM T3, Coudrat *et al*. 2014). The conventional camera-trap method is hence possibly adequate for detecting ferret badgers. Thus, the rarity of encounters in much of their range is likely to reflect low abundance, at least in the precise microhabitats where camera-traps are typically set. Several of these six new northeast Indian records are from degraded and modified habitats where camera-trapping is rarely undertaken.

Despite finding ferret badger the joint-fourth most commonly camera-trapped small carnivore in Namdapha TR in southeast Arunachal Pradesh, Datta *et al*. (2008: 4) considered it "very rare" in the state. The new location, Chayang Tajo, is only the third Indian ferret badger locality north of the Brahmaputra, after a skin near Roing, Lower Dibang Valley district (Chakraborty & Sen 1991) and a stuffed animal from Seijosa, East Kameng district (Datta 1999), all in Arunachal Pradesh. (Both these latter specimens were published as *M. personata*,

but it would be cautious to consider them indeterminate in the light of the dorsal stripe being found unreliable for species identification.) Chayang Tajo is 80 km north of Seijosa and 290 km west of Roing. *Melogale* has not been camera-trapped, however, inside the Pakke WLS & TR between Seijosa and Chayang Tajo even after a combined effort of nearly 9,000 camera-trap-nights (231, Datta *et al*. 2008; 718, Chauhan *et al*. 2006; 8,048, JB pers. obs.). Neither does *Melogale* feature in the list of 33 mammal species reported during a survey of hunting practices in four Arunachal Pradesh districts, including East Kameng and Tawang north of the Brahmaputra, by Aiyadurai *et al*. (2010). Her survey used semi-structured questionnaire interviews of individual hunters, with bird and mammal guide books to indicate identity of a species, with inspection of animal remains and skulls. Further west of Chayang Tajo, in the adjacent West Kameng district of Arunachal Pradesh, N. Velho's (*in litt.* 2014) 856 camera-trap-nights in the Eagle Nest WLS (500–3,250 m asl), and 677 in community forest outside it, did not record ferret badger. Extensive camera-trapping, mainly for Tiger, in the Eastern Himalayan foothill and plains tracts in Indian Manas TR (Borah *et al*. 2013a, 2013b, Goswami & Ganesh 2014), has not yet found *Melogale* although it has been live-trapped and camera-trapped in Royal Manas NP, Bhutan (UWICE 2011, Tempa *et al*. 2013). Perhaps *Melogale* is rarer in the Eastern Himalaya, north of the Brahmaputra, than in the southern hill areas of northeast India, south of the said river.

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# Trade in Common Palm Civet *Paradoxurus hermaphroditus* in Javan and Balinese markets, Indonesia

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## Abstract

Wildlife trade is a major threat to wild populations of many species, especially in South-east Asia. In Indonesia, Common Palm Civet *Paradoxurus hermaphroditus* has become increasingly exploited as an exotic pet and for the production of civet coffee. The species is not protected in Indonesia but its commercial trade is subject to an annual quota system. Surveys of 17 animal markets on the Indonesian island of Java (February 2012 – October 2014) and of two on Bali (July 2013 – July 2014) in 92 visits recorded 720–750 Common Palm Civets openly for sale. Large markets (over 50 shops) held about 13 Civets/survey, medium-sized markets (20–49 shops) about eight and small markets (fewer than 20 shops) about two. No differences between years within markets or across markets were apparent. Jatinegara in Jakarta stands out as one of the most significant in terms of the number of Civets openly for sale, with some 500 recorded during 16 surveys. Other significant markets are Barito in Jakarta (42 Civets recorded; Civets present in 10 out of 11 surveys) and Sukahaji in Bandung (38 Civets; 10 out of 11 surveys) and Kupang in Surabaya (40 Civets during one survey). Many Civets in the markets were still very young. In four of the largest markets (Satria in Denpasar, Jatinegara, Barito and Sukahaji) there were more non-adults than adults. Overall, some three-quarters of the trade comprised non-adults. Most Civets observed in the markets are to be sold as pets. The species has become popular as a pet in Indonesia in recent years. The towns surveyed hold numerous 'civet-lovers clubs'. Information from traders and the poor conditions in which the Civets were offered for sale, suggests that most, if not all, Civets observed were derived directly from the wild. The impact of this trade on wild populations of Common Palm Civet is unknown. The numbers observed at the markets in Java and Bali and their recent rise in popularity as pets are enough to raise concern.

*Keywords*: animal markets, civet coffee, civet-lover clubs, Jatinegara, social media, Viverridae, wildlife trade

## Perdagangan Musang Pandan *Paradoxurus hermaphroditus* di Pasar Burung di Jawa dan Bali, Indonesia

## Abstrak

Perdagangan satwa liar merupakan ancaman besar bagi populasi banyak jenis satwa, terutama di Asia Tenggara. Di Indonesia Musang Pandan *Paradoxurus hermaphroditus* telah semakin dieksploitasi sebagai hewan peliharaan dan untuk produksi kopi luwak. Jenis musang ini tidak dilindungi di Indonesia tetapi perdagangan komersial dibatasi oleh sistem kuota. Survei dari 16 pasar burung di Pulau Jawa (Pebruari 2012 – Oktober 2014) dan dua pasar burung di Bali (Juli 2013 – Juli 2014) dengan total 92 kunjungan tercatat antara 720–750 Musang Pandan dijual. Di pasar burung skala besar (lebih dari 50 pedagang) kami menemukan 13 musang / survei, di pasar burung berukuran skala sedang (20–49 pedagang) kami menemukan delapan musang / survei dan di pasar burung skala kecil (kurang dari 20 pedagang) kami menemukan sekitar dua musang / survei. Tidak ada perbedaan yang nyata antara tahun diantara pasar burung ataupun dalam pasar burung. Pasar burung Jatinegara di Jakarta merupakan pasar yang paling signifikan dalam hal jumlah Musang Pandan yang dijual; tercatat sekitar 500 ekor selama 16 kali survei. Pasar hewan lainnya yang cukup penting adalah Barito di Jakarta (42 tercatat dalam 10 dari 11 survei) dan Sukahaji di Bandung (38 musang tercatat dalam 10 dari 11 survei) dan pasar hewan Kupang di Surabaya (40 musang ditemukan dalam satu kali survei). Kebanyakan musang yang ditemukan di pasar hewan masih sangat muda. Di empat pasar burung terbesar (Satria di Denpasar, Jatinegara, Barito dan Sugihaji) dijumpai lebih banyak musang muda daripada musang dewasa. Secara keseluruhan, sekitar tiga-seperempat atau 75% musang di pasar burung adalah belum dewasa. Kebanyakan musang yang berada di pasar burung adalah untuk dijual sebagai hewan peliharaan. Jenis musang ini telah menjadi populer di Indonesia dalam beberapa tahun terakhir dan di beberapa kota yang disurvei telah berdiri beberapa "kelompok pecinta musang". Dari informasi para pedagang, dan hasil pengamatan kondisi musang, menunjukkan bahwa musang diperoleh langsung dari alam. Sementara dampak langsung dari perdagangan terhadap populasi liar Musang Pandan tetap tidak diketahui, namun dari jumlah yang teramati di pasar burung di Jawa dan Bali dan meningkatnya popularitas musang sebagai hewan peliharaan perlu mendapatkan perhatian lebih lanjut.

## Introduction

Wildlife trade is a threat to wild populations of many species and has been highlighted as a major cause of species declines and extinction risk because it is often unsustainable (Li *et al*. 2000, McNeely *et al*. 2009, Smith *et al*. 2009). Internationally, Southeast Asia has been identified as a hotspot for the illegal trade in wildlife (Nijman 2010, Rosen & Smith 2010).

Civets (Viverridae) are small nocturnal carnivores found in Africa and across South and Southeast Asia (Jennings & Veron 2011). Common Palm Civet *Paradoxurus hermaphroditus* is one of the more widely distributed civets, ranging from

Afghanistan through the Indian Subcontinent into Indochina and insular Southeast Asia east to the Philippines (Patou *et al*. 2010, Stevens *et al*. 2011). *The IUCN Red List of Threatened Species* categorises Common Palm Civet as Least Concern, largely because of its wide distribution, assumed large populations, and tolerance of habitat disturbance and hunting (IUCN 2014). In parts of its range, the species is potentially threatened by hunting for the bushmeat trade and by capture for the pet trade and for *kopi luwak* ('civet coffee') production.

Common Palm Civet occurs widely in western Indonesia, i.e. Sumatra, Borneo, Java and their off-lying smaller islands. Possibly as a result of introductions it is furthermore known from individual records in central and eastern Indonesia, including Sulawesi, Seram, Sumba and Timor (Patou *et al*. 2010). In Indonesia, it is not a protected species, but its trade (domestic and international) is regulated through a quota set annually by the Indonesian Institute of Sciences. In the last five years quotas of 250–300 individuals were allotted to the provinces of North Sumatra, Lampung, West Java, Central Java and West Lesser Sunda Islands (Wirdateti unpubl. data). Quotas of 100–150 each for Malay Civet *Viverra tangalunga* and Small Indian Civet *Viverricula indica* were set for the provinces of South Sumatra, Lampung, and, for Small Indian Civet only, West Java. In each province the Regional Natural Resources Conservation Agency (BKSDA) is responsible for implementing and enforcing these quotas. A species cannot be harvested legally from a province with no quota. In such provinces it is the Regional Natural Resources Conservation Agency's responsibility to prevent trade in the species. The remaining volume of an allotted quota not used in a calendar year cannot be added to the following year's quota (Shepherd 2008). In most of the last five years only 30–50% of the Common Palm Civet quota was realised (Wirdatati unpubl. data). Only 10% of the quota may be used domestically, with the remainder to be exported (Shepherd 2008). In 2014 a Jakarta-based company was given provisional permission by the Directorate General of Forest Protection and Nature Conservation (PHKA) to captive-breed 30 Common Palm Civets, the offspring to be sold as pets, pending a recommendation from the Indonesian Institute of Sciences (Partono 2014). To date, Common Palm Civet trade in Indonesia is poorly regulated and enforcement efforts are limited (Shepherd 2008, 2012).

Across much of Asia, civets are traded for their meat (Corlett 2007, Shepherd 2010). In Indonesia, as in some other parts of Asia, Common Palm Civet has become increasingly popular as a pet and many are now kept captive for *kopi luwak* ('civet coffee') production (Shepherd 2012, D'Cruze *et al*. 2014). A likely origin for most of these animals is direct from the wild via the animal markets that can be found in most large towns in western Indonesia.

We here report on the Indonesian trade in Common Palm Civet based on many market visits from 2012 to 2014, to increase knowledge and awareness of the trade in this species and to advocate for better regulation and enforcement of existing legislation.

## Methods

We covered 17 markets in nine towns on Java between February 2012 and October 2014, and two markets in two towns on Bali between July 2013 and July 2014. All were open animal markets (known as '*pasar burung*' or '*pasar satwa*' in Indonesia), ranging from the Pramuka market in Jakarta with some 200 shops to smaller, sometimes mobile, markets comprising a dozen or so shops. The towns surveyed are spread over large parts of western Java, eastern Java and Bali; they should be representative for the trade in this part of Indonesia.

Common Palm Civet (hereafter, 'Civet') is traded openly in the animal markets so there was no need to resort to undercover techniques. We walked through markets slowly, recording Civets by typing the species and their numbers into a mobile phone or by memorising numbers and writing them in a notebook directly on leaving the market. Counts include what is known in the trade as 'Musang Bali', which appears to be a pale morph of Common Palm Civet, with a pinkish nose and pale soles. Age class (infant, juvenile, adult) was noted when possible, with photographs taken opportunistically. Most Civets were on sale openly: only once did we observe one hidden from view, in a plastic box. In Jatinegara market in Jakarta, the sheer number of animals for sale, and the many civets (of multiple species) often in one cage, sometimes precluded exact counts. We purchased no civets.

For analysis, markets were grouped into large (typically more than 50 stalls selling animals), medium (20–49 stalls) and small (fewer than 20 stalls). For each market the average number of Civets is the total number of Civets observed divided by the number of visits. Five markets in three towns surveyed at least twice during each of the three study years allowed some check for annual differences of the Civet trade. Four markets, surveyed over three years and with a substantial number of Civets recorded, were used to calculate the proportion of non-adults in trade, allowing comparison between years and between markets.

## Results

*Numbers and temporal patterns*

In total 92 visits recorded 720–750 Common Palm Civets in trade in 15 of the 19 markets surveyed. This broke down to 121–126 Civets in 2012, at an average of 7.1–7.4 Civets per survey, 281 in 2013, at an average of 9.7 Civets per survey, and 322–347 in 2014, at an average of 7.0–7.5 Civets per survey (Table 1). Common Palm Civet was the most commonly recorded civet in the markets. A total of 72 individuals of four additional species were offered for sale (Table 2). Two of these species, Malay Civet *Viverra tangalunga* and Masked Palm Civet *Paguma larvata*, are not known to occur on Java or Bali. They must have been imported, most probably from Sumatra or Kalimantan, the Indonesian part of Borneo. There is a weak positive relationship between the average number of Common Palm Civets and the average number of other civets recorded in markets when all markets are included in the analysis. When only the 14 markets surveyed at least twice are included, the relationship becomes strong. Thus, markets with on average many Common Palm Civets often have a relatively large number of other civets for sale as well.

The numbers of Common Palm Civet recorded at individual markets differed substantially. In three markets none was observed. Few Civets are traded in Pramuka market, Jakarta (nine Civets / 10 surveys), Bandung Indah Plaza (BIP),

**Table 1.** Common Palm Civet *Paradoxurus hermaphroditus* surveys in animal markets in Java and Bali, Indonesia, February 2012 to October 2014.

| PROVINCE, town | Market name | Type | Surveyor | 2012 | | 2013 | | 2014 | | TOTAL | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Visits | Civets | Visits | Civets | Visits | Civets | Visits | Civets | |
| SPECIAL DISTRICT JAKARTA | | | | | | | | | | | | |
| Jakarta | Jl Kebayoran Lama | Pet shop | 1,2,4,5 | 0 | | 1 | 3 | 2 | 11 | 3 | 14 | 4.7 |
| Jakarta | Jatinegara | Large market | 1–5 | 4 | 95–100 | 4 | 159 | 8 | 227–252 | 16 | 481–511 | 31.0 |
| Jakarta | Barito | Medium market | 1–5 | 2 | 6 | 2 | 4 | 7 | 32 | 11 | 42 | 3.8 |
| Jakarta | Pramuka | Large market | 1,2,4,5 | 2 | 7 | 3 | 0 | 5 | 2 | 10 | 9 | 0.9 |
| WEST JAVA | | | | | | | | | | | | |
| Bogor | Empang | Small market | 2 | 2 | 1 | 0 | | 0 | | 2 | 1 | 0.5 |
| Sukabumi | Sukabumi | Small market | 4,5 | 0 | | 1 | 0 | 1 | 0 | 2 | 0 | 0 |
| Bandung | Bandung Indah Plaza | Small mobile market | 1–5 | 1 | 0 | 3 | 0 | 5 | 1 | 9 | 1 | 0.1 |
| Bandung | Sukahaji | Medium market | 1–5 | 2 | 9 | 3 | 15 | 6 | 18 | 11 | 38 | 3.5 |
| Bandung | Sunday market | Small market | 2 | 1 | 0 | 0 | | 0 | | 1 | 0 | 0 |
| Garut | Mawar | Small market | 1–5 | 2 | 1 | 3 | 3 | 6 | 1 | 11 | 5 | 0.5 |
| Tasikmalaya | Cikurubuk | Small market | 1,2 | 0 | | 2 | 4 | 0 | | 2 | 4 | 2.0 |
| EAST JAVA | | | | | | | | | | | | |
| Malang | Malang | Large market | 2 | 1 | 2 | 0 | | 0 | | 1 | 2 | 2.0 |
| Surabaya | Kupang | Large market | 4,5 | 0 | | 1 | 40 | 0 | | 1 | 40 | 40.0 |
| Surabaya | Bratang | Large market | 4,5,6 | 0 | | 1 | 12 | 1 | 6 | 2 | 18 | 9.0 |
| Surabaya | Turi | Medium market | 4,5,6 | 0 | | 1 | 11 | 1 | 3 | 2 | 14 | 7.0 |
| Bondowoso | Bondowoso | Small market | 4 | 0 | | 1 | 0 | 0 | | 1 | | 0 |
| Banyuwangi | Pujasera-Pakis | Small market | 4,5 | 0 | | 1 | 13 | 0 | | 1 | 13 | 13.0 |
| BALI | | | | | | | | | | | | |
| Mengwi | Beringkit | Small market | 1,4,5 | 0 | | 1 | 0 | 1 | 0 | 2 | 0 | 0 |
| Denpasar | Satria | Medium market | 1,4,5 | 0 | | 1 | 17 | 2 | 21 | 3 | 38 | 12.7 |
| **TOTAL** | | | | 17 | 121–126 | 29 | 281 | 42 | 322–347 | 92 | 720–750 | |

Surveyors: 1 = D. Spaan; 2 = E. J. Rode-Margono; 3 = P. Roberts; 4 = V. Nijman; 5 = K. A. I. Nekaris; 6 = Wirdateti.
Large markets comprise over 50 shops, medium markets 20–49 shops, and small markets under 20 shops (see text for details).

**Table 2.** Civets other than Common Palm Civet *Paradoxurus hermaphroditus* recorded in animal markets in Java and Bali, Indonesia, February 2012 to October 2014.

| Market, town | Malay Civet *Viverra tangalunga* | Masked Palm Civet *Paguma larvata* | Small Indian Civet *Viverricula indica* | Small-toothed Palm Civet *Arctogalidia trivirgata* | Other civets / survey |
|---|---|---|---|---|---|
| Jl Kebayoran Lama, Jakarta | | 2 | 1 | 3 | 0.5 |
| Jatinegara, Jakarta | 3 | 7 | 36 | 1 | 2.9 |
| Barito, Jakarta | | 3 | 1 | 3 | 0.6 |
| Bandung Indah Plaza, Bandung | | | | 1 | 0.1 |
| Sukahaji, Bandung | 2 | 1 | | 1 | 0.4 |
| Bratang, Surabaya | | 1 | 1 | | 0.5 |
| Bondowoso, Bondowoso | | | 1 | | 1.0 |
| Satria, Denpasar | | | 2 | 1 | 1.0 |
| Total | 5 | 14 | 42 | 10 | |

Details of the markets are given in Table 1.

Bandung (one Civet / nine surveys) and Mawar, Garut (five Civets / 11 surveys). Larger numbers were observed in Barito, Jakarta (42 Civets / 11 surveys), Sukahaji, Bandung (38 Civets / 11 surveys) and Satria, Denpasar (38 Civets / three surveys). The Pujasera-Pakis market in Banyuwangi and Kupang in Surabaya, both visited once, had 13 and 40 Civets for sale, respectively. The largest numbers were recorded in Jatinegara market, Jakarta: some 500 Civets during 16 surveys, with up to 54 on one survey. While Jatinegara was both the market surveyed most frequently and the one with most Civets recorded for sale, other markets were frequently surveyed without encountering many Civets (e.g. Mawar and BIP) and others with a large number of Civets for sale were visited only once (e.g. Kupang, Surabaya and Pujasera-Pakis). Overall there was no relationship between number of visits and average number of Civets recorded per market. On average large markets had more Civets for sale (average of averages 13.4 Civets / survey) than medium (7.8 Civets / survey) and small (2.0 Civets / survey) ones. Notable exceptions were the small market of Pujasera-Pakis in Banyuwangi (13 Civets, one visit) and the large markets of Pramuka and Malang, with few Civets observed for sale, despite ten visits to the former.

The five markets visited multiple times during each of the three study years seemed stable in numbers of Civets for sale. Thus, Jatinegara consistently held 20–40 Civets per survey, rarely as few as 12 (Fig. 1), with no notable difference between weekdays and weekends (survey of other markets was insufficient to compare weekdays with weekends). In Barito and Sukahaji the number was 2–5 with Civets almost always present. In Garut and Pramuka the numbers rarely exceeded 3–4 on any given survey, with frequently no Civets openly for sale.

*Age and physical condition*

Common Palm Civets in the markets ranged in age from newborn to adult. When asked, vendors said that these animals were all wild-caught, including those apparently 6–8 weeks old and not yet independent from their mother. Vendors said that they could easily get more Civets, often within 1–2 weeks, with one vendor indicating that these animals will come from wild nests. Not once did a vendor state that any Civets on offer

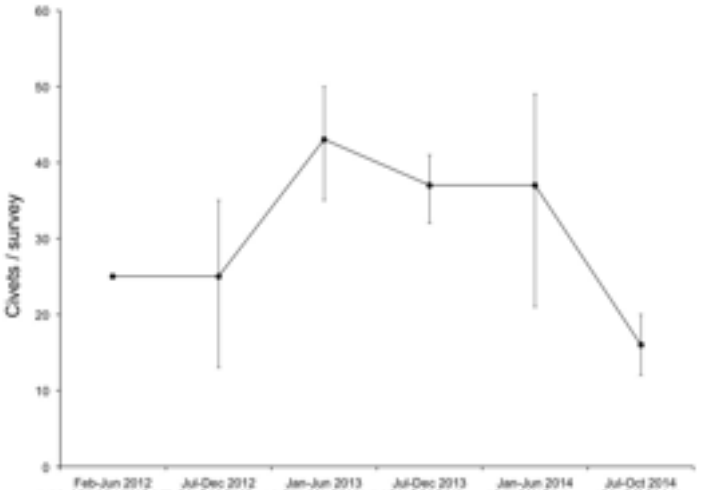


**Fig. 1.** Numbers of Common Palm Civets *Paradoxurus hermaphroditus* offered openly for sale at Jatinegara market, Jakarta, Indonesia, in six survey periods between February 2012 and October 2014. Indicated are the average, minimum and maximum number of Civets for sale.

**Fig. 2.** Common Palm Civet *Paradoxurus hermaphroditus* on display in Bali, Indonesia, in June 2013 for demonstrating to tourists the production of civet coffee; faeces can be seen in the left corner (photo: Anna Nekaris).

were captive-bred. The clientele for market Civets is, according to vendors, mainly people who seek Civets as pets. At a few markets, mostly in East Java and Bali, civet coffee farms (Fig. 2) were mentioned.

Four pale 'Musang Bali' civets (initially thought to be bleached 'normal' Common Palm Civets) were amongst the 521 Civets in Jakarta. In 2013 in Surabaya five of the 44 Civets were of the 'Musang Bali' type and in Bali this number was close to about a fifth of the total.

The proportion of non-adult Civets was generally high, i.e. 0.88 in Barito, 0.72 in Jatinegara, 0.57 in Sukahaji and 0.56 in Satria. These four markets held 86% of Civets recorded. If the proportion of non-adults in these four markets is representative for Indonesian Common Palm Civet trade as a whole, this suggests that about 76% of this trade comprises non-adults.

Civets had a range of injuries, mostly to the face and muzzle. Civets were mostly caged without food or water. They were often emaciated. Cages that contained food mostly had fruits such as banana, papaya or mango (Fig. 3); they never had a balanced species-appropriate diet. Civets were often openly exposed to the heat of the sun and many animals were panting, indicating distress and dehydration.

**Fig. 3.** Row of Common Palm Civet *Paradoxurus hermaphroditus* cages with pieces of papaya in Satria market, Denpasar, Indonesia, June 2013 (Photo: Anna Nekaris).

**Fig. 4.** Common Palm Civet *Paradoxurus hermaphroditus*, Jatinegara market, Jakarta, Indonesia, July 2013 (Photo: Vincent Nijman)

Civets were mostly housed singly (Fig. 4), in duos, or, especially with very young ones, in groups of 4–5 (presumably siblings). Occasionally, groups of ten or more were observed in a cage. Civets were usually displayed close to other animals, such as birds, bats or primates.

## Discussion

*Volumes in trade*

The many Common Palm Civets in trade throughout Java and Bali demonstrates the volume of this trade. Jatinegara in Jakarta stands out as the largest market for Civets although future surveys in Kupang in Surabaya, here visited only once, might reveal this market to be hold similar numbers. The species was recorded in all 16 surveys in Jatinegara and in all but one of the 11 surveys in each of Barito and Sukahaji. Five markets were surveyed only once, precluding firm conclusions regarding availability. While many bird markets were surveyed, many were not: especially in Java, just about every sizeable town has a bird market, some of which might sell large numbers of Civets. Based on visits before 2012 (VN own data), the size of the market, and the frequency of its mention in relation to Civet trade in online forums, Ngasem market in Yogyakarta and Depok market in Surakarta might be the most important Civet markets not included in the present survey.

Shepherd (2012) surveyed each of Jatinegara, Pramuka and Barito markets twice in 2010 and once in 2012, and obtained data from one survey of Satria market in 2012. He recorded one Common Palm Civet in Barito and 20 in Jatinegara. His averages for all are somewhat lower than those of our surveys (6.7 vs 30.0 for Jatinegara; 0 vs 0.9 for Pramuka; 0.3 vs 3.8 for Barito). Conversely, our average in Satria is somewhat lower than on Shepherd's (2012) single visit, i.e. 12.7 vs 25. The only other study of trade in the species in Indonesian animal markets comparable in size and scope, Shepherd (2008), surveyed the three markets of Medan, Sumatra (Jalan Bintang, Petisah and Sembahe), a total of 59 times each in the period 1997–2001. In total 264 Civets were recorded (an average of 1.5 Civets per market, or 4–5 for the three combined). These numbers from Sumatra are comparable to most of the small, and some of the medium-sized, markets we surveyed on Java and Bali.

Numbers of the four other species of civet observed in these markets (Table 2) are smaller than those of Common Palm Civet, although higher than those reported in Medan and Jakarta by Shepherd (2008, 2012). Especially the number of Small Indian Civets stands out. The observations of Small-toothed Palm Civet *Arctogalidia trivirgata* and Masked Palm Civet, for which no quotas have been allocated, and of Small Indian Civets in East Java and Bali, where no quotas were allocated, shows the ineffectiveness of trade regulations and enforcement.

*Origin and clientele*

Three-quarters of the Civets for sale were not yet adult, with significant numbers apparently being young taken from their nests. The Civets' conditions suggest mortality to be high, especially for youngsters. Information from vendors and observations of dependent young invariably without their mothers both indicate that most Civets were derived from the wild.

In Indonesia, in particular in the larger towns of Java, Common Palm Civet has become a popular pet in recent years. Owners have organised themselves in so-called civet-lover clubs (*kelompok cinta musang* or 'musang lovers'). While the 'civets' they keep as pets include a wide range of small carnivores (Binturong *Arctictis binturong*, Banded Linsang *Prionodon linsang*, martens *Martes*, mongooses *Herpestes*, otters (Lutrinae) etc.), from online forums, blogposts, Facebook pages and information from traders, the most commonly kept civet is indeed Common Palm Civet. The clubs keep in contact with each other through social media (Indonesia is the world's fourth most numerous Facebook user with 51.4 million registered users in 2014: Anon. 2014), mobile phone apps (What's App?) and meet up on special events in public spaces. Some clubs operate nationwide with regional 'chapters' (e.g. MLI – Musang Lovers Indonesia), others focus on individual towns. Of the towns surveyed for Civets, there are (one or multiple) civet-lover clubs in Jakarta (including Central Jakarta, Bekasi, Depok and Tangerang), Sukabumi, Bandung, Garut, Tasikmalaya, Malang and Surabaya (including Central Surabaya, Gresik and Sidoarjo), as well as numerous others in towns on Java, Sumatra and Kalimantan. The Facebook pages of 36 such clubs number over 85,000 members as of May 2014. Traders are well aware of these civet-lover clubs and promote Common Palm Civet as a suitable pet and the clubs as useful sources of information on how to keep Civets.

There is a clear rise in the popularity of civet coffee and a rise of civet coffee farms in Java and Bali over the last decade (Shepherd 2012, D'Cruze *et al*. 2014, VN, KAIN, PDR unpubl. data). It is unclear how this is linked to Civet numbers in Java and Bali's animal markets. While traders did sometimes mention '*kopi luwak*' to us, we will have seemed more like potential buyers of pets than for the civet coffee industry. In East Java and Bali, where civet coffee is produced, animal markets do seem to cater to some extent for the civet coffee trade. Our limited experience with commercial civet coffee producers in East Java and Bali in 2012–2013 (VN, KAIN, PDR unpubl. data) suggests that they obtain their Civets by putting out calls to neighbouring villages and then buying the Civets directly from the villagers. But reported mortality levels are high, so the markets might at least sometimes supply Civets for use in the production of '*kopi luwak*'.

*Regulation of trade and conservation implications*

Shepherd (2012) outlined the national quota system for wild-caught Common Palm Civets to be traded as pets. Ninety percent of this quota is mandated for export. The quotas for the last five years have been for 250–300 Civets, roughly equally divided between the five provinces that had submitted requests to harvest and trade in them (see Introduction). Numbers observed in trade in West Java (including Jakarta) greatly exceeded the total provincial quota in each of the three survey years. No quotas have been allocated to East Java or Bali, despite the high numbers observed there. Unless the Civets we observed in these provinces were harvested from Central Java or Sumatra, as part of their allocated quota, then transported to Bali, East or West Java with the appropriate trans-provincial permits (Shepherd 2012) – an unlikely scenario – the trade in Common Palm Civets is largely illegal.

It is clear that Civet trade in Java and Bali's wildlife markets is poorly regulated. Traders in many markets, especially smaller ones, seem to have little knowledge of the rules and regulations that govern trade in non-protected species. As Shepherd (2008) proposed, authorities should ensure that wildlife traders are aware of annual quotas. Action should be taken against wildlife traders breaking legislation pertaining to harvest, possession and trade, by arrests and prosecutions which entail sufficient penalties to deter future or repeat offences. Civet numbers observed in the markets of Java and Bali, the species's omnipresence at many of these markets, and the poor conditions (suggesting high turnovers) raise concerns about the trade's potential impact on wild populations. The species's wide habitat-use and the large extent of potential suitable habitat in Java and Bali might suggest the species is still abundant, but few recent quantitative data on population size are available. The increasing popularity of the species as a pet, associated with rising numbers of civet-lover clubs on Java especially, organising themselves on social media, suggests that the types of people who now want the species as a pet – and have the means to acquire one – have increased and diversified. While market data appear to have limited value for gauging the off-take of Civets for the civet coffee industry, it is clear that in recent years the trade in Civets for various reasons has increased dramatically. Indonesia's current quota system is failing to limit commercial trade in the species. This necessitates a rethink of how best to regulate trade as part of an overall management strategy of the species.

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# Observations of small carnivores in Son Tra Nature Reserve, a small and isolated protected area in central Vietnam

Ulrike STREICHER[1] and Larry ULIBARRI[2]

## Abstract

Over half the 45.5 km$^2$ Son Tra peninsula in central Vietnam is a nature reserve. The peninsula has been isolated from other natural habitat by sea and urbanisation for decades. Various surveys since the 1960s have recorded Large-toothed Ferret Badger *Melogale personata*, Small Indian Civet *Viverricula indica*, Common Palm Civet *Paradoxurus hermaphroditus*, Small Asian Mongoose *Herpestes javanicus* and Leopard Cat *Prionailurus bengalensis*; and probably otter (Lutrinae) and Large Indian Civet *Viverra zibetha*, although the original basis for these two is not available. Several species typical of forest in this region and active at least in large part by day were not found, suggesting that they are possibly susceptible to hunting or need larger landscapes (or both). None of the surveys targeted small carnivores, so some species, particularly nocturnal ones, might have been overlooked. The easily accessible Son Tra Nature Reserve with its unusually confiding wildlife is ideal for wildlife and conservation studies and education.

*Keywords*: breeding seasonality, community, fragmentation, habitat change, *Herpestes javanicus*, locality records, *Melogale personata*, persistence

## Ghi nhận thú ăn thịt nhỏ ở Khu Bảo tồn Thiên nhiên Sơn Trà, một khu bảo vệ nhỏ và cô lập ở miền trung Việt Nam

## Tóm tắt

Khoảng một nửa diện tích 45,5 km² của bán đảo Sơn Trà ở miền trung Việt Nam là môt khu bảo tồn. Bán đảo đã bị cô lập với các sinh cảnh tự nhiên khác bởi biển và các khu đô thị từ vài thập kỷ nay. Nhiều đợt khảo sát từ những năm 1960 đã ghi nhận Chồn bạc má nam *Melogale personata*, Cầy hương *Viverricula indica*, Cầy vòi đốm *Paradoxurus hermaphroditus*, Cầy lỏn tranh *Herpestes javanicus*, Mèo rừng *Prionailurus bengalensis*, và có thể là cả rái cá (Lutrinae) và Cầy giông *Viverra zibetha*, tuy nhiên cơ sở để khẳng định ghi nhận về hai loài này là chưa chắc chắn. Không có ghi nhận một số loài điển hình cho rừng ở khu vực này nhất là trong thời gian ngày cho thấy chúng rất có thể đang bị đe dọa bởi săn bắn hoặc bị ảnh hưởng do cần diện tích sinh cảnh lớn hơn (hoặc do cả hai nguyên nhân). Chưa có các điều tra tập trung vào các loài thú ăn thịt nhỏ, vì vậy một số loài, nhất là các loài hoạt động về đêm, có thể đã bị bỏ sót. Giao thông thuận tiện đến Khu Bảo tồn Thiên nhiên Sơn Trà và việc dễ tiếp cận các loài động vật hoang dã là điều kiện lý tưởng cho các hoạt động nghiên cứu và giáo dục bảo tồn.

## Introduction

Little is known about the adaptability of small carnivores in Southeast Asia to habitat fragmentation and isolation. Most surveys understandably prioritise large, remote areas (e.g. Than Zaw *et al*. 2008); but with Southeast Asia having some of the world's highest rates of forest clearance (e.g. Sodhi *et al*. 2010), better information on the ability of its wildlife to persist in converted, degraded and/or fragmented areas is vital to inform conservation planning and management. A recent rise in interest in the region's small carnivores of converted and degraded areas (e.g. plantations and logging concessions; Mathai *et al*. 2010, Wilting *et al*. 2010, Hedges *et al*. 2013) has been concentrated in southern (Sundaic) Southeast Asia and has not been echoed by equivalent interest in documenting the species surviving in small, long-isolated, patches. To a certain extent, this reflects (i) the difficulties of disentangling the effects of hunting, widespread in northern SE Asia (e.g. Corlett 2007), from those of habitat isolation; (ii) the challenges of defining an isolated area, given that many species are known or reasonably suspected to move through otherwise unsuitable habitat; and (iii) the very recent nature of much habitat perturbation, making it unclear whether today's communities in habitat isolates are potentially stable, or represent stages in inevitable decline during a lag to adjust to the new level of habitat availability.

## Survey area

Son Tra Nature Reserve (NR), central Vietnam, is a perfect place to document a small carnivore community in a small forest isolate. The rocky Son Tra peninsula (16°06–09′N, 108°13–21′E) is surrounded on three sides by the South China Sea and on the fourth it borders the fifth largest city of Vietnam: Danang (Fig. 1). The foothill area connecting the nature reserve with the mainland is very densely populated, with many roads and houses, the container harbour and much army infrastructure. There is no real non-urban land on this isthmus, nor any forest within almost 15 km. Son Tra has been isolated like this for at least 50 years. Dispersal opportunities for non-volant, non-urban wildlife to the peninsula have thus been very limited for decades. Son Tra NR comprises 26.7 km$^2$ of the overall 45.5 km$^2$ peninsula and contains most of the native forest left on the peninsula. Son Tra rises from sea level to 696 m asl. It receives significantly more rainfall and is cooler than Danang. The rainy season lasts from June to January and the dry season from February to May.

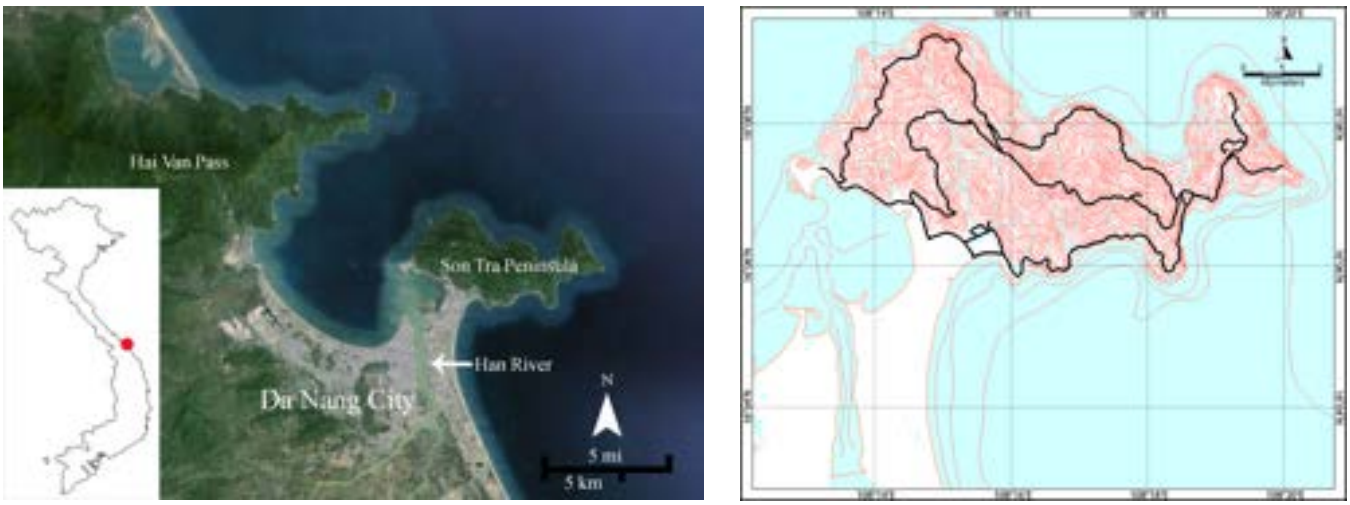


**Fig. 1.** The Son Tra peninsula, Vietnam. Left, aerial image: blue = sea, green = vegetation, pale grey = urban and other non-vegetated land. Right, roads (thick black lines) and contours (thin lines; interval 20 m).

Based on weather parameters, Son Tra's forest has wet tropical semi-evergreen forest with never more than 1.8% of trees shedding at least a quarter of their leaves (Ulibarri 2013). Van Peenen *et al*. (1971), noting that most of the vegetation was heavily disturbed even then, divided the peninsula into tropical primary forest, tropical secondary moist forest, secondary dry forest and grassland. Son Tra held an American military base in the 1960s–1970s. Since the end of the war it has been an important base for the Vietnamese military. Several roads cross the reserve. The area has been accessible to the public only since 2007. Most of the local people in this coastal region are fishermen and not hunters. These access restrictions and cultural predispositions mean hunting and logging are much less prevalent than is typical in Vietnam, reflected most clearly by the survival of the second largest remaining population of Red-shanked Douc *Pygathrix nemaeus* in Vietnam (a species notoriously sensitive to even moderate levels of hunting and hugely declined even in some quite remote large forest blocks; e.g. Coudrat *et al*. 2012) and a large population of the Critically Endangered valuable timber tree, White Seraya *Parashorea stellata* (Ulibarri 2013).

Reflecting the longstanding large, mostly non-threatening, presence of people, animals in this reserve are less shy of human voice and scent than is typical elsewhere in Vietnam. Wildlife is therefore more easily spotted. During a long-term ecology study of the Red-shanked Doucs (Ulibarri 2013), quietly sitting observers were occasionally approached within a few meters by various wildlife including Red Muntjac *Muntiacus muntjak*, ferret badger *Melogale* and Small Asian Mongoose *Herpestes javanicus*.

During the 1960s and 1970s, Son Tra was the site of many wildlife observations (e.g. Hoogstraal *et al*. 1968, Van Peenen *et al*. 1971, Lippold 1977).

## Small carnivore records

Five species of small carnivore, plus unidentified otter (Lutrinae) and Leopard Cat *Prionailurus bengalensis*, were listed for Son Tra NR in various surveys (Table 1). Van Peenen *et al*. (1971) trapped mammals and made some day-time observations over four periods within 1966–1969. Specimens were deposited at the United States National Museum. Between December 1995 and May 1997, Dinh (1997) conducted a comprehensive survey, but the report does not specify source for each record, and error-prone methods (e.g. signs and interviews) were used. A short survey in 2007 focusing on Red-shanked

**Table 1.** Small carnivore species recorded in Son Tra, Vietnam, 1966–2014.

| Species | Source |
|---|---|
| Large-toothed Ferret Badger *Melogale personata* | VP, DTPA*, aro* |
| Otter (Lutrinae) | DTPA |
| Large Indian Civet *Viverra zibetha* | DTPA |
| Small Indian Civet *Viverricula indica* | VP, DTPA |
| Common Palm Civet *Paradoxurus hermaphroditus* | VP, DTPA, aro |
| Small Asian Mongoose *Herpestes javanicus* | VP, DTPA, VNT, aro |
| Leopard Cat *Prionailurus bengalensis* | DTPA, aro |

Sources: VP, Van Peenen *et al*. 1971; DTPA, Dinh 1997; VNT, Vu *et al*. 2007; aro, authors' 2010–2014 observations.
*Not confirmed to species; the very similar looking Small-toothed Ferret Badger *M. moschata* occurs widely in Vietnam (Abramov & Rozhnov 2014) and potentially could also occur on Son Tra.
Vu *et al*. (2007) reported Masked Palm Civet *Paguma larvata* based on interviews with reserve staff and/or local people.

**Fig. 2.** Small Asian Mongoose *Herpestes javanicus*, Son Tra peninsula, Vietnam, 31 December 2010.

Douc noted a few other mammals, mostly based on signs and interviews (Vu *et al*. 2007).

During 2010–2014 the authors visited the reserve frequently, to watch Doucs and implement conservation measures (Ulibarri & Streicher 2012, Ulibarri 2013). No specific search was made for small carnivores. There was neither spotlighting nor camera-trapping. Approximately 440 days (2,226) hours were spent on Douc observations during 2010–2012. After this study ceased, the reserve was visited about 200 times during 2012–2014. With much variation, an average visit lasted about 3 hours and used the reserve's roads. To enter the forest, foreigners require a special permit. Overnight stays are not permitted. As our project was to reduce illegal impacts and manage tourism activities, we strictly adhered to regulations. The visits focused on monitoring the Douc groups, collecting rubbish, identifying habitat restoration sites and maintaining them after trees had been planted. Rarely the reserve was left after nightfall. Small Asian Mongoose (Fig. 2) was seen about once every three visits, ferret badger about once every 20. Common Palm Civet was seen on half the drives during darkness, whereas Leopard Cat was spotted only twice. Footprints and faeces of small carnivores were regularly found along the road.

## Observations of courting behaviour in small carnivores

Two observations of courting are of interest, given the limited knowledge of small carnivore breeding seasonality across Southeast Asia. Both sightings lasted long enough to rule out any other reason for the obviously harmonious association of two full-grown animals. On 6 August 2014 at 05h30, two ferret badgers were spotted from motorbikes along a stretch of the Tien Sa Road through secondary dry forest (150 m asl). As the motorbikes stopped they ran across the road, the slightly larger animal following the other, twice, being so heavily engrossed in courting that they approached the observers within 30 cm. On 10 April 2014 at 06h30, two Small Asian Mongooses were observed along the Tien Sa Road in an area of secondary moist semi-evergreen forest (200 m asl). The leader was considerably smaller than the other, which was so focused on the former that it apparently did not see the quiet observer and came within arm's length. The follower, assumed on size to be the male (males are considerably larger than females; Francis 2008), was uttering high-pitched excited noises. The gestation period of Small Asian Mongoose is approximately 49 days (Lekagul & McNeely 1977) and if the observed courting incident was followed by a successful mating, cubs would be born towards the end of May. Consistent with this, an adult Small Asian Mongoose leading two cubs was spotted nearby in late July 2014. Ferret badgers' gestation period is reported to be about 60–80 days (Smith & Xie 2008), so this observation suggests cubs would be born around mid-October.

## Discussion

The small carnivores recorded by all surveys combined are typical for low-altitude forest in central Indochina. Four of the five species recorded are extremely robust, surviving even in the areas of southern China surveyed by Lau *et al*. (2010) where few other species of small carnivore were confirmed to persist. Anomalous in this respect on Son Tra is Large Indian Civet, suspected to be extirpated (or nearly so) from those areas of southern China (Lau *et al*. 2010). This species was listed for Son Tra only by Dinh (1997). With no information on methods, this might best be seen as in need of confirmation. Given the limited night-time observation during 2010–2014, it is quite possible that this largely nocturnal species persists and was overlooked. Dinh (1997) also listed unidentified otter; all four tropical Asian otter species have declined greatly in the interim and otters should not be assumed to persist on Son Tra, even if the earlier report was reliable.

Van Peenen *et al*. (1971: 126) stated that mammal "populations at Mt. Son Tra seemed ecologically similar to others we have studied elsewhere in South Vietnam". Other species of small carnivore which, based on distribution and habitat use elsewhere in Indochina and neighbouring areas (e.g. Duckworth 1997, Than Zaw *et al*. 2008, Gray *et al*. 2014, Willcox *et al*. 2014: SOM Table 3, Chutipong *et al*. 2014) could quite confidently be expected to occur, or at least to have been present formerly, on Son Tra are Yellow-throated Marten *Martes flavigula*, Hog Badger *Arctonyx collaris*, Spotted Linsang *Prionodon pardicolor*, Masked Palm Civet *Paguma larvata*, Small-toothed Palm Civet *Arctogalidia trivirgata*, Binturong *Arctictis binturong* and Crab-eating Mongoose *Herpestes urva*. Stripe-backed Weasel *Mustela strigidorsa*, Yellow-bellied Weasel *M. kathiah*, Large-spotted Civet *Viverra megaspila* and Owston's Civet *Chrotogale owstoni* also potentially might have occurred, but their habitat use is not well enough known for confident prediction.

The linsang and weasels are readily overlooked even when present (Abramov *et al*. 2008, Supparatvikorn *et al*. 2012, Chutipong *et al*. 2014). The nocturnal Spotted Linsang, Large-spotted Civet, Owston's Civet, Masked and Small-toothed Palm Civets are unlikely to be found by day, the time of almost all direct observation in Son Tra: even Van Peenen *et al*. (1971) were not able to observe by night. Some of these five species are at least semi-arboreal. Although Van Peenen *et al*. (1971) set overnight traps, all were at ground level. And their trapping effort had been too low to record Leopard Cat and Large Indian Civet (both subsequently recorded there, but unlikely to have colonised in the interim), so other species might have

been overlooked. None of these nocturnal species should be assumed to be absent from the reserve.

By contrast, Yellow-throated Marten, Hog Badger, Binturong and Crab-eating Mongoose are all at least partly diurnal and are fairly readily seen when present in any numbers (e.g. Duckworth 1997, Nettelbeck 1997, Than Zaw *et al*. 2008, Naniwadekar *et al*. 2013). The absence of records strongly suggests their absence or at least great rarity on the peninsula. Hog Badger and Binturong are widely suspected to decline in the face of human activities. They are categorised on *The IUCN Red List of Threatened Species* (IUCN 2013) as Near Threatened and Vulnerable, respectively. Their absence from the area might reflect hunting pressure. By contrast, there are many records of Yellow-throated Marten and Crab-eating Mongoose from heavily hunted and degraded areas of Lao PDR and Vietnam (e.g. Duckworth 1997, Duckworth & Robichaud 2005, Willcox *et al*. 2014: SOM Table 3). If surveys of other small (under 50 km$^2$) habitat isolates also do not find them, this could suggest a possibly greater dependence by these species on large semi-natural landscapes than by the species persisting on Son Tra. A comprehensive survey of Son Tra NR including substantial amounts of camera-trapping and spotlighting would thus be of great interest in confirming which small carnivore species not so far recorded do in fact occur there. All the carnivore species recorded in the 1960s by Van Peenen *et al*. (1971) were also found in the late 1990s and/or 21st century.

The frequency of sighting small carnivores at this site seems high relative to rates typical in Vietnam and neighbouring countries (pers. obs.). This is assumed to relate to the long-standing relatively low threat from people, rather than any inherent habitat attribute. Although the frequency of mammal sightings appears relatively high today, past observers perhaps did not perceive it thus. Van Peenen *et al*. (1971) found mammal "populations" at Mt. Son Tra to seem "ecologically similar" to those elsewhere in southern Vietnam. So, today, there might indeed be what should be 'normal' populations of at least some small carnivores on Son Tra, whereas the populations typically found in other areas of Vietnam might in fact represent very depleted (or perhaps merely very shy) populations.

Son Tra, although small, provides an exceptional opportunity to study wildlife. One of the most pressing conservation needs in Vietnam is to generate more conservation-minded field naturalists for tackling the pressing threats facing many of the country's species (e.g. Brook *et al*. 2014). For this, accessible sites where wildlife can readily be found, observed and studied, such as Son Tra, are essential. The basic natural history in Southeast Asia of two small carnivores readily observed at Son Tra, ferret badger and Small Asian Mongoose, remains almost unknown.

Similarly, while large remote forest areas are vital for conservation of many sensitive species, accessible areas for the increasingly urban population of Vietnam to learn about, enjoy, and so wish to conserve, wildlife are essential. Son Tra is ideal: city children cycle up that mountain in the afternoons, frequently seeing mongooses and Doucs. Adults drive up on the weekend on motorcycles. Thousands of people visit on a sunny day.

Although the area has survived well to date, its opening to the public and the construction of a large road has been accompanied by some hunting (in particular for small mammals and birds) and a fair amount of collecting of non-timber forest products (Fig. 3). Regardless, the forest is still in fairly good condition. This might not continue without increased attention to the area.

**Fig. 3.** Rattan collection, Son Tra peninsula, Vietnam, 2 December 2013.

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# The occurrence of wild-living American Mink *Neovison vison* in Transylvania, Romania

Zsolt HEGYELI* and Attila KECSKÉS

## Abstract

American Mink *Neovison vison* is a common wild-living alien species across most of northern Europe, but few data are available about wild presence in Eastern Europe. Field observations and collected specimens from the last 25 years indicate wild-living American Mink along the River Mureş in Transylvania, Romania. These are likely to have originated from fur farms, three of which existed in the area. Earlier observations suggested only the presence of escapees; more recent records might imply the existence of wild populations. Part of the study area held European Mink *Mustela lutreola* until at least the 1990s. This highly threatened species might still occur there. The presence of the alien species might reduce its chances of survival.

*Keywords*: alien species, European Mink, fur farms, *Mustela lutreola*, mustelids, River Mureş

## Vadon élő amerikai nyércek *Neovison vison* előfordulása Erdélyben (Románia)

## Kivonat

Az amerikai nyérc *Neovison vison* gyakori idegenhonos faj Európa északi felének nagy részén, viszont vadon élő állományainak kelet-európai előfordulásáról csekély számú adat áll rendelkezésre. Az elmúlt 25 évben a Maros folyó mentéről (Erdély, Románia) származó terepi megfigyelések valamint begyűjtött példányok arra utalnak, hogy a térségben előfordulnak a faj vadon élő egyedei. Ezen példányok minden bizonnyal szőrmefarmokról származtak, amelyekből a vizsgált területen korábban három is működött. Míg a korábbi megfigyelések csupán farmi szökevények előfordulását sugallták, az újabb adatok valószínűsítik egy vadon élő állomány itteni jelenlétét. A vizsgált terület egy része a fokozottan veszélyeztetett európai nyércnek *Mustela lutreola* is otthont adott legalább az 1990-es évekig, és az sem kizárt, hogy az őshonos menyétféle napjainkig is fennmaradt itt, utóbbi esetben viszont az idegenhonos amerikai nyérc itteni jelenléte komolyan veszélyeztetheti e faj túlélését.

## Introduction

American Mink *Neovison vison* is a medium-sized semi-aquatic generalist and opportunist predator, native to most of North America. It was first brought to Europe in the 1920s for commercial purposes, as a fur animal (Kauhala 1996b, Bonesi & Palazon 2007). Accidental escapes or deliberate releases from fur farms led to the establishment of feral populations in many regions of Europe by the second part of the 20th century. Rapid colonisation was documented in several cases (e.g. Bevanger & Henriksen 1995, Kauhala 1996a). In Norway the development of mink farming correlated well with the dispersal of feral populations (Bevanger & Henriksen 1995). American Mink is now believed to have self-sustaining populations in at least 20 European countries, with a continuous distribution in much of northern and western Europe (Mitchell-Jones *et al.* 1999, Bonesi & Palazon 2007, Reid & Helgen 2008). American Mink poses serious threats to indigenous fauna by predation, especially to waterfowl (Ferreras & Macdonald 1999, Bartoszewicz & Zalewski 2003) and to vulnerable Water Vole *Arvicola amphibius* populations (mainly in Great Britain; Rushton *et al.* 2000), but also to invertebrates such as crustaceans (Fischer *et al.* 2009). Genovesi *et al.* (2012) identified American Mink as the alien mammal with the highest impact on native species in Europe. Competition of American Mink with the Critically Endangered European Mink *Mustela lutreola* is a serious threat to the remaining populations of the latter (Maran & Henttonen 1995, Sidorovich 2001, Maran *et al.* 2011).

Very little information is available about the presence of American Mink in Romania. The species is generally omitted from works such as national species lists (Murariu 1984, 2010). The Romanian fauna volume (Murariu & Munteanu 2005) merely mentions the intrusion of the species in northern Romania from Ukraine, without any exact data. Although there were no published records of wild-living American Mink in Romania, the species was listed in the hunting law from 1996 (Law n° 103; 23 September 1996) as a game species. It was removed from later versions of the law, for unknown reasons. It was listed in a nature protection legal act (Law n° 462; 18 July 2001; Annex 5) as a species for which harvesting requires management measures. Cuzic *et al.* (2002) provided the first published record of wild-living American Mink in Romania: a single individual found dead near Somova, at the periphery of the Danube Delta. Two records based on museum specimens are provided by Kranz *et al.* (2004), the same authors also reporting a feral American Mink population east of Izmail, in the Ukrainian part of the delta. Recent introductions of American Mink in the Danube Delta were mentioned by de Jongh *et al.* (2007), without specifying the information source or region of the delta. Most recently, Marinov *et al.* (2012) mentioned an American Mink occurrence in the Romanian part of the Danube Delta.

Istrate (2005) hinted the occurrence of American Mink in Transylvania: he erroneously mentioned the presence of European Mink along the River Târnava Mică, stating that the observed individuals escaped from fur farms along the River Târnava Mare, then expanded from the confluence of the two rivers upstream on the Târnava Mică. In Romania, former tax-

onomy treated the two mink species as conspecific, under the scientific name *M. lutreola*. This confounds information on the two species in Romania. As examples, in the Fur Animal Research Station from Tîrgu-Mureş, old cage boards held the inscription "*Mustela lutreola*", while some American Mink specimens are labelled "*Mustela lutreola*", such as two mounts in the mammal collection of the Babeş-Bolyai University Museum of Zoology from Cluj-Napoca, originating from a nearby fur farm (inventory number 1379/2; Gergely Osváth *in litt.* 2014).

The few American Mink records from some countries neighbouring Romania refer to single individuals, with no proof of the existence of populations. As such, a single Serbian record is available, just near the Romanian border: in Banatska Palanka (Vojvodina) an American Mink was trapped on the River Danube on 15 September 1972 (Miric 1992, in Kryštufek *et al.* 1994, Mitchell-Jones *et al.* 1999). There is no further information on American Mink occurrence in Serbia (Boris Kryštufek *in litt*. 2011). Scattered observations in Hungary attested to at least occasional presence of American Mink; no feral populations have ever been known (Bihari *et al.* 2007). In Ukraine however, the species is believed to be widespread in the forest and the forest-steppe zone, but less so in the steppe zone and in the mountains (Andriy-Taras Bashta *in litt.* 2013). It was reported to be common in plain areas of Transcarpathia, a region bordering Romania and Hungary (Bashta & Potish 2007).

The present paper summarises all known records of wild-living American Mink from the River Mureş valley of Transylvania, Romania.

## Study area

The study area is the middle stretch of the River Mureş downstream of the Mureş Gorge, in the hilly region of the Transylvanian Plateau, in Mureş County, Romania. The landscape is characterised by a mosaic of broad-leaved (mostly oak *Quercus* – hornbeam *Carpinus*) forests, grasslands and arable land, at 300–600 m asl. Apart from the River Mureş, the area's most important water bodies are two tributaries, the Gurghiu and the Niraj on the left bank (as proceeding downstream), as well as the Glodeni-Păingeni fishponds and the Fărăgău lake on the Mureş's right bank. Following river and stream regulations during the past decades, wetlands are generally few. They comprise mostly oxbows, canals, gravel pits and temporary ponds.

## Methods

American Mink records were collected opportunistically over 2007–2012, during surveys of museum collections as well as discussions with hunters, anglers, fur-farm workers and field biologists. Most records comprise museum specimens or animals hunted or found dead. Sight-records were included from observers (field biologists and fur farm workers) able positively to rule out similar species (Western Polecat *M. putorius* and European Mink), as attested by discussion about identification. Two-thirds of the data come from the collection of the Kohl István Natural History Museum, Reghin (KINHM), which holds specimens collected in the neighbourhood, prepared by the late István Kohl. His personal notes on the specimens, stored in the Library of the Transylvanian Museum Society from Cluj-Napoca, provided additional information about the specimens' circumstances of collection, weight and colour morph, as well as his records of other species.

## Results and discussion

The total of 21 occurrence records date from 1986 to 2009 (Fig. 1, Table 1). Museum specimens (14) are from 1986–1991, whereas other records (including four sight records, all by day) come from the 1990s and 2000s (Table 1). This difference in timing might reflect diminishing hunters' interest in furbearers during the past two decades, caused by the gradual reduction of the fur market. The concentration of field observations near Tîrgu-Mureş and their lack near Reghin could be caused by the presence of numerous field biologists in the former locality, versus their general lack in the latter. Apart from three museum specimens, habitat types are only available for the more recent seven records (Table 1).

*Escaped or established in the wild?*

Three fur farms (all with American Mink) are known from the study area. One closed in 2013 after the others during the 1980s–1990s. One was founded as an institute in 1981, but the fur farm itself existed prior to this (Fig. 1). Considering the distance of individual records from the fur farms (Table 1), these farms are the potential sources of the wild-

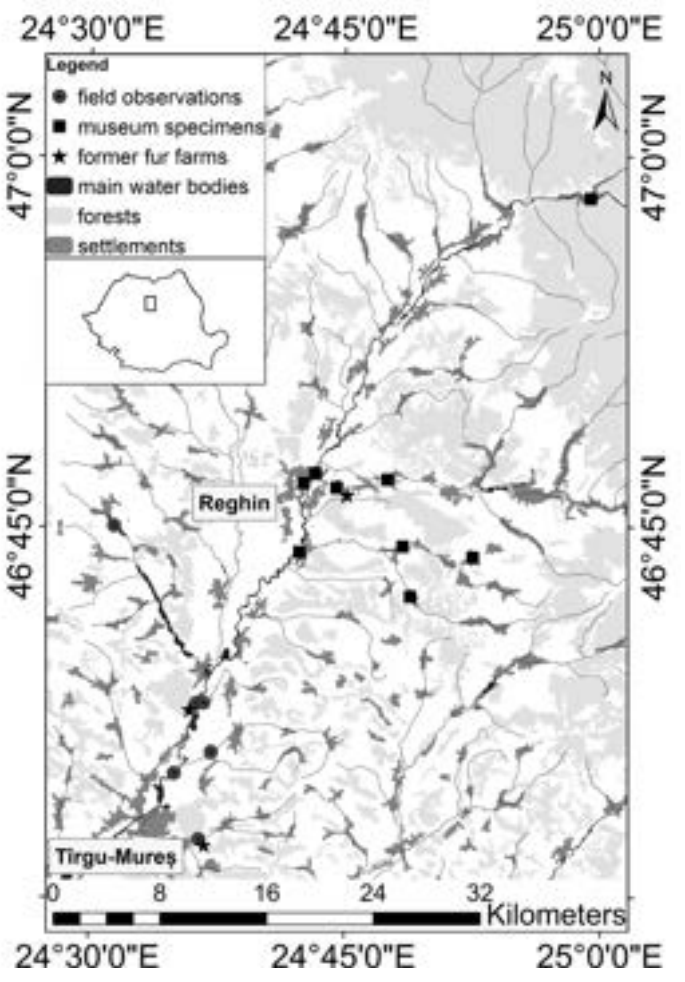


**Fig. 1.** American Mink *Neovison vison* records in Transylvania, Romania.

**Table 1.** Records of wild-living American Mink *Neovison vison* in Transylvania, Romania.

| Locality | Co-ordinates[1] | Date | Sex | Weight (g) | Colour | Type of record | Habitat[2] | Distance[3] to nearest fur farm (km) | Source |
|---|---|---|---|---|---|---|---|---|---|
| Răstolița | 46°58′N, 24°59′E | 28 Nov 1986 | ♀ | 700 | white | Specimen | | 29 | KINHM |
| Reghin | 46°47′N, 24°42′E | 4 Dec 1986 | ♂ | 1,430 | | Specimen | | 3.1 | KINHM |
| Reghin | 46°47′N, 24°42′E | 14 Jan 1987 | ♂ | 1,020 | white | Specimen | | 3.1 | KINHM |
| Unknown | - | 10 Aug 1987 | ♀ | 660 | white | Specimen | | | KINHM |
| Reghin | 46°46′N, 24°42′E | 24 June 1988 | juv ♂ | | blackish | Specimen | Slain by R. Mureș | 2.6 | KINHM |
| Petelea | 46°44′N, 24°42′E | 1988 | ♀ | 660 | | Specimen | Caught by R. Mureș | 5.7 | KINHM |
| Beica de Jos | 46°44′N, 24°48′E | 15 Nov 1988 | ♂ | 1,120 | dark brown | Specimen | Caught by stream | 3.2 | KINHM |
| Reghin | 46°47′N, 24°42′E | 22 Mar 1989 | ♂ | 1,540 | | Specimen | | 3.1 | KINHM |
| Sânmihai de Pădure | 46°44′N, 24°52′E | 26 Aug 1989 | ♀ | 520 | dark brown | Specimen | | 8.3 | KINHM |
| Reghin | 46°47′N, 24°42′E | 2 Sept 1989 | ♀ | 720 | grey | Specimen | In sawmill, under wood pile | 3.1 | KINHM |
| Reghin | 46°47′N, 24°44′E | 13 Sept 1989 | ♀ | 530 | dark brown | Specimen | Gurghiu road | 1 | KINHM |
| Jabenița | 46°47′N, 24°47′E | 4 Sept 1990 | ♀ | 780 | dark brown | Specimen | | 2.2 | KINHM |
| Reghin | 46°47′N, 24°42′E | 5 Nov 1991 | ♀ | 930 | | Specimen | Caught by slaughter-house | 3.1 | KINHM |
| Nadășa | 46°42′N, 24°49′E | 19 Dec 1991 | ♀ | 600 | grey | Specimen | | 6.7 | KINHM |
| Sângeorgiu de Mureș | 46°35′N, 24°35′E | 1990s | - | - | dark brown | Observed | Gravel pits | 4.8 | Z. Szombath verbally 2010 |
| Tîrgu-Mureș | 46°32′N, 24°36′E | 1998 | - | - | dark brown | Observed | Stream | 0.5 | AK |
| Glodeni | 46°38′N, 24°37′E | 1999 | - | - | dark brown | Observed | River | 1.2 | Cs. Ajtay verbally 2009 |
| Fărăgău | 46°45′N, 24°31′E | between 2003 and 2005 | - | - | blackish | Hunted | Natural lake | 15 | T. Palotás *in litt*. 2010 |
| Ernei | 46°36′N, 24°37′E | 27 Oct 2005 | - | - | dark brown | Observed | Stream | 3.5 | A. Deák *in litt.* 2011 |
| Glodeni | 46°38′N, 24°36′E | 4 Apr 2009 | - | - | dark brown | Found dead | Gravel pits | 0.8 | AK & T. Sos |
| Fărăgău | 46°45′N, 24°31′E | 3 Nov 2009 | - | - | blackish | Observed (photo) | Natural lake | 15 | I. Plájás *in litt*. 2012 |

[1]For museum specimens, the coordinates of the indicated settlement are provided, because their exact finding location is unknown.
[2]I. Kohl's notes verbatim, for museum specimens.
[3]Distance of indicated settlements from the fur farm in case of museum specimens, exact distance for all other records.

**Fig. 2.** Some of the American Minks *Neovison vison* recorded in Transylvania, Romania: (top left) carcase found near Glodeni, Romania, 4 April 2009 (Photo: T. Sos); (top right) observed by the Fărăgău lake, Romania, 3 November 2009 (Photo: I. Plájás); (bottom left) stealing fish from anglers by the Fărăgău lake, Romania, 3 November 2009 (Photo: I. Plájás); (bottom right) pelt hunted by the Fărăgău lake, Romania, within 2003–2005 (Photo: T. Palotás).

living individuals (Fig. 1). But some individuals found at considerable distances from mink farms suggest colonisation of available habitats. Among the more recent records, one (Tîrgu-Mureș, 1998) can be regarded as a former fur-farm escapee, because it was observed in a stream near a fur farm by AK. Fur colour of 10 of the 14 museum specimens is known from notes of I. Kohl (Table 1). The colour morphs can be associated with the four strains kept in some fur farms (e.g. in Tîrgu-Mureș): 'standard' (dark brown or blackish), 'hedlund' (jonquil), 'silver' (silvery grey) and 'pastel' (greyish-brown). Contrasting with the museum records, the other seven of the recorded individuals were all identified as dark brown or blackish (Table 1, Fig. 2). The above data, particularly the colour morphs involved, suggest that wild-taken American Minks in the region during the 1980s and early 1990s were farm escapees. More recent records from locations adjacent to closed-down fur farms and further away from these support the idea that wild-living individuals now exist.

*Conservation implications*

Competition aspects between American Mink and other riparian carnivores in this area have not been documented.

European Mink records in the study area date mainly from the first part of the 20th century (Szunyoghy 1974, Youngman 1982), although some records are much more recent (Table 2). Local extinction of this species from this part of the Carpathians has been suspected but never proven. Recent unconfirmed sightings from mountain regions suggest the persistence of some individuals at least, although we found no certified published records from the past two decades. Rigorous examination is needed given the confusion risks with American Mink and Western Polecat. The occurrence of American Mink in the Mureș Gorge (Răstolița locality) might mean another serious threat to a remnant (if still extant) European Mink population. I. Kohl's notes regarding mammal skins he prepared over several decades include four European Minks, all during 1964–1993 (Table 2) and 14 American Minks, all during 1986–1991 (Table 1). These records, however few, imply that during the presumed appearance of American Mink in the wild (possibly in the mid–late 1980s), the European species was already rare. A general scarcity of European Mink is further corroborated by the fact that during 1976–1995 he received 370 Western Polecats, another riparian mustelid. Uncertainty about the time of the first American Mink escapes hinders speculation

**Table 2.** Specimens of European Mink *Mustela lutreola* from Transylvania, Romania held at the Kohl István Natural History Museum, Reghin.

| Locality | Co-ordinates | Date | Sex | Weight (g) |
|---|---|---|---|---|
| Lăpuşna | 46°46′N, 25°13′E | 19 Apr 1964 | ♂ | 999 |
| Răstoliţa | 46°58′N, 24°59′E | 25 Sept 1976 | ♂ (juv) | 305 |
| Senetea | 46°38′N, 25°35′E | 18 Nov 1979 | ♂ | 940 |
| Lunca Bradului | 46°58′N, 25°06′E | 24 Aug 1993 | ♂ | 560 |

All animals were trapped or hunted.

about the beginning of potential competition between the two mink species, or the effects of American Mink on the native species.

Given the recent, albeit unconfirmed, American Mink sightings from various river basins of Transylvania (authors' unpublished data), as well as the history of fur farms in nearly all regions of the country, individuals or populations of American Mink are likely to exist in other river basins, at least in regions with a colder climate such as the Carpathians and the Transylvanian Plateau. Targeted surveys are needed, however, to clarify this issue, which might have significant conservation implications, given the obscure status of the European Mink in the region.

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This paper is dedicated to the memory of the late István Kohl, who provided the first data of American Mink occurrence in Transylvania, through his invaluable collecting work. Csaba Ajtay, Attila Deák, István Plájás, Tibor Palotás, Tibor Sos and Zoltán Szombath provided us records of American Mink, while our colleagues Szilárd J. Daróczi and Hana Latková drew our attention to some of these observations. We are grateful to Andriy-Taras Bashta (Institute of Ecology of the Carpathians, Lviv, Ukraine) for providing us the Ukrainian data, to Boris Kryštufek (University of Primorska, Ljubljana, Slovenia) for the Serbian data, to employees of the Kohl István Natural History Museum (Reghin) and to Gergely Osváth (Babeş-Bolyai University Museum of Zoology, Cluj-Napoca) for the data about museum specimens, and to Aurel Vâgă (Fur Animal Research Station, Tîrgu-Mureş) for information about farmed minks.

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# Recent camera-trap records of Owston's Civet *Chrotogale owstoni* and other small carnivores from Xe Sap National Protected Area, southern Lao PDR

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## Abstract

There are few published studies on small carnivores from southern Lao PDR. Camera-trapping (39 stations; 4,630 camera-trap-nights) in western Xe Sap National Protected Area, Salavan province, largely in Hill Evergreen Forest over 1,000 m asl, recorded nine species of small carnivore including Hog Badger *Arctonyx collaris,* Large Indian Civet *Viverra zibetha* and the *IUCN Red List* Vulnerable Owston's Civet *Chrotogale owstoni.* The latter was the most frequently encountered small carnivore with 42 notionally independent encounters from 11 camera-trap stations between 1,066 m asl and the upper limit of survey at 1,492 m asl. Owston's Civet has now been camera-trapped from four protected areas in Lao PDR, all at sites above 1,000 m asl.

*Keywords*: Activity patterns, *Arctonyx collaris*, Annamite mountains, Hog Badger, Large Indian Civet, Salavan province, Vietnam, *Viverra zibetha*

**ຂໍ້ມູນລ້າສຸດຂອງເຫງັນລາຍພາດກອນ(Owston's Civet *Chrotogale owstoni*) ແລະບັນດາສັດປະເພດລາເນື້ອຂະໜ້າດນ້ອຍ ບັນທຶກຈາກການຕັ້ງກ້ອງສຳຫຼວດໃນເຂດປ່າສະຫງວນແຫ່ງຊາດເຊຊັບ, ທາງພາກໃຕ້ຂອງລາວ**

**ບົດສະຫຼຸບຫຍໍ້**

ການສຶກສາທາງດ້ານສັດປະເພດລ່າເນື້ອຂະໜາດນ້ອຍໃນລາວທີ່ໄດ້ຖືກເຜີຍແຜ່ຢ່າງເປັນທາງການແມ່ນມີຈຳນວນໜ່ອຍ. ການສຳຫຼວດຕັ້ງກ້ອງ(39 ຈຸດ; 4,630 ຄືນການສຳຫຼວດ) ໃນພາກຕາເວັນຕົກຂອງເຂດປ່າສະຫງວນແຫ່ງຊາດເຊຊັບ, ແຂວງສາລະວັນ, ເຊິ່ງປົກຄຸມໄປດ້ວຍປ່າດົງດິບເຂດສູງ(ລະດັບຄວາມສູງຂອງໜ້າດິນເໜືອກ່ວາ 1,000 ແມັດ), ໄດ້ບັນທຶກຂໍ້ມູນຂອງ 9ຊະນິດພັນສັດລາເນື້ອຂະໜາດນ້ອຍ, ເຊິ່ງໃນນັ້ນກໍ່ລວມມີໝູລຶ່ງ Hog Badger *Arctonyx collaris*, ເຫັງນຫາງການ Large Indian Civet *Viverra zibetha* ແລະເຫັງນລາຍພາດກອນ Owston's Civet *Chrotogale owstoni* (ເຊິ່ງເປັນສັດບັນຊີແດງຂອງ IUCNຈັດໃນປະເພດທີ່ມີຄວາມສ່ຽງສູງ). ເຫັງນລາຍພາດກອນໄດ້ຖືກພົບເຫັນຫຼາຍທີ່ສຸດໃນບັນດາຈຳພວກສັດລ່າເນື້ອຂະໜາດນ້ອຍ ເຊິ່ງລວມມີ 42 ເຫດການເອກະລາດທີ່ໄດ້ຖືກບັນທຶກໃນ 11 ຈຸດທີ່ມີການຕັ້ງກ້ອງສຳຫຼ້ວດ ເຊິ່ງວ່າບັນດາຈຸດສຳຫຼວດດັ່ງກ່າວນັ້ນແມ່ນມີລະດັບຄວາມສູງຂອງໜ້າດິນຢູ່ທີ່ລະຫວ່າງ 1,066 ຫາ 1,492 ແມັດ. ຈົນເຖິງປັດຈຸບັນນີ້, ເຫັງນລາຍພາດກອນໄດ້ຖືກພົບເຫັນຜ່ານການຕັ້ງກ້ອງສຳຫຼວດຈາກປ່າສະຫງວນສີ່ແຫ່ງຢູ່ໃນ ສປປ ລາວ ເຊິ່ງແຕ່ລະເຂດແມ່ນຕັ້ງຢູ່ທີ່ລະດັບຄວາມສູງເໜືອກ່ວາ 1,000 ແມັດຂຶ້ນໄປ.

## Introduction

Lao PDR has been identified as part of a priority region for small carnivore conservation (Schreiber *et al*. 1989) with 21 species of small carnivores recorded (Duckworth 1997, Coudrat *et al*. 2014). Intensive camera-trapping has improved the knowledge of the local status of selected small carnivores in Lao PDR including in two national protected areas (NPAs) in Central and North Lao PDR: respectively, Nakai–Nam Theun NPA (Coudrat *et al*. 2014) and Nam Et–Phou Louey NPA (Johnson *et al*. 2009). However, small carnivores in the Annamite mountains in southern Lao PDR remain little known. This paper summarises records of mustelids (Mustelidae), linsangs (Prionodontidae), civets (Viverridae) and mongooses (Herpestidae) from camera-trapping in Xe Sap NPA, Salavan province, southern Lao PDR, between December 2012 and December 2013.

## Survey area

Xe Sap National Protected Area lies in southeast Lao PDR (Fig. 1) in the Central Annamites. This camera-trapping occurred in western Xe Sap NPA, in Muang (= District of) Ta-Oy, Salavan province. The surveyed area comprised Semi-Evergreen Forest (*sensu* Lamxay 2012), mostly below 1,000 m asl, and Hill Evergreen Forest at higher elevations. Hill Evergreen Forest in Xe Sap NPA is characterised by a 20–30 m canopy of *Pinus dalatensis, Dacrydium elatum*, *Podocarpus neriifolius* and species of Fagaceae, Lauraceae, Myrtaceae, Theaceae and Magnoliaceae (Lamxay 2012, R. J. Timmins *in litt*. 2014). The only previous small carnivore field records from Xe Sap NPA seem to be those from a short direct observation and sign survey of the western part in early 1999: direct sightings of Common Palm Civet *Paradoxurus hermaphroditus* and Crab-eating Mongoose *Herpestes urva*, and signs of otter

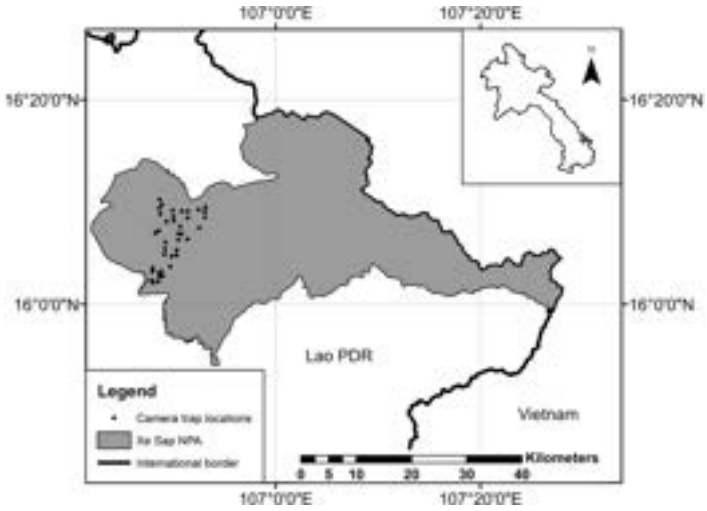


**Fig. 1.** Xe Sap National Protected Area, southern Lao PDR, showing locations of camera-trap stations during December 2012 – December 2013.

(Lutrinae) and potentially of various other genera (Steinmetz *et al*. 1999).

## Methods

A semi-structured design placed one camera-trap (Bushnell Trophy Cam; infrared flash) within each of 39 1 × 1 km grid cells, selected using a random number generator from ~300 numbered grid cells across western Xe Sap NPA (Fig. 1). Survey teams visited each cell and searched for 25–60 minutes for suitable camera-trap stations. These sought to maximise encounters with ungulates and ground-dwelling carnivores (cats [Felidae], dogs [Canidae] and bears [Ursidae]). They were along small animal or human trails (22), positioned to photograph animals using streams (10), along larger human trails (four), and in open pine grassland (three, over 1,108–1,201 m asl). Camera-traps were set to take a three-picture burst when triggered and each photograph was stamped with the date and time. Successive triggers were separated by at least 10 seconds. Triggers during camera setup and removal assessed whether the unit was operational. All camera-traps were placed on trees at 20–130 cm above the ground (mean = 45 cm, standard deviation = 25), none was baited and all were operational throughout the 24-hour cycle.

The 39 camera-traps operated for 86–173 camera-trap-nights (mean 119) between December 2012 and December 2013 at stations between 613 and 1,492 m asl (mean 1,096 m asl). Elevations were derived from hand-held GPS units in the field and are given as by the unit, despite the misleading implication of precision to within 1 m. Notionally independent encounters with small carnivores were defined as those when successive photographs of the same species at the same station were separated by at least 30 minutes. Species identifications from the photographs were initially made by KT and all were verified by TNEG and AT.

## Results

Of the total of 4,630 camera-trap-nights, 3,418 (74%) were from above 1,000 m asl. No camera-trap stations below 1,000 m asl were beside streams. The total of 508 notionally independent mammal (87%) and bird (13%) encounters included 147 (29%) of small carnivores. Many (22 notionally independent encounters; 15% of the 147 small carnivore encounters) of these photographs could not be identified to species level because of blurring and 'whitening' from the infrared flash.

At least nine species of small carnivore were recorded (Table 1). One is categorised on *The IUCN Red List of Threatened Species* as Vulnerable (Owston's Civet *Chrotogale owstoni*) and two as Near Threatened (Hog Badger *Arctonyx collaris* and Large Indian Civet *Viverra zibetha*) (IUCN 2014).

Owston's Civet was the most frequently recorded small carnivore (42 encounters between 1,066 m and the upper limit of survey at 1,492 m asl). Two other taxa, Crab-eating Mongoose and ferret badger *Melogale*, were recorded only above 1,000 m asl (Table 1). There were few records of small carnivores from below 1,000 m: only 12 of the 124 identified

**Table 1.** Small carnivores camera-trapped in Xe Sap National Protected Area, Lao PDR, December 2012 – December 2013.

| Elevation (m asl) | # (%) of CTN[1] | # of CTS | Y-t Marten | Hog Badger | Ferret badger | L. I. Civet | C. P. Civet | M. P. Civet | Owston's Civet | S. Lins. | C-e Mong. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 601–700 | 244 (5) | 2 | | | | | | | | | |
| 701–800 | 333 (7) | 3 | 1 (1) | | | | 2 (1) | | | 1 (1) | |
| 801–900 | 319 (7) | 3 | | 1 (1) | | 2 (1) | | 1 (1) | | | |
| 901–1,000 | 316 (7) | 3 | | 1 (1) | | 3 (1) | | | | | |
| 1,001–1,100 | 526 (11) | 5 | | | 2 (1) | | | 4 (2) | 12 (2) | 1 (1) | |
| 1,101–1,200 | 1,225 (26) | 10 | | | 3 (2) | 6 (2) | 2 (1) | 3 (3) | 5 (2) | 2 (1) | 5 (3) |
| 1,201–1,300 | 666 (14) | 5 | 2 (1) | 4 (2) | 4 (1) | 2 (2) | | 3 (3) | 14 (3) | 2 (1) | 7 (2) |
| 1,301–1,400 | 612 (12) | 5 | | 1 (1) | 7 (3) | | | 4 (3) | 9 (2) | 1 (1) | |
| 1,401–1,500 | 389 (8) | 3 | | | | | 2 (1) | 3 (2) | 2 (2) | | |
| Total | 4,630 | 39 | 3 (2) | 7 (5) | 16 (7) | 13 (6) | 6 (3) | 18 (14) | 42 (11) | 7 (5) | 12 (5) |

The figure for each species in each altitude-band gives the number of notionally independent camera-trap encounters (see text) and camera-trap stations with records (in parentheses). Full English names and scientific names in Table 3.

[1]CTN = camera-trap-nights, CTS = camera-trap stations.

**Table 2.** Activity patterns for small carnivores camera-trapped in Xe Sap National Protected Area, Lao PDR, during December 2012 – December 2013.

| Species | 04h00–06h00 | 06h01–18h00 | 18h01–20h00 | 20h01–03h59 |
|---|---|---|---|---|
| Yellow-throated Marten | - | 100 | - | - |
| Hog Badger | 14 | 43 | - | 43 |
| Ferret badger | 13 | - | 20 | 67 |
| Large Indian Civet | 23 | 8 | 23 | 46 |
| Common Palm Civet | 17 | - | - | 83 |
| Masked Palm Civet | - | - | 17 | 83 |
| Owston's Civet | - | 2 | 9 | 88 |
| Spotted Linsang | - | - | 20 | 80 |
| Crab-eating Mongoose | - | 100 | - | - |

The figure for each species in each time period is the percentage of notionally independent camera-trap detections of that species. Scientific names in Table 3.

records, involving six taxa of which four were found at only one station each.

Activity patterns of each species (Table 2) matched published information: Crab-eating Mongoose and Yellow-throated Marten *Martes flavigula* were entirely diurnal with Masked Palm Civet *Paguma larvata*, Common Palm Civet, Owston's Civet and Spotted Linsang *Prionodon pardicolor* markedly nocturnal (over 80% of encounters between 20h00 and 03h59). The two Owston's Civet records by daylight were at 07h32 and 08h17.

## Discussion

This camera-trapping from Xe Sap NPA, southern Lao PDR, complements that in Nakai–Nam Theun NPA (Coudrat *et al*. 2014) and Nam Et–Phou Louey NPA (Johnson *et al*. 2009) further north in the country. Despite more than four times the effort (20,452 camera-trap-nights), Coudrat *et al.* (2014) camera-trapped only one additional small carnivore species: Binturong *Arctictis binturong*, once. Johnson *et al*. (2009) in Nam Et–Phou Louey NPA camera-trapped three additional species (Small Indian Civet *Viverricula indica* and single encounters of Stripe-backed Weasel *Mustela strigidorsa* and Oriental Small-clawed Otter *Aonyx cinereus*) whilst not detecting ferret badger. Of these three areas, Nakai–Nam Theun NPA has received far heavier direct observation survey than the other two; it is the only one to have hosted intensive spotlight surveys (Duckworth 1998). Coudrat *et al*. (2014), collating all previous records from the NPA, presented direct sightings of three additional small carnivore species (Siberian *Mustela sibirica* and Stripe-backed Weasels and Small-toothed Palm Civet *Arctogalidia trivirgata*) and sign observations of otter, whilst skulls confirmed the presence of two species of ferret badger (Coudrat & Nanthavong 2013). Recent field surveys in Xe Sap NPA have also detected otter by sign (Timmins 2012). With a range of methods evidently required for complete area-lists of small carnivores in the Annamites, because other survey methods are not yet much applied in Xe Sap NPA, its true carnivore richness cannot be determined.

The breakdown of identified small carnivore encounters across the three survey areas is given in Table 3. Each survey's most frequently photographed small carnivore differed: ferret badger (with Common Palm Civet a close second) in Nakai–Nam Theun NPA, Yellow-throated Marten in Nam Et–Phou Louey NPA and Owston's Civet in Xe Sap NPA. Much variation could result from differences between surveys in precise camera-trap placement. Some might reflect between-area habitat differences, but with each protected area so large and so patchily camera-trapped, vagaries of survey block selection might also be significant. In Nakai–Nam Theun NPA, very little camera-trapping was in areas with extensive habitat believed suitable for Owston's Civet, although the NPA holds several such areas (R. J. Timmins *in litt*. 2014). Some species showed similar encounter rates in the three areas, notably Large Indian Civet and Masked Palm Civet. Than Zaw *et al*. (2008) strongly suspected that the latter species's semi-arboreality might reduce its camera-trap encounter rate. In Xe Sap NPA the low number of repeat encounters at camera-trap stations are consistent with this idea of low detectability of the species by standard camera-trapping.

All three studies obtained a few photographs (fewer than 10) of Spotted Linsang supporting the assumption that the species, although likely to be under-recorded by camera-trapping (see discussion in Coudrat *et al*. 2014), remains relatively widespread across its Lao range.

The most significant small carnivore records from Xe Sap NPA are those of Owston's Civet, the first live records from South Lao PDR. Extensive spotlighting in South Lao PDR in the 1990s did not detect Owston's Civet (Duckworth 1997). None took place in the Annamites: all previous Lao Owston's Civet records are in the Annamites or eastern northern highlands (Sivilay *et al*. 2011). R. J. Timmins (2012, *in litt*. 2014) found at least two Owston's Civet skulls in Ban Bhale, a village south-east of Xe Sap NPA. The species's presence in Xe Sap NPA is unsurprising given its Annamite location and the records from much further south in Vietnam (Dang & Le 2010). To encounter Owston's Civet so many times in a generic camera-trap survey suggests high detectability of the species from such camera-trapping. Thus, non-recording of Owston's Civet by other camera-trapping surveys is more likely to reflect the species's local absence than for some other species of small carnivores that are readily overlooked by 'standard' camera-trapping, such as weasels (Supparatvikorn *et al*. 2012 and references therein).

**Table 3.** Comparison of small carnivore camera-trapping results across three protected areas in Lao PDR.

| Species | Xe Sap NPA | Nakai–Nam Theun NPA | Nam Et–Phou Louey NPA |
|---|---|---|---|
| Stripe-backed Weasel *Mustela strigidorsa* | – | – | <1 (<1) |
| Yellow-throated Marten *Martes flavigula* | 2 (5) | 4 (3) | 37 (16) |
| Hog Badger *Arctonyx collaris* | 6 (13) | 16 (9) | 10 (5) |
| Ferret badger *Melogale* | 13 (18) | 20 (7) | – |
| Oriental Small-clawed Otter *Aonyx cinereus* | – | – | <1 (<1) |
| Large Indian Civet *Viverra zibetha* | 10 (15) | 10 (8) | 14 (9) |
| Small Indian Civet *Viverricula indica* | – | – | 1 (1) |
| Common Palm Civet *Paradoxurus hermaphroditus* | 5 (8) | 20 (12) | 13 (7) |
| Masked Palm Civet *Paguma larvata* | 15 (36) | 11 (8) | 16 (8) |
| Binturong *Arctictis binturong* | – | <1 (<1) | – |
| Owston's Civet *Chrotogale owstoni* | 34 (28) | 12 (3) | <1 (<1) |
| Spotted Linsang *Prionodon pardicolor* | 6 (13) | 1 (<1) | 3 (2) |
| Crab-eating Mongoose *Herpestes urva* | 10 (13) | 8 (6) | 5 (4) |
| Total identified small carnivore encounters | 124 | 508 | 244 |
| Elevation range (m asl) | 613–1,492 | 532–1,942 | 543–2,288 |
| Total camera-trap-nights | 4,630 | 20,452 | 8,499 |

The figure for each species in each survey area is the percentage comprised by that species of all notionally independent small carnivore camera-trap detections identified to species in that survey area. The percentage of camera-trap stations in the survey area which detected the species is in parentheses. Sources: Xe Sap NPA, this study; Nakai–Nam Theun NPA, Coudrat *et al*. (2014); Nam Et–Phou Louey NPA, Johnson *et al*. (2009).

Whilst recorded as low as about 100 m asl in Vietnam (Roberton 2007), all Lao camera-trap records of Owston's Civet are from above 1,000 m asl. Coudrat *et al*. (2014) recorded Owston's Civet between 1,033 and 1,675 m asl, whilst the single photograph from Nam Et–Phou Louey NPA was at 1,600 m asl (Johnson *et al*. 2009) and that from Phou Chomvoy Provincial Protected Area, Bolikhamxai province, at 1,100 m asl (Sivilay *et al*. 2011). Coudrat *et al*. (2014) suggested occurrence at lower elevations in Vietnam could be linked to the species's preference for wet evergreen forest. This occurs widely at lower altitudes in Vietnam than in Lao PDR, where it is patchily distributed. There seems to have been no significant camera-trapping effort in Lao wet evergreen forest much below 1,000 m. Thus, the lower limit to which Owston's Civet occurs in Lao PDR remains uncertain. Captive animals in Ban Lak-20 in the 1990s reportedly came from the villages of Ban Nape-3 (local name, Ban Tongphe) (Duckworth 1997) or Ban Nape (King 2002), two villages amid wet evergreen forest at about 550 m.

Owston's Civet is categorised as Vulnerable on the *IUCN Red List*. This is based on ongoing population decline, inferred to exceed 30% per three generations (taken as 15 years) from over-exploitation and habitat loss. Its ground-dwelling habits (corroborated by high detection rates and multiple photographs per camera-trap station in Xe Sap NPA) suggest that the pervasive snaring widespread in its range (Vietnam, eastern Lao PDR and a small part of adjacent China; Schreiber *et al*. 1989, Dang & Le 2010, Sivilay *et al*. 2011) might affect it strongly. Extensive camera-trapping in the Hue and Quang Nam Saola Nature Reserves in wet evergreen forest at 280–1,000 m asl has not detected the species in over 15,000 camera-trap-nights since August 2012 (WWF unpublished data). Conceivably this might reflect a natural scarcity of the species in this particular area, perhaps in part because of its lower elevation. An alternative, perhaps more likely, explanation, given the relatively large number of past lowland records in Vietnam, is that it declined through the sustained, intensive hunting there before protected area establishment. Indeed, none of the post-2005 camera-trap surveys in Vietnam collated by Willcox (2014: Table SOM T3) found Owston's Civet, whereas all those during 1998–2006 did so. In this light, on current knowledge Xe Sap NPA – and plausibly other large tracts of wet evergreen forest in easternmost Lao PDR – might now be the most important known areas for the species.

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# Intake of an ethnomedical shrub by Yellow-bellied Weasel *Mustela kathiah*

Jay P. H. WAN

## Abstract

An episode of consumption of the bark, stem and/or fluid of the ethnomedical plant *Mallotus peltatus* by Yellow-bellied Weasel *Mustela kathiah* was camera-trapped in Yinggeling Nature Reserve, Hainan, China. This behaviour lasted about one minute and involved the weasel's climbing into the crown, so seemed to be intentional. More behavioural and dietary studies would inform understanding of ethnomedical plant usage by carnivores.

*Keywords*: camera-trapping, China, diet, Hainan, *Mallotus peltatus*, medical treatment, plant consumption

**黄腹鼬 *Mustela kathiah* 咬食民间药用植物一例**

**摘要**

于中国海南省鹦哥岭自然保护区进行红外线自动相机兽类监测期间，意外拍摄到一只黄腹鼬 *Mustela kathiah* 正在咬食一种民间药用植物，山苦茶 *Mallotus peltatus* 的树皮和茎，或是想取食其汁液。由于这棵山苦茶位处陡坡，黄腹鼬仍然爬到树的冠部，并持续咬食一分钟，因此被认为是一种有意识的行为。关于食肉动物利用民间药用植物所知甚少，亟待更多行为学和食性相关的研究。

Yellow-bellied Weasel *Mustela kathiah* is a small carnivore distributed from South and East China, west to the Himalayan region and south to West Thailand and southern Vietnam (Corbet & Hill 1992, Abramov *et al*. 2013, Chutipong *et al*. 2014, Phan *et al*. 2014). It is not considered threatened in South China, although its ecology is still poorly known (Lau *et al.* 2010). Camera-trapping was conducted as part of training in wildlife monitoring at Yinggeling Nature Reserve (18°49′–19°06′N, 109°11–34′E), Hainan province of China in 2009–2010. One of the seven infrared auto-triggered cameras-traps (Wildlife II, Shenzhen Changxin Electronics Technology Co. Ltd, China) was set 1.5 m above ground, facing an animal trail on a rocky steep slope 15 m from the nearest water source, at 400 m asl in a scrub valley dominated by fig trees *Ficus virens*. No lure or bait was used.

A series of photographs taken at 06h55–06h56 on 8 May 2009 showed a Yellow-bellied Weasel biting a branch of the shrub *Mallotus peltatus* (Fig 1). The action lasted about one minute despite the presumed disturbance from the camera-trap's flash. It therefore seems to have been intentional feeding. The camera-trap was in position for three weeks from 1 May, but the Yellow-bellied Weasel was photographed only once, on the eighth day, so presumably did not return in the subsequent fortnight. A careful check of the plant in the field showed no bee hive or ant nest (Hymenoptera) on the branch. Xylophagous beetle (Coleoptera) larvae, which live in decaying wood, were unlikely to have been present in this fresh branch. The weasel seems, therefore to have been feeding on the plant directly.

*Mallotus peltatus* (Euphorbiaceae) is a shade-tolerant plant common in secondary forests at altitudes of 200–1000 m. It occurs in Guangdong and Hainan provinces of China, Vietnam, Thailand, India, Malaysia, Myanmar, Indonesia, New Guinea and the Philippines (eFloras 2014). *Mallotus* has long been used as ethnomedicine, not only by the Li minority of Hainan, China but also by indigenous people in Vietnam and India, to treat stomach-ache, enteritis and atherosclerosis (Chakraborty & Rao 1988, Dagar & Dagar 1991, Liu *et al.* 2008, Arunachalam *et al.* 2009, Nguyen Hoai *et al.* 2009). Leaf and stem-bark extracts have antimicrobial, anti-inflammatory and neuropharmacological functions for skin infections, vulnerary, choleretic and trematodic problems (Ambasta 1992, Hua *et al.* 1992, Chattopadhyay *et al.* 2002, 2003).

This Yellow-bellied Weasel might have been feeding on *M. peltatus* because of these medicinal properties. The five most preferred plant species in the exudativorous diet of Bengal Slow Loris *Nycticebus bengalensis* have high medicinal value and are used traditionally by people (Das *et al.* 2014). Great apes are known to ingest plants rich in non-nutritional secondary compounds that may help reducing parasites (Huffman 2003). Evidence suggestive of self-medication in animals, including carnivores, was summarised by Huffman (2003), who documented the use of bark, root and fruit. Bengal Slow Loris's consumption of plants also used medicinally by local people might be why the local people use the lorises themselves as medicine (Nekaris *et al*. 2010, Das *et al*. 2014). Although being hunted for pelts, weasels are not valued in China medicinally or as food compared with other small carnivores like Masked Palm Civet *Paguma larvata*, Common Palm Civet *Paradoxurus hermaphroditus*, Small Indian Civet *Viverricula indica* and Eurasian Otter *Lutra lutra* (Wu 1993), but there is one record of Stripe-backed Weasel *M. strigidorsa* in trade in adjacent Lao PDR, for medicinal use (Hansel & Tizard 2006).

Alternatively, this episode might have been purely dietary, with no medicinal basis. Consumption of plant parts,

**Fig. 1.** A series of camera-trap photographs of a Yellow-bellied Weasel *Mustela kathiah* biting on a branch of the ethnomedical plant *Mallotus peltatus*, Yinggeling Nature Reserve, Hainan, China, 8 May 2009.

in particular fruit, is widespread among members of the Carnivora: in addition to the extensively frugivorous palm civets (Paradoxurinae), this includes in tropical Asia species such as Yellow-throated Marten *Martes flavigula*, Small-toothed Ferret Badger *Melogale moschata* and Small Indian Civet (e.g. Rabinowitz & Walker 1991, Corlett 1996, 1998, Zhou *et al.* 2008a, 2008b, 2008c). Nectarivory has been documented in palm civets and Yellow-throated Marten (Joshi *et al.* 1995, Nandini & Karthik 2007, Lau 2012, Moore & Wihermanto 2014). Although *M. peltatus* flowers and fruits in February–June and June–November respectively (eFloras 2014), neither flower (hence nectar) nor fruit is visible in the photographs nor was noted at time of camera setting. Grass is consumed as an intestinal scourer or a digestion aid by Sulawesi Civet *Macrogalidia musschenbroekii* and *Viverra* civets in northern and central Sulawesi (Wemmer & Watling 1986). It is unlikely that this camera-trapped Yellow-bellied Weasel fed on the *Mallotus* plant, which grew on a steep slope so was perhaps more difficult to reach than were many other plants nearby, as an intestinal scourer, although Yellow-bellied Weasel is apparently at least a fair climber (Supparatvikorn *et al.* 2012).

This seems to be the first description of the intake of non-fruiting parts of any ethnomedical plant by any small carnivore in Southeast Asia or China, perhaps over a wider area. In Latin America, coatis *Nasua* have been documented grooming with resin of the plant genus *Trattinnickia*, perhaps because of its medicinal properties (Gompper & Hoylman 1993). Yellow-bellied Weasel diet seems not to have been studied. As well as an expected diet of rodents, other small mammals and birds, it reportedly eats fruit (Larivière & Jennings 2009). Wu (1993) noted that some local people in Guangxi province of China described Yellow-bellied Weasel as fond of feeding on mushrooms; they thus call it 'mushroom weasel'. Although weasels are generally considered highly carnivorous, at least one species, Siberian Weasel *M. sibirica*, consistently eats fruit, at least in some of its range (Tatara & Doi 1994).

The camera-trapped Yellow-bellied Weasel was chewing on the stem with its molars. It was clearly not merely licking the food. Such biting suggests that it was either consuming the bark itself or was trying to damage the stem so it could consume an exudate. A weasel consuming exudate would be startling: exudativory is a rare dietary niche known mainly in primates, with only seven genera known so far to gouge for exudate (Nash 1986, Nash & Burrows 2010, Smith 2010, Starr & Nekaris 2013). Evidence of carnivores incorporating plant solids or exudates in their diet could perhaps be provided by comparative studies of dental morphology from skull collections; dental signals of such diet are evident in galagos (Galagidae) (Burrows & Nash 2010). Further studies on diet, including close examination of camera-trap images, would allow a better understanding of ethnomedical plant usage by carnivores.

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# Additional remarks on Flat-headed Cusimanse *Crossarchus platycephalus* in Nigeria

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## Abstract

Data recently published on the Nigerian Flat-headed Cusimanse *Crossarchus platycephalus* by Angelici & Di Vittorio (2013) are re-analysed in view of the errors in both altitude and geographic coordinates of many of the locality records. In addition, new information is presented on the habitat characteristics and natural history of this little-known species in the Niger Delta region of southern Nigeria.

*Keywords*: Common Cusimanse, correction of published data, *Crossarchus obscurus*, Ghana, locality records, Niger Delta, West Africa

## Remarques supplémentaires sur le Crossarque à tête plate *Crossarchus platycephalus* au Nigéria

## Résumé

Les données récemment publiées par Angelici & Di Vittorio (2013) sur le Crossarque à tête plate *Crossarchus platycephalus* du Nigéria sont ré-analysées du fait d'erreurs importantes constatées sur l'altitude et les coordonnées géographiques de plusieurs des localités collectées. De plus, de nouvelles informations sont ajoutées sur les caractéristiques de leur habitat et l'histoire naturelle de cette espèce peu connue de la région du Delta du Niger au sud du Nigéria.

*Mots clés*: Afrique de l'Ouest, correction de données publiées, Crossarque commun, *Crossarchus obscurus*, Delta du Niger, Ghana, localités

## Introduction

Recently, *Small Carnivore Conservation* published an article by Angelici & Di Vittorio (2013) on the comparative ecology of Common Cusimanse *Crossarchus obscurus* in Ghana and Flat-headed Cusimanse *C. platycephalus* in Nigeria. In this "tentative" study, the authors compared some environmental 'parameters' (habitat types and elevation) for the locations where cusimanse specimens were trapped by local hunters. They concluded that *C. platycephalus* appears more tolerant of mosaic or partly degraded environments than is *C. obscurus*, although overall the two taxa show rather similar patterns. The authors demonstrated by t-test that the two species differed significantly in terms of elevation. This result is potentially important, because it is little known whether altitudinal partitioning may have driven community structure and even speciation patterns of not only West African mammals but also vertebrates in general (e.g. Luiselli 2007, for West African chameleons [Chameleonidae]). However, Angelici & Di Vittorio (2013) contains several points in need of correction, related to unsatisfactory statistical presentation and, more importantly, to inaccuracies in locations (altitudes and geographic coordinates) of several records. In Angelici & Di Vittorio (2013), the locality errors arose through repeated exchange of preliminary files between FMA and MDV, using different geographical scales of detection latitude–longitude. Our aims here are (i) a new perspective of Angelici & Di Vittorio's (2013) dataset based on a solid re-analysis of the evidence; and (ii) to present additional data on the ecology of *C. platycephalus* in southern Nigeria, this species being still very little known ecologically.

## Re-analysis methodology

Geographic coordinates and elevations of the sites were recalculated using Google Earth software, with, for some localities, our (FP, GCA, LL) GPS records. The geographic coordinates given by Angelici & Di Vittorio (2013) were placed into Google Earth to derive elevations (Table 1). Google Earth altitudes can be misleading in areas of rugged topography (for example they are useless in karst landscapes, at least at the spatial resolution of a few years ago): they are inferior to (carefully!) user-assigned altitudes. Such problems are much less in areas of gentle terrain, such as the area surveyed in Nigeria by Angelici & Di Vittorio (2013). Indeed, that area is on very gentle deltaic terrain, never exceeding about 100 m of elevation (and in most cases below 30 m asl), so the Google Earth altitudes should not be misleading. As a second step, geographic coordinates for these place-names as reported by Angelici & Di Vittorio (2013) were checked in Google Earth and in our GPS records when available (Table 2). The original authors (FMA and MDV) agree that the place-names in Google Earth correspond to the place-names of their records. To be conservative in statements, only elevations that differed by more than 70 m asl are considered as questionable, as are geographic coordinates more than 10 km apart.

## Data inconsistencies

Angelici & Di Vittorio's (2013) dataset presents wrong elevations of several *C. platycephalus* sites and inaccurately reports geographic coordinates of some of them (Tables 1–2). Indeed, the Google Earth elevation of the sites with geographic coor-

**Table 1.** Altitude information for the Nigerian Flat-headed Cusimanse *Crossarchus platycephalus* sites reported by Angelici & Di Vittorio (2013).

| Coordinates (as in A&DV) | Elevation (A&DV) | Elevation (GE) | Difference (m) |
|---|---|---|---|
| 4°51′05″N, 7°00′59″E | 27 | 19 | -8 |
| 5°03′40″N, 6°39′49″E | 220 | 7 | **-213** |
| 4°51′18″N, 6°50′13″E | 178 | 8 | **-170** |
| 4°47′19″N, 6°53′35″E | 355 | 6 | **-349** |
| 4°44′18″N, 6°38′46″E | 270 | 12 | **-258** |
| 5°21′06″N, 6°39′07″E | 17 | 16 | -1 |
| 4°51′29″N, 6°55′15″E | 5 | 14 | 9 |
| 5°06′53″N, 7°22′01″E | 400 | 61 | **-339** |
| 5°18′07″N, 8°21′29″E | 460 | 107 | **-353** |
| 5°10′50″N, 7°42′43″E | 155 | 77 | **-78** |

A&DV = Angelici & Di Vittorio (2013); GE = Google Earth. Differences exceeding 40 m asl are in boldface.

**Table 2.** Geographic coordinate information for the place-names for the Nigerian Flat-headed Cusimanse *Crossarchus platycephalus* sites reported by Angelici & Di Vittorio (2013).

| Place-name (A&DV) | Coordinates (GE/GPS) | Coordinates (A&DV) | Difference (km) |
|---|---|---|---|
| Port Harcourt (airport surr.) | 5°00′53.53″N, 6°57′01.15″E | 4°51′05″N, 7°00′59″E | **19** |
| Abarikpo | 5°09′16″N, 6°38′10″E | 5°03′40″N, 6°39′49″E | **10.25** |
| Otari | 4°53′22″N, 6°41′11″E | 4°51′18″N, 6°50′13″E | **16.97** |
| Tombia forest | 4°47′42.36″N, 6°54′41.52″E | 4°47′19″N, 6°53′35″E | 2 |
| Orashi River | 4°44′43″N, 6°38′10″E | 4°44′18″N, 6°38′46″E | 6.5 |
| Omoku | 5°20′34.18″N, 6°39′17.30″E | 5°21′06″N, 6°39′07″E | 0.91 |
| Billebokiri | 4°51′29″N, 6°55′15″E | 4°51′29″N, 6°55′15″E | 0 |
| Abia | 5°25′56.29″N, 7°31′35.42″E | 5°06′53″N, 7°22′01″E | **39.28** |
| Akamkpa | 5°19′09.78″N, 8°20′59.48″E | 5°18′07″N, 8°21′29″E | 2.08 |
| 4 km east of Ikot-Ekpene | 5°10′54.76″N, 7°40′50.13″E | 5°10′50″N, 7°42′43″E | 0.14 |

A&DV = Angelici & Di Vittorio (2013); GE/GPS = Google Earth or authors' GPS records when available. Differences exceeding 10 km are in boldface.

dinates as given by Angelici & Di Vittorio (2013) differed considerably from the elevations reported in the original article in 70% of the Nigerian cases (Table 1), as it did in 33.3% of the Ghana sites. The substantial error in altitudes of Angelici & Di Vittorio's (2013) records simply makes it impossible to consider their conclusions concerning altitudinal differences between *Crossarchus* species of any soundness. Anyway, also re-calculating the t-value in Angelici & Di Vittorio's (2013) Table 1 data with PAST software, using a two-tailed procedure, the original conclusion of a statistically significant altitudinal difference between species (Angelici & Di Vittorio 2013) was not found. Indeed, we obtained nearly identical mean ± SD elevations for the two species; respectively, 178.7± 137.6 m asl in Nigeria versus 176.2 ± 123. 6 m asl in Ghana ($t$ =0.0411, $df$ = 17, $P$ = 0.968). Angelici & Di Vittorio's (2013) reported t-test regards another table omitted from the published version of the paper.

Using the place-names as reported by Angelici & Di Vittorio (2013), there were also some clear inaccuracies, of up to 39.3 km, in the reported geographic coordinates of the Nigerian sites (Table 2), thus hindering understanding of whether the reported altitude and the habitat categories are anyway corrected or not (Table 1). For instance, when reporting data for the surroundings of Abia (actually in Enugu State), the authors presented coordinates roughly corresponding to Aba (Abia State), but indicating the altitude of Abia. Geographic coordinates of the Ghana sites were not checked, so their level of accuracy is unknown.

## Novel information concerning *Crossarchus platycephalus*

During 2010–2014, the community ecology of reptiles was studied in several Nigerian forest fragments (e.g. Akani *et al*. 2014a), with data on the local mammal fauna also collected (Akani *et al*. [2014b] detailed the field methods): Edumanon Forest Reserve (FR) (4°24′54″N, 6°27′01″E; Akani *et al*. 2014b), Taylor Creek FR (5°06′25.0″–5°24′31.5″N, 6°23′09″–6°36′18.2″E; Akani *et al*. in press), Nun River FR (4°57′06″N, 6°08′18″E, 6 m elevation; GCA *et al*. unpublished data), Egbedi Creek FR (4°38′49″N, 6°20′01″E, 7 m elevation; GCA *et al*. unpublished data) and Upper Orashi FR (4°55′57″N, 6°27′28″E; Shell Petroleum Development Company 2013). For each reserve except Taylor Creek FR, the coordinates, taken with a Garmin GPSMAP 62, indicate an arbitrary point inside it. We did not

find *C. platycephalus* inside the forest blocks of these reserves, although it was common in adjacent non-forest habitats. Angelici & Di Vittorio (2013), by contrast, reported *C. platycephalus* in the Upper Orashi FR. However, the precise site lies outside the reserve (Omoku), with farmbush as main habitat. Consistent with our evidence, this species was considered to be absent from the Niger Delta marsh forest also by Blench (2007).

On the other hand, this species was commonly observed by FP, GCA and LL in bushmeat markets (Figs 1–2) surrounding farmbush areas, forest-derived savannas and gallery forests, such as along the Imo River (Oigbo bushmeat market at the border between Rivers and Abia States; Fig. 3). In this regard, we concur with Angelici & Di Vittorio (2013) that *C. platycephalus* is a typical species of altered habitats in southern Nigeria, usually avoiding mature forest and swamp forest. It is most common in the lowlands and plains. Our observations agree with Blench (2007), who considered this species widespread in the largely deforested lowland forest zone east of the Orashi River, indeed in general everywhere that mature forest is absent.

Interviews with hunters, in 2012–2014, revealed that netting is the favoured method for capturing *C. platycephalus*, although single individual captures using iron lariats are also not uncommon (Angelici *et al*. 1999). Most of the interviewed hunters reported that they always try to catch 'family groups' of mongooses. For instance, when they discover a group around a likely sleeping site on a tree in the evening, they set nets round the tree before dawn, then lie in ambush. As soon as the animals appear at the base of the tree at dawn, the hunters make sharp, threatening sounds that cause the mongooses to stampede and run helter-skelter into the netting, thereby becoming entangled. Next, the hunters use a piece of wood to hit the entangled victims on the head. At a single sleeping tree, as many as 8–12 mongooses may be netted, according to hunters' reports. This hunting strategy explains why it is usually easy to find multiple individuals of these mongooses with a given trader in the Niger Delta bushmeat markets. Therefore, multiple specimens in a single market place should be considered as a single capture event in statistical analyses of presence and/or abundance for this species.

**Fig. 1.** Two Flat-headed Cusimanses *Crossarchus platycephalus* for sale at Oigbo market, Niger Delta, Nigeria (Photo: L. Luiselli).

**Fig. 2.** Skinned Flat-headed Cusimanses *Crossarchus platycephalus* for sale at the Omagwa bushmeat market, Niger Delta, Nigeria (Photo: Fabio Petrozzi).

**Fig. 3.** Typical habitat of Flat-headed Cusimanse *Crossarchus platycephalus* in the Niger Delta, Nigeria: Imo River, November 2013 (Photo: L. Luiselli).

## Concluding remarks

These several important flaws in the geographic attributes of the data given by Angelici & Di Vittorio (2013) for Nigerian *C. platycephalus* are, unfortunately, not so rare in studies on Af-

rican tropical vertebrates and do not only concern the dataset reviewed in our paper. As a general concluding remark, zoologists in tropical regions should provide as precise as possible geographic and elevation data for small carnivores. In this regard, it should be reminded that topographic names tend to be quite unstable over time in West Africa, hindering reliable location of potentially important records merely based on place-names lacking correct altitude and geographic coordinates. For instance, a supposedly extinct rodent (Groove-toothed Forest Mouse *Leimacomys buettneri*), endemic to Togo, has never been observed again after its discovery (in the year 1890, by R. Büttner) not just because the place-name has changed (from Bismarckburg to Adele), but because the altitudinal details of the site of capture are not available.

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# Records of small carnivores in Barsey Rhododendron Sanctuary, Sikkim, India

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## Abstract

Limited information is available on the distribution and abundance of Sikkim's 18–21 small carnivore species from most areas of the State, including Barsey Rhododendron Sanctuary. Camera-trapping at Barsey RS during February 2011–March 2013 and January–March 2014 photographed four species: Red Panda *Ailurus fulgens* (seven records), Yellow-throated Marten *Martes flavigula* (15), Spotted Linsang *Prionodon pardicolor* (three) and Siberian Weasel *Mustela sibirica* (two).

*Keywords*: *Ailurus fulgens*, camera-trapping, *Martes flavigula*, *Mustela sibirica*, Red Panda, Siberian Weasel, Yellow-throated Marten

## Introduction

The Eastern Himalayas are situated at the confluence of three biogeographic realms. This contributes to the region's high diversity of small carnivores (Datta *et al*. 2008). At least 18 of the 32 species of small carnivores in India (Datta *et al*. 2008, Mudappa 2013) are recorded from Sikkim, with three others reported or likely to occur (Table 1). Like most areas in the Eastern Himalayas, little is known about small carnivore distribution and abundance in Sikkim. Limited systematic survey has been undertaken. Camera-trapping is effective at detecting some small carnivore species (Datta *et al*. 2008), particularly rarely directly observed ground-dwelling ones. Camera-trapping by Sathyakumar *et al*. (2011) in Khangchendzonga National Park (Khangchendzonga NP) and by Khatiwara & Srivastava (2014) in Kyongnosla Alpine Sanctuary provided valuable information on small carnivores in Sikkim. It can be difficult to camera-trap primarily arboreal species, like Red Panda *Ailurus fulgens* (Datta *et al*. 2008, Sathyakumar *et al*. 2011). However, Red Panda often descends from the trees for drinking water or while travelling between two distant locations (pers. obs.). With this presumption, this study aimed to determine the distribution of Red Panda (categorised as Vulnerable on *The IUCN Red List of Threatened Species*; IUCN 2014) in Barsey Rhododendron Sanctuary through camera-trapping, while recording other small carnivore species sharing the same habitat.

**Table 1.** Small carnivores known[1] from the state of Sikkim, India.

| Taxon | Sources[2] |
|---|---|
| **Family Ailuridae** | |
| Red Panda *Ailurus fulgens* | a,c,d |
| **Family Mustelidae** | |
| Pale (= Mountain) Weasel *Mustela altaica* | c,d |
| Yellow-bellied Weasel *Mustela kathiah* | d |
| Siberian Weasel *Mustela sibirica* | a,b,c,d |
| Stripe-backed Weasel *Mustela strigidorsa* | d |
| Stone (= Beech) Marten *Martes foina* | c,d |
| Yellow-throated Marten *Martes flavigula* | a,b,c,d |
| Eurasian Otter *Lutra lutra* | a,b |
| Asian Small-clawed Otter *Aonyx cinereus* | d |
| **Family Prionodontidae** | |
| Spotted Linsang *Prionodon pardicolor* | a,b,d |
| **Family Viverridae** | |
| Large Indian Civet *Viverra zibetha* | a,b,c,d |
| Small Indian Civet *Viverricula indica* | d |
| Common Palm Civet *Paradoxurus hermaphroditus* | d |
| Himalayan (= Masked) Palm Civet *Paguma larvata* | a,b,c,d |
| Binturong *Arctictis binturong* | a,b,d |
| **Family Herpestidae** | |
| Small Asian Mongoose *Herpestes javanicus* | d |
| Indian Grey Mongoose *Herpestes edwardsii* | d |
| Crab-eating Mongoose *Herpestes urva* | d,e |

[1]In addition, Hog Badger *Arctonyx collaris*, Large-toothed Ferret Badger *Melogale personata* and Smooth-coated Otter *Lutrogale perspicillata* have been reported from the state, but remain to be confirmed (Choudhury 2013).

[2]a, Biswas & Ghose 1982; b, Anon. 1989; c, Sathyakumar *et al*. 2011; d, Choudhury 2013; e, P. S. Ghose & B. K. Sharma (pers. obs., 26 November 2008: direct sighting at Rorathang, 27°11.789′N, 88°36.503′E; about 500 m asl).

## Survey area

Barsey Rhododendron Sanctuary (Barsey RS; 104 km$^2$; 2,200–4,100 m asl) lies in the southwestern corner of Sikkim, in the West district. The sanctuary is bordered to the west by Nepal and to the south by the neighbouring Indian state of West Bengal. It provides habitat contiguity between Khangchendzonga Biosphere Reserve to the north and Singalila National Park (West Bengal) to the south. Its major forest types are east Himalayan wet temperate forest, east Himalayan moist temperate forest, east Himalayan dry temperate coniferous forest, east Himalayan subalpine birch *Betula* / fir *Abies* forest, birch–rhododendron *Rhododendron* scrub forest, deciduous alpine scrub and alpine pastures (Champion & Seth 1968, Department of Forest Environment and Wildlife Management undated) (Fig. 1). There are 42 designated forest villages; 17 other villages close to the Sanctuary are shown in the map (Fig. 1).

## Methods

A predesigned questionnaire sought Red Panda reports from farmers, labourers, herders and ex-hunters in villages around the Sanctuary, and the park managers and field personnel of the Department of Forests, Environment and Wildlife Management (Government of Sikkim). Rapid surveys between April

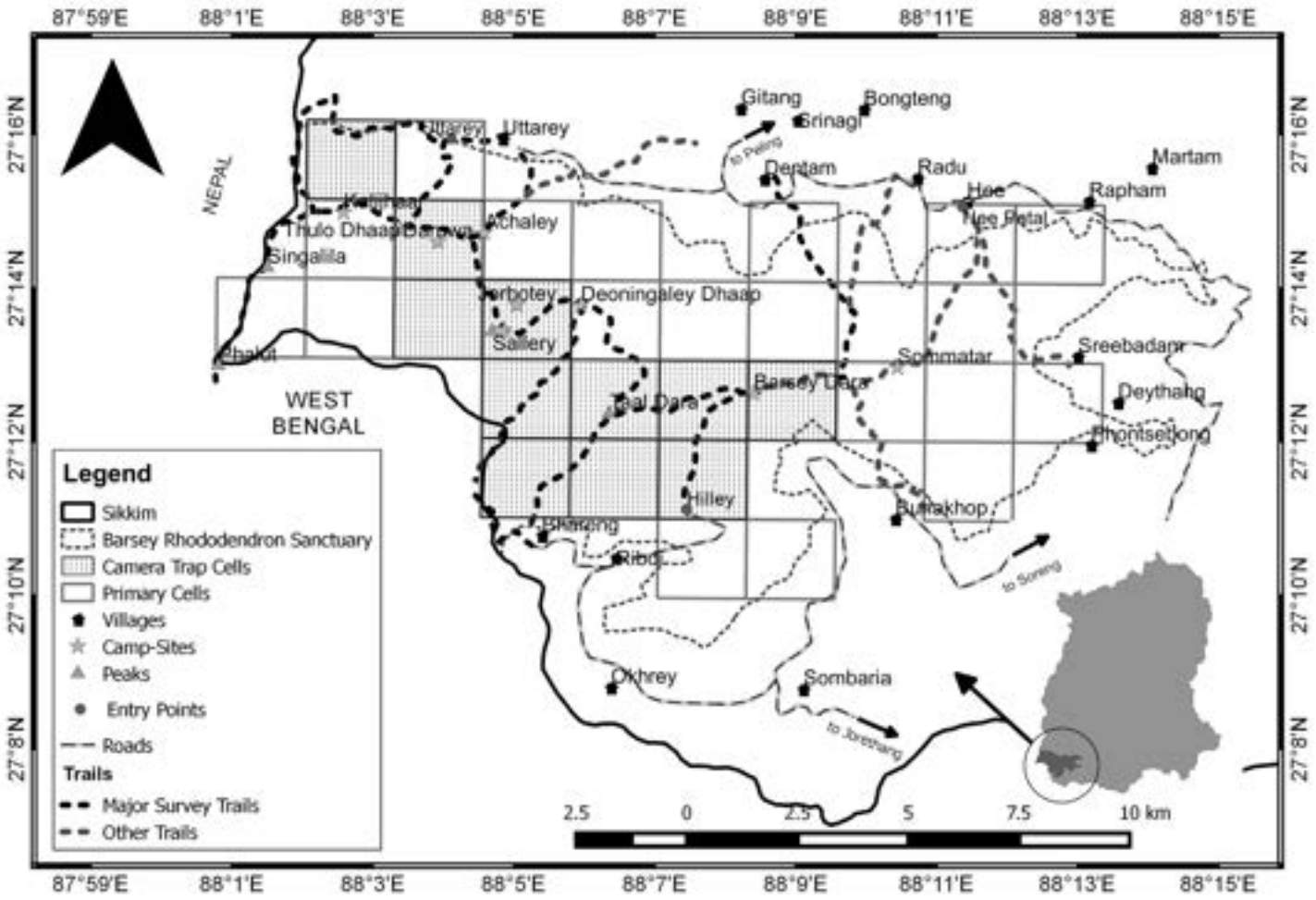


**Fig. 1.** Barsey Rhododendron Sanctuary, Sikkim, India, showing the camera-trap survey cells and survey routes for 2011–2014.

and June 2010 along major transects (Fig. 1) sought to confirm these reports of Red Panda and other wildlife by direct sightings, carcases, footprints and faeces. Transects across the Sanctuary's major altitudinal levels and habitat types used animal and human trails and cattle migratory routes, given the difficulties of establishing straight paths across mountainous terrain (see Pradhan *et al*. 2001).

Intensive trail monitoring of 31 altitudinal transects covered 206 km from July 2010 to February 2012 for Red Panda evidence, in line with Pradhan *et al*. (2001). Mean (± SD) length of transects was 3.32 ± 0.32 km (range 2–5 km). Red Panda faeces were distinguished from those of other species by their morphology and proximity to healthy ringal bamboo patches (bamboo being the species's principal diet). Faecal groups of zoo individuals were examined during the onset of the survey to reduce the possibility of misidentification in the field.

A week's experiment from December 2010 used five camera-traps. In February 2011 four heat-and-motion sensitive Cuddeback Capture camera-traps were deployed, shifted to new stations every 4–6 weeks. Camera-trapping was interrupted temporarily during the monsoon and post-monsoon season of July 2011 – January 2012, then reinitiated from February 2012 to March 2013 with four Cuddeback Capture, a Bushnell passive infrared and four heat-and-motion sensitive Cuddeback Attack camera-traps. Three camera-traps were withdrawn from the field after one was stolen during monsoon 2012. An additional cycle from 21 January to 19 March 2014 used four Cuddeback Attack camera-traps. The landscape was divided into a grid of fifty-six 2 × 2 km cells. Of these, 31 (primary) cells lay at least half within the Sanctuary (Fig. 1). Eleven of these 31 cells, covering Barsey RS's major habitat zones, were selected for intensive camera-trapping using the RANDBETWEEN function in Microsoft Excel 2007 (Fig. 1). Camera-traps were set along existing animal and human trails and near water sources, particularly in areas with much Red Panda evidence. Camera-traps (one per station) were mounted on sturdy supports (mainly trees and large shrubs) 35–50 cm above the ground with a focal range of 3.5 m. During each cycle camera-trap stations were at least 500 m apart. Camera-traps were operational throughout the 24-hour cycle. Baits of rotten beef, honey and salt during the experimental period seemed ineffective so were not used during the main camera-trapping. Altitudes were recorded by a Garmin GPS 72 and checked using Digital Elevation Model on QGIS (version 2.2) platform. They are given as read, despite the spurious impression of precision to within 1 m.

Any photograph of a species taken after a gap of half-an-hour or more from the previous one of that species at the same camera-trap station was considered a notionally independent record.

## Results

A total of 2,492 camera-trap-nights over 2,490 to 3,190 m asl gave 3,258 photographs, 1,144 of vertebrates. Among these,

**Table 2.** Small carnivores camera-trapped in Barsey Rhododendron Sanctuary, Sikkim, India, 2011–2014.

| Species | N° notionally independent records (total photographs) | N° camera-trap stations | Altitude range(m) |
|---|---|---|---|
| Red Panda | 7 (7) | 5 | 2,740–3,101 |
| Yellow-throated Marten | 15 (30) | 10 | 2,569–3,142 |
| Siberian Weasel | 2 (2) | 2 | 2,903–2,930 |
| Spotted Linsang | 3 (3) | 2 | 2,569–3,014 |

Scientific names in Table 1.

**Fig. 2.** Camera-trap photographs from Barsey Rhododendron Sanctuary, Sikkim, India, of (a) Red Panda *Ailurus fulgens* (at Cowrikharka, 16 April 2011), (b) Yellow-throated Marten *Martes flavigula* (near Bhareng Camp, 22 March 2011), (c) Spotted Linsang *Prionodon pardicolor* (at Sallery Ridge, 19 April 2012) and (d) Siberian Weasel *Mustela sibirica* (at Sunatar, 13 March 2011).

1,073 belonged to wild mammals (18 species), 35 to birds (15 species) 15 to domestic yaks and feral dogs, and 21 to people (tourists and villagers). About half (589) of the total wild animal photographs were notionally independent records. Four small carnivores, Red Panda, Yellow-throated Marten *Martes flavigula*, Spotted Linsang *Prionodon pardicolor* and Siberian Weasel *Mustela sibirica*, were camera-trapped (Table 2, Fig. 2).

Seven camera-trap records of Red Panda came from five stations. The three direct sightings comprised solitary individuals at Bantey Cowk (13 April 2011, 14h10; 21 January 2014, 14h58; 2,946 m) and a duo at Achaley (23 January 2014, 14h42; also 2,946 m). The duo was probably a courting pair; when the observers approached, the animals separated and occupied two branches of a maple *Acer* tree. Red Panda camera-trap records came by day (07h36, 11h38, 12h59, 14h22) and night (02h16, 03h12, 04h34). Red Panda faecal pellet groups were found at 94 (61%) random plots during trail monitoring between 2,502 and 3,353 m asl.

Yellow-throated Marten was the most commonly camera-trapped small carnivore. Community consultations suggested that it is also among the main animals in human-wildlife conflict in villages around Barsey RS. It was widely stated to cause serious damage to poultry in the fringe villages. Siberian Weasel was camera-trapped twice and sighted once: a single on 23 April 2010 at 13h30 along the Hiley–Barsey forest trail (27°12.495′N, 88°07.750′E; 2,837 m), amid *Lithocarpus pachyphylla* forests with dense bamboo undergrowth. The animal fled into dense undergrowth on approach. The three Spotted Linsang records from two camera-stations, the first photographic records from Sikkim, were detailed in Ghose *et al*. (2012).

## Discussion

Red Panda records at c. 61% of faecal survey plots indicate a wide distribution in the sanctuary. However, it was only the second most frequently camera-trapped species. The most commonly camera-trapped species, Yellow-throated Marten, was also encountered frequently in Khanchendzonga NP, Kyongnosla AS and Namdapha NP (Datta *et al*. 2008, Sathyakumar *et al*. 2011, Khatiwara & Srivastava 2014). Sunar *et al*. (2012) reported involvement of Yellow-throated Marten in poultry snatching from Senchal Wildlife Sanctuary in Darjeeling district too. Siberian Weasel seems to be common in temperate and alpine Sikkim (pers. obs.). It was camera-trapped only twice in Barsey RS, paralleling low camera-trap rates in several other Asian weasels (Duckworth *et al*. 2006, Abramov *et al*. 2008, Supparatvikorn *et al*. 2012, Ross *et al*. 2013).

Camera-trapping at Barsey RS recorded four of the 18 small carnivores confirmed from the state of Sikkim. This is at the low end of recorded small carnivore species richness in North-east India. In Khangchendzonga NP and Khangchendzonga BR, Sathyakumar *et al*. (2011) found seven species in 6,278 camera-trap-nights. In Kyongnosla Alpine Sanctuary, Khatiwara & Srivastava (2014) found six, in 2,398 camera-trap-nights. Datta *et al*. (2008) found four and six species in Pakke Tiger Reserve and Namdapha NP (231 and 1,537 camera-trap-nights respectively). It is likely that more than four species of small carnivore inhabit Barsey RS. An increase in camera-trap effort, in particular the use of a diverse selection of camera-trap station microhabitats, might record other small carnivore species. However, it is likely that some of the state's small carnivores do not range as high as Barsey RS's lowest altitude (2,200 m).

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# A Yellow-throated Marten *Martes flavigula* carrying a Small Indian Civet *Viverricula indica*

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## Abstract

Yellow-throated Marten *Martes flavigula* has a wide geographic distribution, but little is known about its ecology and behaviour. A camera-trap survey in and around Chitwan National Park, Nepal, photographed a solitary Marten carrying a Small Indian Civet *Viverricula indica*. The animal was in a grassland patch amid Sal *Shorea robusta* forest. It is unclear whether the Marten killed the Civet. Recent camera-trap surveys suggest that Yellow-throated Marten is widespread in Chitwan NP with records from altitudes of 190–675 m; many records are from Sal forest.

*Keywords*: camera-trap, Chitwan National Park, behaviour, distribution, intra-guild carnivore predation, locality records, Nepal, Sal forest

**मलसाप्रोले सानो निरबिरालो आहाराको रुपमा ल्याईरहेको**

भौगोलिक वितरणक्षेत्र ठूलो भएतापनि मलसाप्रोको आनिबानीको बारेमा थोरैमात्र जानाकारी रहेको छ। यसवर्ष (२०७० सालमा) क्यामरा ट्रयापिङ प्रविधिको प्रयोग गरी गरिएको सर्वेक्षणको क्रममा सालवनले घेरिएको घाँसे मैदान क्षेत्रमा मलसाप्रोले एक्लै एउटा वयश्क निरबिरालो ल्याईरहेको फोटो खिचेको थियो। फोटोको आधारमा मात्र उक्त मलसाप्रोले निरबिरालो मारेको हो कि होईन एकिन गर्न सकिएन। यसैगरी पछिल्ला केही वर्षमा गरिएका क्यामेरा ट्रयापिङ सर्वेक्षणको क्रममा चितवनको धेरैजसो क्षेत्रमा मलसाप्रोले विचरण गर्ने गरेको र १९० देखि ६७५ मिटर सम्मको उचाईमा पाईएको थियो। मलसाप्रोको फोटो खिचिएका धेरैजसो ठाँउ सालवन क्षेत्रमा पर्दछन्।

## Introduction

Yellow-throated Marten *Martes. flavigula* is widely distributed in tropical, subtropical and temperate eastern Asia (Corbet 1978, Corbet & Hill 1992). In Nepal it is reported widely across the Terai (Jnawali *et al.* 2011), with records up to 4,510 m asl (Appel *et al.* 2014). It is regularly reported in Chitwan National Park (e.g. Suwal & Verheugt 1995, DNPWC 2012). Overall, rather little is known about its ecology and behaviour, particularly in its tropical range. It eats a wide variety of food (e.g. Pocock 1941, Nandini & Karthik 2007, Parr & Duckworth 2007, Zhou *et al*. 2008, 2011). This note documents a Yellow-throated Marten carrying a Small Indian Civet *Viverricula indica* in front of a camera-trap set for monitoring large carnivores and their prey (NTNC 2014). It also synthesises Yellow-throated Marten records from multiple seasons of camera-trapping in Chitwan National Park.

## Study area

Chitwan National Park (Chitwan NP; 932 km$^2$) was Nepal's first national park, established in 1973. It lies in the country's south-central lowlands, in the inner Terai (27°16.6'–42.1'N, 83°50.2'–84°46.3'E) and is surrounded by a 750 km$^2$ buffer zone declared in 1996, managed by the local communities according to 'Buffer Zone Management Guidelines 1996' (DNPWC 2012). The park has 80% forest (Sal *Shorea robusta*, riverine and mixed hardwood), 12% grassland, 5% exposed surface and 3% water bodies (Thapa 2011). Chitwan NP is an important part of the Terai Arc, within the Chitwan Annapurna Landscape which is connected through biological corridors such as Barandabhar Corridor Forest.

The 109.69 km$^2$ Barandabhar Corridor Forest links Chitwan NP to hill forest contiguous with the mountainous Annapurna Conservation Area. It extends from the Rapti river in the south, the border with Chitwan NP; Bachhauli, Jutpani and Padampur Village Development Committee (VDCs) and Ratnanagar municipality in the east; Patihani, Gitanagar VDCs and Bharatpur municipality to the west; and Mahabharat range to the north. The corridor is dominated by Sal forest (71.6%) followed by shrubland (13.1%), grassland (8%), water bodies (2.1%) and other (6.2%) (WWF Nepal 2013). The Bishazar lake complex, a Ramsar site, falls within this corridor (Ramsar 2014). Regular records of Tiger, Leopard, Greater One-horned Rhinoceros *Rhinoceros unicornis*, Gaur *Bos gaurus* and many other wildlife suggest the functionality of the corridor (MOFSC 2011).

## Methods

As part of monitoring of Tiger *Panthera tigris*, Leopard *P. pardus* and their potential prey, camera-trapping in Barandabhar Corridor Forest during January–February 2014 used a grid of 1 × 1 km. A pair of camera-traps was installed at one station

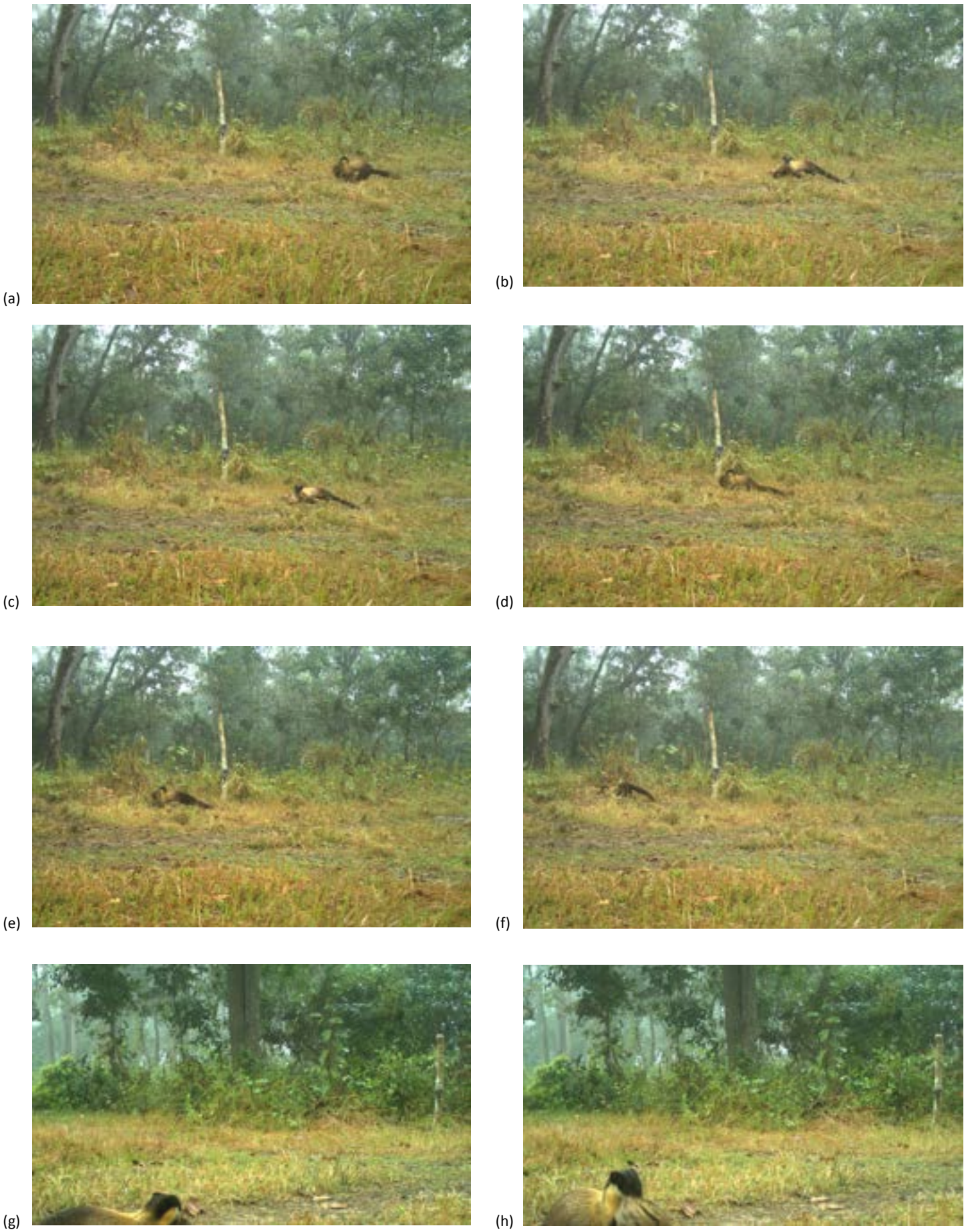

**Fig. 1.** The series of camera-trap images of a Yellow-throated Marten *Martes flavigula* carrying a Small Indian Civet *Viverricula indica*, Chitwan National Park, Nepal, 2 February 2014.

in each cell for 15 consecutive nights. In total, 88 camera-trap stations were surveyed in two blocks: 1) south of the Khageri canal and 2) north of the Khageri. Camera-traps were installed after intensive sign survey to select the optimal stations. The latitude, longitude and altitude of each station were recorded by handheld GPS (Garmin eTrex 20) under the WGS 1984 datum. Two types of camera-traps (Reconyx 550 and Reconyx 450) were used, with no picture delay option. Camera-traps were set 45 cm above ground with the two cameras of a pair 6–10 m apart. Camera-traps were operated day and night without bait or lure. Distribution records of Yellow-throated Marten in Chitwan NP were also obtained from Tiger-focussed camera-trapping surveys in 2013 (DNPWC & DOF 2013) and 2010 (Karki 2012). The 2010 and 2013 surveys covered the whole park with a total of 310 and 362 camera-trap stations respectively, with one station per cell in a 2 × 2 km grid. Detailed methodology can be found in Karki (2012) and in DNPWC & DOF (2013).

## A Yellow-throated Marten carrying a carnivore

At 27°35′21.0″N, 84°27′50.1″E (recorded elevation: 195 m asl) a series of images taken on 2 February 2014 at 08h57–08h58 showed a Yellow-throated Marten carrying a carnivore (Fig. 1). The station lay in a grassland patch surrounded by Sal forest, about 200 m from the nearest stream and 600 m from the nearest settlement. Eight photographs from the paired camera-traps (six from one and two from other) were obtained. The Marten was moving (thus most images are blurred) and carrying an animal. Clear photographs of the presumed prey animal show the forequarters (Figs 1c, 1h) and tail (Fig. 1f) clearly enough to allow confident identification as a Small Indian Civet *Viverricula indica* of adult size. The photographs do not reveal whether the Marten killed the Civet, whether the Civet was already dead, or whether the Marten ate the Civet. Small Indian Civet uses various habitats, is active on the ground, and is mostly nocturnal (Prater 1971). It occurs widely through Chitwan NP including its buffer zone and the Barandabhar Corridor Forest (Karki 2011, Mishra 2013).

Yellow-throated Marten and Small Indian Civet are similar in body size (Prater 1971). Pocock (1941) mentioned reports that Yellow-throated Marten kills domestic cats in the Kumaun hills of India. There seems to be no record of Yellow-throated Marten killing or eating other species of Carnivora, although the killing of carnivores by other species of carnivores is more common than is popularly supposed (e.g. Palomares & Caro 1999, Donadio & Buskirk 2006). Yellow-throated Marten does, however, apparently regularly chase and take ungulates, including those larger than itself (e.g. Heptner *et al*. 1967, Sathyakumar 1999).

## Distribution of Yellow throated Marten in Chitwan National Park

In 2014, 1,412 camera-trap-nights spread across 88 camera-trap stations found Yellow-throated Marten only once. Overall, Marten was recorded at only 10 camera-trap stations in Chitwan NP (including buffer and corridor) from the three different camera-trapping years: 2010 (four stations), 2013 (five) and 2014 (one); only one station recorded the species more than once (Table 1, Fig. 2). Marten sightings are very frequent in Chitwan NP (Bishnu Lama, senior wildlife technician, National Trust for Nature Conservation, verbally 2014), so this camera-trap encounter rate seems low. Selecting stations for the survey target species may have biased against the detection of Marten.

Six of the ten stations recording Marten were in Sal forest, two were in dry stream beds amid Sal forest, one in grassland at the edge of Sal forest and one in mixed hardwood forest. Yet out of totals of 310 and 362 camera-trap stations in 2010 and 2013 respectively, only 34% and 38% were in Sal forest. This suggests a preference for Sal forest by Martens in Chitwan NP. Marten records ranged in altitude from 194 to 674 m. Of the ten stations, one (CNP012, in 2013) was outside the buffer zone and two were within it (Bagai 05 in 2010; CT26 in 2014), all in spots with high human disturbance. The remaining seven were inside the core area of the park with comparatively lower disturbance.

**Table 1.** Yellow-throated Marten *Martes flavigula* camera-trap locality records in Chitwan National Park, Nepal, 2010–2014.

| Date | Station | Latitude N | Longitude E | Altitude (m) | Habitat type | Distance to settlement (km) |
|---|---|---|---|---|---|---|
| 21 Feb 2010 | Amua 07 | 27°27′25.6″ | 84°34′12.6″ | 675 | Sal forest | 10.06 |
| 25 Feb 2010 | Bagai 05 | 27°25′05.6″ | 84°28′55.9″ | 325 | Mixed hardwood forest | 7.62 |
| 19 Feb 2010 | Bagai 08 | 27°28′01.6″ | 84°30′36.0″ | 640 | Sal forest | 2.02 |
| 14 Mar 2010 | Bandela 04 | 27°30′37.3″ | 84°38′39.3″ | 315 | Sal forest | 6.87 |
| 18 Feb 2013 & 3 Mar 2013 | CNP269 | 27°30′40.8″ | 84°34′04.7″ | 320 | Streambed | 5.67 |
| 1 Apr 2013 | CNP306 | 27°23′03.5″ | 84°37′29.1″ | 325 | Streambed | 2.24 |
| 24 Apr 2013 | CNP012 | 27°35′45.6″ | 83°55′36.4″ | 190 | Sal forest | 2.27 |
| 2 Mar 2013 | CNP044 | 27°31′55.2″ | 84°01′43.0″ | 225 | Sal forest | 3.06 |
| 18 Feb 2013 | CNP282 | 27°27′01.9″ | 84°35′11.7″ | 635 | Sal forest | 8.58 |
| 28 Apr 2014 | CT26 | 27°35′21.0″ | 84°27′50.1″ | 195 | Sal forest/ grassland | 0.60 |

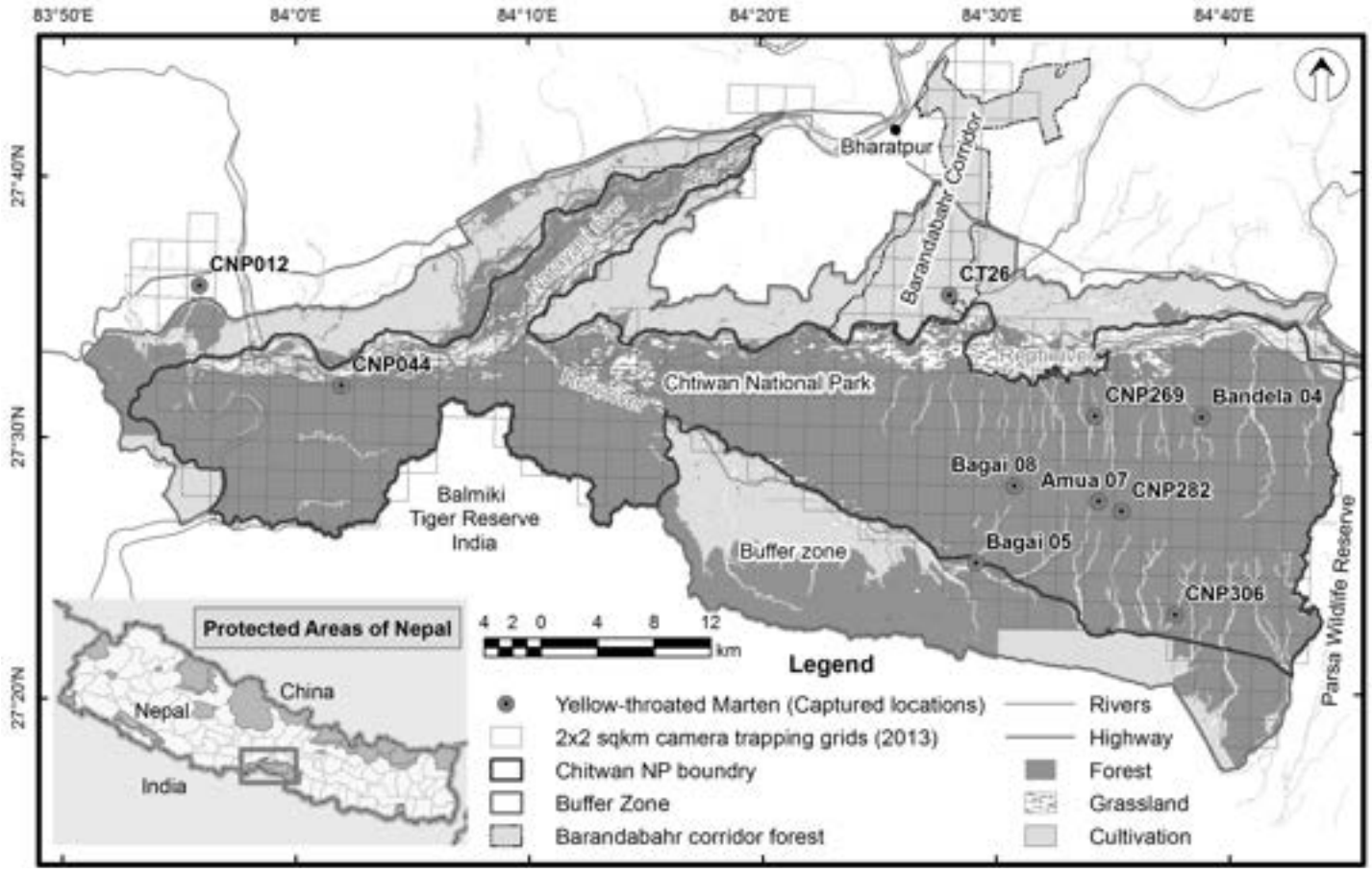


**Fig. 2.** Camera-trap localities recording Yellow-throated Marten *Martes flavigula* in Chitwan National Park, Nepal, in 2010, 2013 and 2014. Habitat-types are shown for Chitwan National Park, its buffer zone area and the Barandabhar Corridor Forest only.

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# Recent records of Stripe-necked Mongoose *Herpestes vitticollis* and Asian Small-clawed Otter *Aonyx cinereus* from the north Western Ghats, India

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## Abstract

Stripe-necked Mongoose *Herpestes vitticollis* is known only from the Western Ghats of southern India and Sri Lanka, while Asian Small-clawed Otter *Aonyx cinereus* is widespread in tropical Asia. Recent records (2008–2014; direct sightings, camera-traps and [otter only] signs) of both come from the north-central Western Ghats in the states of Maharashtra and Goa, where these species were hitherto poorly documented. Stripe-necked Mongoose observations were restricted to relatively higher elevations (560–1,300 m asl), while Small-clawed Otter was observed from 40 m to 820 m asl. In this area, Stripe-necked Mongoose does not seem at present to be at risk, but Small-clawed Otter appears threatened by dams.

*Keywords*: camera-trap, clarification of known range, damming, direct observations, Goa, Maharashtra, small carnivore, spraint

**उत्तर पश्चिम घाटात नुकताच घडलेला नोंदी: मानेवर पट्टा असलेला मुंगूस *Herpestes vitticollis* आणि लहान नख्याच्या पाणमांजर *Aonyx cinereus***

**सारांश**

मानेवर पट्टा असलेला मुंगूस *Herpestes vitticollis* भारतीय पश्चिम घाटाच्या दक्षिण भागात आणि श्रीलंके मध्ये सापडते. लहान नख्याच्या पाणमांजर *Aonyx cinereus* आशिया खंडाचा उष्णकटिबंधीय भागामध्ये सापडते. आम्ही इथे या प्राण्यांचा नोंदीचे (२००८- २०१४, खूणा, प्रत्यक्ष दर्शन, कॅमेरा- ट्राप) वर्णन केले आहे. या सर्व नोंदी महाराष्ट्र आणि गोवा राज्यांसाठी प्रथमच नोंदवल्या जात आहे. आम्हाला मानेवर पट्टा असलेला मुंगूस समुद्रसपाटीपासून ५६० मी. ते १२९६ मी. उंची वर आढळला, आणि लहान नख्याच्या पाणमांजर समुद्रसपाटीपासून ४३ मी. ते ८२१ मी. उंची वर आढळला. मानेवर पट्टा असलेला मुंगूसाचा अस्तित्वाला धोका आता पर्यंत आढळलेला नाही, परंतु धरण बांधकाम लहान नख्याच्या पाणमांजराचे अधिवासासाठी धोकादायक ठरू शकते.

## Introduction

Stripe-necked Mongoose *Herpestes vitticollis* has generally been believed to be restricted to India (Western Ghats and neighbouring regions) and Sri Lanka (Van Rompaey & Jayakumar 2003). Recent records extend its known range considerably north-eastwards in India (Nayak *et al*. 2014). It is a large diurnal mongoose, easily distinguished by a characteristic stripe along the neck (in aberrant animals this may be hard to see; Mudappa & Ganesh 2014). It is taller than all sympatric mongooses: Indian Grey *H. edwardsii*, Ruddy *H. smithii* and Brown Mongooses *H. fuscus*. Asian Small-clawed Otter *Aonyx cinereus* is the world's smallest otter species, occurring in riparian habitats such as hill streams and rivers, swamps, tidal pools and sometimes in mangroves and, in some areas, rice paddies and urban storm drains (Meijaard 2014). Small-clawed Otter populations in the Western Ghats have been assumed to be completely isolated from other parts of the species's range. The species's wide distribution otherwise extends from India along parts of the Himalayan foothills, through most of northeast India and south China to Southeast Asia (Prater 1971, Corbett & Hill 1992). Its recent discovery in Odisha (formerly, Orissa) (Mohapatra *et al*. 2014), in the large gap in previously known occurrence between northeast India and southern India, questions whether the Western Ghats population is in fact disjunct.

Both Stripe-necked Mongoose and Small-clawed Otter persist in fragmented forest landscapes of the Western Ghats (Van Rompaey & Jayakumar 2003, Prakash *et al.* 2012). However, given a suite of threats from conversion of streams for aquaculture and dams, river sand-mining and hunting (Kumara & Singh 2002, Meena 2002), Small-clawed Otter is listed as Vulnerable in *The IUCN Red list of Threatened Species* (IUCN 2014). Mongooses are illegally hunted for meat and hair, the latter used in paint and shaving brushes (Hanfee & Ahmed 1999). But Stripe-necked Mongoose does not appear severely threatened and is listed as Least Concern in the *IUCN Red List* (IUCN 2014).

Both species occur commonly in the southern Western Ghats (Prater 1971, Van Rompaey & Jayakumar 2003, Pillay 2009, Perinchery *et al*. 2011, Prakash *et al*. 2012), but few specific records exist from the north-central Western Ghats, reflecting a lack of mammal surveys. The following recent records of these two species from the north-central Western Ghats in the states of Maharashtra (districts of Kolhapur and Sindhudurg) and Goa (North and South Goa districts) thus clarify their current status in this little-surveyed area.

## Methods

Recent opportunistic direct sighting (with photographs) and camera-trap records (from 2008–2014) of Stripe-necked Mongoose and Asian Small-clawed Otter were compiled from different parts of the north-central Western Ghats in Maharashtra and Goa, together with sign records of the otter. The location (WGS 84 datum) and elevation in most cases were recorded using a hand-held Garmin GPS unit, but in a few cases were calculated approximately using Google Earth. Elevations are presented as recorded, despite the misleading implication of precision to the nearest meter.

Small-clawed Otter signs were identified based on descriptions in Prater (1971) and Hussain *et al.* (2011), specifically an abundance of macerated freshwater crab shells over rocks or sand bars along hills streams (see Larivière 2003). Generally, these were associated with footprints, identified as those of Small-clawed Otter by the small size (length about 6 cm, width 4.5–5 cm), absence of claw marks projecting beyond toe pads (Prater 1971), and relatively long middle digit (Larivière 2003). The presence of Small-clawed Otter was corroborated by observations of local people wherever possible. The other two otters of the region, Smooth-coated Otter *Lutrogale perspicillata* and Eurasian Otter *Lutra lutra*, are markedly larger with foot-prints dissimilar to those of Small-clawed Otter.

## Results

The recent records from Maharashtra and Goa are shown, with the historical records of Stripe-necked Mongoose from the north-central Western Ghats and the known south-west Indian range of Asian Small-clawed Otter, in Fig. 1. Stripe-necked Mongoose was recorded 13 times over 2008 to 2014 (Table 1, Figs 2–4). All photographs were taken by day. Records came from 560 m to 1,300 m asl. Asian Small-clawed Otter was recorded 13 times over 2013 to 2014, ten times by signs and thrice by photograph of the animals (Table 2, Fig. 5–8). One camera-trap photograph (16 May 2014; Fig. 7) does not show the complete animal, but the animal's size, overall build, visibly short fur, short ears positioned to the side of the head, and small stout legs allow provisional identification as an otter. Identity as this species was corroborated by spraint along the river next to the camera-trap station. Small-clawed Otter records occurred over 40 m to 820 m asl.

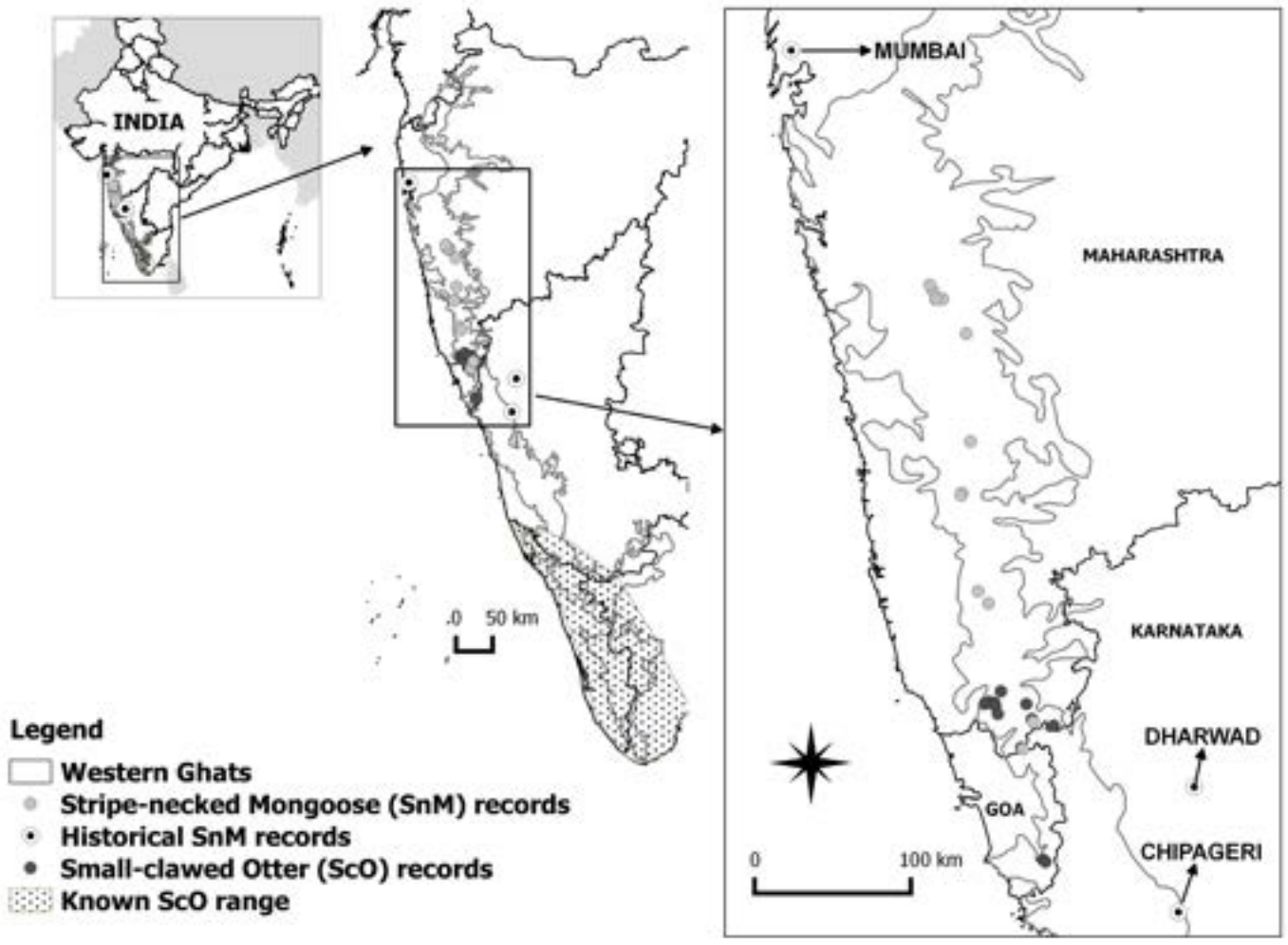


**Fig. 1.** Recent locality records of Stripe-necked Mongoose *Herpestes vitticollis* and Asian Small-clawed Otter *Aonyx cinereus* from Maharashtra and Goa, India, with historical records of the mongoose from the north-central Western Ghats (the Mumbai locality is questionable: see text) and the south-west Indian range of Asian Small-clawed Otter as given by Hussain *et al*. (2011).

**Fig. 2.** Stripe-necked Mongoose *Herpestes vitticollis* photographed by hand-held camera, Amba, Maharashtra, India, on 7 May 2012 (Photo: Dhananjay Joshi, Faruk Mhetar and Raman Kulkarni).

**Fig. 5.** Asian Small-clawed Otter *Aonyx cinereus* habitat in the village of Gharpi, Sawantwadi Tehsil, north Western Ghats, Maharashtra, India, 11 November 2013.

**Fig. 3.** Two Stripe-necked Mongooses *Herpestes vitticollis* photographed by hand-held camera, Chorla Ghats, Goa, India, on 10 Feb 2013 (Photo: Atul Sinai Borker).

**Fig. 6.** Camera-trap image of two Asian Small-clawed Otters *Aonyx cinereus* from Netorli, Goa, India, on 27 March 2014 (Photo: Atul Sinai Borker).

**Fig. 4.** Stripe-necked Mongoose *Herpestes vitticollis* camera-trapped on 25 May 2014 at Navli, Mahabaleshwar, Maharashtra, India (Photo: M. K. Rao, Maharashtra Forest Department).

**Fig. 7.** Camera-trap image provisionally identified as Asian Small-clawed Otter *Aonyx cinereus*, Umgaon, Maharashtra, India, 16 May 2014 (Photo: M. K. Rao, Maharashtra Forest Department).

**Fig. 8.** Asian Small-clawed Otter *Aonyx cinereus* photographed by hand-held camera on 17 July 2014 near Amboli, Maharashtra, India (Photo: Shubham Alave and Nikhil Gaitonde).

## Discussion

There appear to be gaps in the known distribution of both Stripe-necked Mongoose and Small-clawed Otter in the Western Ghats. There are only a few previous records of Stripe-necked Mongoose from the north-central Western Ghats: Dharwad (then, Dharwar; roughly 15°30′N, 75°04′E; Van Rompaey & Jayakumar 2003) was given as the northern limit by Jerdon (1874) but without any specific record; Blanford (1888) mentioned a Stripe-necked Mongoose near Mumbai (then known as Bombay); and a young male was collected by A. G. Edie in 1908 at Chipageri (then, Chipgeri), North Kanara in the central Western Ghats (roughly 14°49′N, 74°55′E; Pocock 1937). The provenance of the Mumbai record is open to doubt; Pocock (1941: 49) wrote that "it was probably shipped from Bombay, but killed further south on the western side of India". All our records lie between these two historical localities (the northernmost, while approximately 130 km southeast of Mumbai, is 420 km north of the northernmost confirmed locality, Chipageri). There seem to be no previous records of

**Table 1.** Records of Stripe-necked Mongoose *Herpestes vitticollis* from the north-central Western Ghats, India, 2008–2014.

| Date | Coordinates; elevation / m | Locality | Source[1] |
|---|---|---|---|
| 2 June 2008 | 16.439514°N, 73.881619°E; 887 | Dajipur | DJ |
| 24 Apr 2009 | 17.185525°N, 73.842147°E; 943 | Chandoli | DJ |
| 4 Oct 2011 | 17.72315°N, 73.819847°E; 1,211 | Kaas | FM |
| 7 May 2012 | 16.928822°N, 73.797600°E; 825 | Amba | FM, DJ, RK |
| 19 May 2012 | 16.917897°N, 73.792800°E; 844 | Amba | FM, DJ |
| 10 Feb 2013 | 15.650225°N, 74.115207°E; 560 | Chorla ghats | ASB* |
| 4 May 2014 | 15.786200°N, 74.169469°E; 760 | Kodali | MKR, MFD* |
| 19 May 2014 | 17.933333°N, 73.647881°E; 1,250 | Lodwick, Mahabaleshwar | MKR, MFD* |
| 17 May 2014 | 17.892956°N, 73.660881°E; 1,278 | Mangar, Mahabaleshwar | MKR, MFD* |
| 25 May 2014 | 17.894011°N, 73.698647°E; 1,296 | Navli, Mahabaleshwar | MKR, MFD* |
| 26 May 2014 | 17.894156°N, 73.661903°E; 1,272 | Mangar, Mahabaleshwar | MKR, MFD* |
| 9 June 2014 | 16.378436°N, 73.935917°E; 969 | Radhanagri | FM, DJ |
| 19 May 2014 | 17.963094°N, 73.629592°E; 1,282 | Elphinstone, Mahabaleshwar | MKR, MFD* |

[1]MFD = Maharashtra Forest Department. Other abbreviations are those of the authors.
*Camera-trap record. The other records were of one or more animals sighted directly and photographed manually.

**Table 2.** Records of Asian Small-clawed Otter *Aonyx cinereus* from the north-central Western Ghats, India, from 2013 to 2014.

| Date | Coordinates; elevation / m | Locality | Record[1] | Source[2] |
|---|---|---|---|---|
| 1 Feb 2013 | 15.881105°N, 73.96683°E; 231 | Gharpi-Udeli | S, T | GAP |
| 6 Mar 2013 | 15.656302°N, 74.107016°E; 204 | Virdi | S, T | GAP |
| 24 May 2013 | 15.094177°N, 74.220177°E; 66 | Netorli | S, DA | ASB |
| 10 Nov 2013 | 15.88556°N, 73.93953°E; 67 | Dabhil | S, T | GAP |
| 10 Nov 2013 | 15.885419°N, 73.937543°E; 63 | Dabhil | S | GAP |
| 10 Nov 2013 | 15.87516°N, 73.916916°E; 43 | Nevli | S | GAP |
| 11 Nov 2013 | 15.866379°N, 73.970253°E; 364 | Gharpi | S | GAP |
| 12 Nov 2013 | 15.825259°N, 73.98448°E; 268 | Talkat-Bhekurli | S | GAP |
| 11 Dec 2013 | 15.799824°N, 74.162219°E; 236 | Kodali | S | GAP |
| 13 Dec 2013 | 15.766365°N, 74.276077°E; 740 | Mhalunge | S | GAP |
| 27 Mar 2014 | 15.083319°N, 74.233037°E; 78 | Netorli | CT, S | ASB |
| 16 May 2014 | 15.875311°N, 74.132939°E; 728 | Umgaon | CT, S | MKR & MFD |
| 17 July 2014 | 15.938573°N, 74.000231°E; 821 | Amboli | P | SA & NG |

[1]P = photograph, one or more animals sighted directly and photographed manually; CT = camera-trap; S = spraint; T= tracks; DA = defecating area.
[2]MFD = Maharashtra Forest Department; NG = Nikhil Gaitonde. Other abbreviations are those of the authors.

Small-clawed Otter from the north Western Ghats, making these new records the northernmost from the Western Ghats.

Small-clawed Otter was recorded at elevations from 43 m to 821 m asl. Thus, in this area, it might not show a preference for higher elevations (*contra* Perinchery *et al.* [2011], who proposed high-altitude areas with stream pools as potentially prime habitat in the southern Western Ghats). In contrast, Stripe-necked Mongoose observations were all at 560 m to 1,296 m asl, fitting Van Rompaey & Jayakumar's (2003) statement that the species is more common between 400 m and 1,400 m asl in the Western Ghats.

Both species might be threatened by loss of habitat, but threats seem more severe for Small-clawed Otter, which depends on linear watercourses. Prakash *et al.* (2012) identified the number of refuges available (boulders, large fallen logs and burrows) as the most significant factor influencing stream-use by Small-clawed Otter across different land cover types in Valparai, Tamil Nadu. Small-clawed Otter appears to be threatened by near-ubiquitous 'development' activities, especially damming (mini-hydroelectricity projects, medium and large irrigation projects) which destroys habitat such as shallow rivers with reeds, rocks and debris where crabs are found (Kruuk *et al*. 1994). Habitat is also destroyed or disturbed in human-dominated landscapes by sand-mining, blast-fishing, and clearance of debris and woody vegetation (Prakash *et al.* 2012). The impact of poaching on local otter population decline has been noted in the Palni hills (Meena 2012). Stripe-necked Mongoose is hunted for hair which is used in brushes (Hanfee & Ahmed 1999), but there does not seem to be targeted hunting of this mongoose in these areas of the Western Ghats.

Future studies in this area should examine factors allowing persistence of these species in different human-modified land-uses, as well as the impact of damming on distribution and occurrence of Small-clawed Otters.

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# Records of small carnivores from Bukit Barisan Selatan National Park, southern Sumatra, Indonesia

Jennifer L. MCCARTHY[1] and Todd K. FULLER[2]

## Abstract

Sumatra is home to numerous small carnivore species, yet there is little information on their status and ecology. A camera-trapping (1,636 camera-trap-nights) and live-trapping (1,265 trap nights) study of small cats (Felidae) in Bukit Barisan Selatan National Park recorded six small carnivore species: Masked Palm Civet *Paguma larvata*, Banded Civet *Hemigalus derbyanus*, Sumatran Hog Badger *Arctonyx hoevenii*, Yellow-throated Marten *Martes flavigula*, Banded Linsang *Prionodon linsang* and Sunda Stink-badger *Mydaus javanensis*. An unidentified otter (Lutrinae) was also recorded. Even given the relatively low camera-trap effort, photo encounters for several of these species were few, despite their *IUCN Red List* status as Least Concern. This supports the need for current and comprehensive studies to assess the status of these species on Sumatra.

*Keywords*: *Arctonyx hoevenii*, camera-trapping, *Hemigalus derbyanus*, *Martes flavigula*, *Mydaus javanensis*, *Paguma larvata*, *Prionodon linsang*

## Catatan karnivora kecil dari Taman Nasional Bukit Barisan Selatan, Sumatera, Indonesia

## Abstrak

Sumatera merupakan rumah bagi berbagai spesies karnivora berukuran kecil, namun informasi mengenai status dan ekologi spesies-spesies ini masih sedikit. Suatu studi mengenai kucing berukuran kecil (Felidae) menggunakan kamera penjebak dan perangkap hidup di Taman Nasional Bukit Barisan Selatan (1626 hari rekam) mencatat enam spesies karnivora kecil, yaitu: musang galing *Paguma larvata*, musang tekalong *Hemigalus derbyanus*, pulusan *Arctonyx hoevenii*, musang leher kuning *Martes flavigula*, linsang *Prionodon linsang*, dan sigung *Mydaus javanensis*. Tercatat juga satu spesies berang-berang yang tidak teridentifikasi. Walaupun ukuran sampel relatif kecil, perjumpaan dengan beberapa dari spesies-spesies ini hanya sedikit, meskipun status mereka sebagai Least Concern. Ini mendukung perlunya studi saat ini dan studi menyeluruh untuk menilai status spesies-spesies ini di Sumatera.

## Introduction

Sumatra harbours high mammal diversity (Rhee *et al*. 2004, Schipper *et al*. 2008), but deforestation and habitat degradation continue at unprecedented rates, with over 3.1 million hectares of forest (roughly 36% of Sumatra's forested area) lost from 2000 to 2008 (Broich *et al*. 2011). A two-year moratorium on new agriculture and logging concessions by the Indonesian government in 2010 was of disputed efficacy and it appears that high rates of deforestation continue in many areas (Sloan *et al*. 2012).

Sumatra is home to numerous small carnivore species. Schreiber *et al.* (1989) identified the island as a priority area for small carnivore conservation. Yet there have been few studies of small carnivores on Sumatra and little is known of each species's status on the island (Holden 2006). A live-trapping and camera-trapping study of small cats (Felidae) obtained photographs of other small carnivores and trapped some individuals. These data, presented here, contribute to the sparse information on small carnivores on Sumatra.

## Methods

This study was conducted in Bukit Barisan Selatan National Park (NP) in southern Sumatra (Fig. 1). Bukit Barisan Selatan NP is the third largest protected area in Sumatra and is bordered by villages and agricultural fields. Although it contains some of the island's last protected lowland forests, the park has been inundated by illegal logging and agriculture, causing a loss of 28% of its forests between 1985 and 1999 (Kinnaird *et al*. 2003). Since then, encroachment has decreased in some areas, but remains a problem in others. The present study fo-

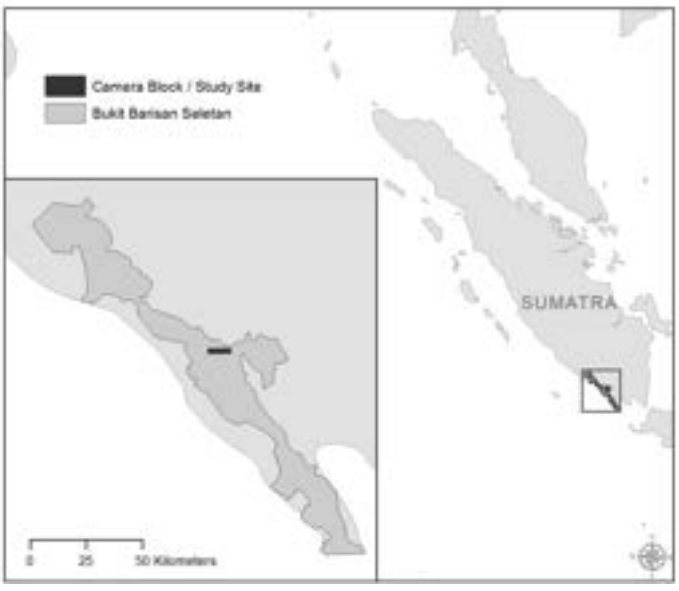


**Fig. 1.** Bukit Barisan Selatan National Park in southern Sumatra, Indonesia.

cused in the east-central region of the park, outside the small village of Talang Lima (5°06′33″S, 104°09′01″E). Despite some encroachment into this area of the park, a sharp ridgeline west of the village limited coffee plantations to lower elevations. A largely untouched primary evergreen forest remains at the top of the ridge (1,089 m). This ridge, down to 800 m, was the location of all the study's camera-trapping and live-trapping. No trapping was conducted outside the park or in non-forested areas. The rough topography consists of sharp, secondary ridges descending perpendicularly from the primary ridgeline. There is no vehicular access into this forest and few trails, although there is some evidence of limited human activity inside the park boundaries.

This study was initiated to assess the ecology and status of small cats within the park. It used both camera-trapping and live-trapping (McCarthy 2013, McCarthy *et al*. 2015). Most of the camera-trapping was conducted from January to September 2011, with a methodology following O'Brien *et al*. (2003). A sampling block was designated and divided into 20 subunits each of 1 km$^2$. Camera-traps (Reconyx HC500) were placed within 100 m of randomly chosen UTM coordinate inside each subunit along a large animal trail, or in an area with sign of recent mammal activity. Four camera-traps had been set opportunistically within the sampling block during 2010 to assess potential live-trapping sites and camera performance. All camera-traps were mounted on tree trunks so that the infrared beam was roughly 25 cm above the forest floor. They were baited with commercial lure (Hawbakers Wild Cat Lures Number One and Two) and chicken meat. Camera-traps were programmed to operate continuously and to take a series of five photographs per triggering event, with a 60 sec delay between sequential triggers. Each photograph of an animal was identified to species. Photographs that did not allow an absolute identification were excluded from the dataset. Unless individual identification was possible, any subsequent photograph of the same species taken within 30 min of the first was not considered a new event.

Live-trapping from November 2008 to February 2009 deployed 23 size 1 and 1½ soft-catch foot hold traps (Oneida Victor) opportunistically within the camera-trapping block. Each trap was fitted with a pan tension device set to high pan tension in an effort to decrease the likelihood of catching small animals such as murids or birds. Traps used the same attractants as the camera-traps and were placed directly on well-travelled game trails and at spots with cat signs. The traps were staked into the ground using cable stakes (Finned Super Stakes) and were concealed with torn leaves. Traps were manually checked twice daily. Captured animals were anaesthetised by a veterinarian, then removed from the trap and given a full physical examination. Morphological information was recorded for all individuals, which were then monitored until fully recovered.

**Fig. 2.** Four small carnivore species camera-trapped in Talang Lima, Bukit Barisan Selatan National Park, southern Sumatra, 2010–2011: (a) Banded Civet *Hemigalus derbyanus*, 8 February 2011; (b) Sumatran Hog Badger *Arctonyx hoevenii*, 16 August 2011; (c) Sunda Stink-badger *Mydaus javanensis*, 6 September 2010; (d) Masked Palm Civet *Paguma larvata*, 9 February 2011.

**Table 1.** Camera-trap photograph rates of small carnivores in Talang Lima, Bukit Barisan Selatan National Park, Sumatra, Indonesia.

| Species | Number of notionally independent photos (N) | Photo rate (N/100 camera-trap-nights) |
|---|---|---|
| Masked Palm Civet *Paguma larvata* | 17 | 1.04 |
| Banded Civet *Hemigalus derbyanus* | 12 | 0.73 |
| Sumatran Hog Badger *Arctonyx hoevenii* | 3 | 0.18 |
| Yellow-throated Marten *Martes flavigula* | 2 | 0.12 |
| Banded Linsang *Prionodon linsang* | 2 | 0.12 |
| Sunda Stink-badger *Mydaus javanensis* | * | * |

*camera-trapped only during the 2010 pilot phase.

## Results and discussion

A total of 1,636 camera-trap-nights during 2011 photographed five small carnivore species (Fig. 2). Encounter rates were highest for Masked Palm Civet *Paguma larvata* and Banded Civet *Hemigalus derbyanus*, but substantially lower for Sumatran Hog Badger *Arctonyx hoevenii*, Yellow-throated Marten *Martes flavigula* and Banded Linsang (Table 1). One additional species, Sunda Stink-badger *Mydaus javanensis*, was camera-trapped only during the 2010 pilot phase. All six species are categorised on *The IUCN Red List of Threatened Species* (IUCN 2014) as Least Concern except Banded Civet (Vulnerable) and Sumatran Hog Badger (Not Recognised). Live-trapping for a total of 1,265 trap nights captured four small carnivore species (Table 2, Fig. 3): three Masked Palm Civets, one Yellow-throated Marten, one Sumatran Hog Badger and one unidentified otter, which escaped before handling. All five handled individuals had several ticks, but were in excellent condition otherwise.

(a)

(b)

(c)

**Fig. 3.** Small carnivore species live-trapped in Talang Lima, Bukit Barisan Selatan National Park, southern Sumatra, Indonesia, November 2008 – February 2009: (a) Sumatran Hog Badger *Arctonyx hoevenii*; (b) Yellow-throated Marten *Martes flavigula*; (c) Masked Palm Civet *Paguma larvata*.

**Table 2.** Small carnivores captured in live-traps in Talang Lima, Bukit Barisan Selatan National Park, Sumatra, Indonesia.

| Species | Sex | Age | Weight (kg) | HB* length (cm) | Tail length (cm) | Paw width (cm) |
|---|---|---|---|---|---|---|
| Masked Palm Civet | Female | Adult | 4.25 | 68 | 56 | 3 |
| Masked Palm Civet | Male | Adult | 5.40 | 80 | 58 | 4 |
| Masked Palm Civet | Male | Subadult | 2.47 | 52 | 43 | - |
| Yellow-throated Marten | Male | Adult | 2.78 | 61 | 41 | 3.5 |
| Sumatran Hog Badger | Male | Adult | 5.42 | 71 | 17 | 5 |
| Otter | - | - | - | - | - | - |

*HB = head-and-body.

Masked Palm Civet, the species encountered most frequently by both camera-trap and live-trap, is thought to be fairly common in central Sumatra (Holden 2006). These high trapping rates suggest that it is fairly common in the Talang Lima study area. However, threats to the species on Sumatra are not well defined. There are no harvest quotas for the species in Indonesia, making trade technically illegal, but it is traded in northern Sumatra, with the exact amount of harvest and trade unknown (Shepherd 2008). The species uses a wide variety of habitats in China (Wang & Fuller 2003), but with no studies of its habitat use on Sumatra, effects of the significant habitat alteration there are unknown.

Banded Civet was camera-trapped relatively frequently. Although none was live-trapped, it was photographed throughout the Talang Lima study area and seemed common. In Kerinci Seblat NP, central Sumatra, Holden (2006) found it only in primary lowland forests; but in this part of Bukit Barisan Selatan NP it was photographed up to over 1,000 m asl. Reduction of primary forest is thought to be the main threat to this species, although its present status on Sumatra is barely documented.

Sumatran Hog Badger was photographed thrice and captured once. Holden (2006) recorded it frequently in Kerinci Seblat NP, concluding that it was common at elevations higher than those covered in the present survey. However, it is considered rare in other areas of Sumatra, so might be distributed patchily (Holden 2006). Yellow-throated Marten was recorded frequently by Holden (2006) in Kerinci Seblat NP. In Talang Lima it was photographed twice and captured once. The survey area, at 800–1,089 m, lies right at the lower edge of the altitudinal range proposed for the species by Helgen *et al*. (2008).

Banded Linsang and Sunda Stink-badger were recorded only by camera-trap. The linsang was recorded twice. It was also recorded infrequently by Holden (2006) and although camera-trapped widely across its range, it is rarely among the commonly encountered species (e.g. Hedges *et al.* 2013). Sunda Stink-badger, recorded only once, was not camera-trapped by Holden (2006), although one was directly observed. In Borneo Payne *et al.* (1985) recorded the species mostly in secondary forest, which may contribute to the low photograph rate for this species in the Talang Lima study area, located in primary forest.

A Malay Weasel *Mustela nudipes* was sighted along the side of a large mammal trail in lowland secondary forest near the Way Canguk Research Station, but neither it nor Indonesian Mountain Weasel *M. lutreolina* were recorded in the Talang Lima study area: Malay Weasel is rarely camera-trapped even when present (Ross *et al*. 2013) and Talang Lima lies at lower altitude than all records of Indonesian Mountain Weasel traced by Meiri *et al*. (2007). No otter species or Otter Civets *Cynogale bennettii* were camera-trapped, although stations were not selected to represent riverine habitats. Holden (2006) did not record mongooses *Herpestes*, Small Indian Civet *Viverricula indica*, Malay Civet *Viverra tangalunga* or Common Palm Civet *Paradoxurus hermaphroditus* in Kerinci Seblat NP's forest, nor were any of those species recorded in Talang Lima. With all survey located in primary forest within the park, their presence locally but in other habitats is possible. Neither Binturong *Arctictis binturong* nor Small-toothed Palm Civet *Artogalidia trivirgata* were recorded, although this might well simply reflect their arboreal nature.

The ecology and status of most Sumatran small carnivores remain largely undocumented. The rapid deforestation on the island is presumably detrimental to forest-dependent species. Small carnivores are harvested, although the extent and effects on each species are unknown. This study encountered some species categorised as Least Concern only rarely, raising the question of their status on Sumatra. Although this study was limited to a single small area, it highlights the necessity of attaining current information on small carnivore status in Sumatra.

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# Status and ethnobiology of Mountain Weasel *Mustela altaica* in Humla district, Nepal

Yadav GHIMIREY* and Raju ACHARYA

## Abstract

Information on weasels *Mustela* in the western Himalayas is scarce, so even small numbers of records of them are of high value. Frequent sightings of Mountain Weasel *Mustela altaica* during May–June 2013 in Humla, Nepal, indicated that it is common there, even around settlements. Ethnobiological observations revealed killing of the species for superstition, but probably not at levels damaging to the population.

*Keywords*: altitude, Limi valley, local beliefs, locality records, natural history, pika, superstition, threat

## हुम्ला जिल्लामा पहाडी मल्सांप्रो *Mustela altaica* को अवस्था र मानिसहरुसँगको अन्तरसम्बन्ध

## सारांश

पश्चिम हिमालयबाट साना मल्सांप्रा *Mustela* हरुको राम्रो जानकारी नभएकोले यहाँबाट यिनीहरुको सानो जानकारी पनि महत्वपुर्ण हुन्छ । नेपालको हुम्ला जिल्लामा २०१३ को मे देखि जुन सम्म गरिएको अध्ययनको क्रममा पहाडी मल्सांप्रो *Mustela altaica* धेरै पटक देखिएकोले यसको अवस्था सामान्य नै हुनुपर्ने यकिन गर्न सकिन्छ । सामाजिक सर्वेक्षणको परिणामले अन्धविश्वासका कारण मानिसले यसलाई मार्ने गरेको पत्तो लागे पनि मारिने दरले भने यसको अवस्थामा असर नपार्ने देखिन्छ ।

## Introduction

Mountain (= Pale) Weasel *Mustela altaica* is one of six weasel species reported from Nepal (Baral & Shah 2008, Chetri *et al.* 2014) although the presence of Stripe-backed Weasel *M. strigidorsa* and Stoat *M. erminea* remains uncertain (Abramov *et al*. 2008, Thapa 2014). In Nepal, Mountain Weasel is reported to occur along the Himalayan belt including the protected areas of Annapurna Conservation Area (CA), Api-Nampa CA, Dhorpatan Hunting Reserve, Gaurishankar CA, Kanchanjunga CA, Langtang National Park (NP), Makalu-Barun NP, Manaslu CA, Rara NP, Sagarmatha NP and Shey-Phoksundo NP (Jnawali *et al*. 2011) but specific records are known from only Annapurna CA, Kanchanjunga CA, Sagarmatha NP and Mugu district (Ghimirey *et al*. 2014). The species, which inhabits mountainous south and central Asia, China, Mongolia and Russia, is classified as Near Threatened on *The IUCN Red List of Threatened Species* (Abramov *et al*. 2008). There is little information for assessing its conservation status in Nepal (Jnawali *et al*. 2011, Ghimirey *et al*. 2014). Its presence in Humla district is suggested by Jnawali *et al*. (2011) but without explicit documentation. This paper presents observation records and ethnobiological information about the species in the district.

## Study area

Humla district stretches over 29°35′–30°70′N, 81°18′–82°10′E. At 6,134 km$^2$, it is Nepal's second largest district (DDC 2004). It lies in north-westernmost Nepal and borders Tibet Autonomous Region, China (Fig. 1). Within Humla, Limi village development committee (VDC; a VDC is an area, not a collection of people) was explored widely in May–June 2013. Limi is a high, narrow northeast–southwest mountain valley, connected to Tibet but cut off from other parts of Nepal for winter (Goldstein 1974). It has 2.3% Sub-tropical, 8.9% Temperate, 19.4% Sub-alpine, 58.7% Alpine and 10.7% Nival vegetation respectively (Lilleso *et al*. 2005). The River Limi, its largest river, with its many tributaries, including the Sakya khola ('khola' means river or stream in Nepali), Geu khola, Ngin khola and Talung khola, all boast exquisite wide valleys holding many threatened birds and mammals (pers. obs.). The area remains little explored.

## Methods

Dadaphaya, Khagalgaon, Muchu and Limi VDCs were visited, with more than 75% of survey time spent in Limi VDC. The standard trekking trail from Simikot to Bhawin was walked daily at around 2 km/hr from 07h00 to 19h00 with one 1-hr break and 4–5 short breaks of 20–25 minutes. Intervals of 15–20 minutes were taken to look for mammals, on average every 500 m. In and around the base camp in Bhawin, multiple trails were walked. Mountain Weasel was observed by both naked eye and binoculars, with photographs taken whenever opportune. For identification, diagnostic features (underpart colour and pattern, paw colour and lack of black

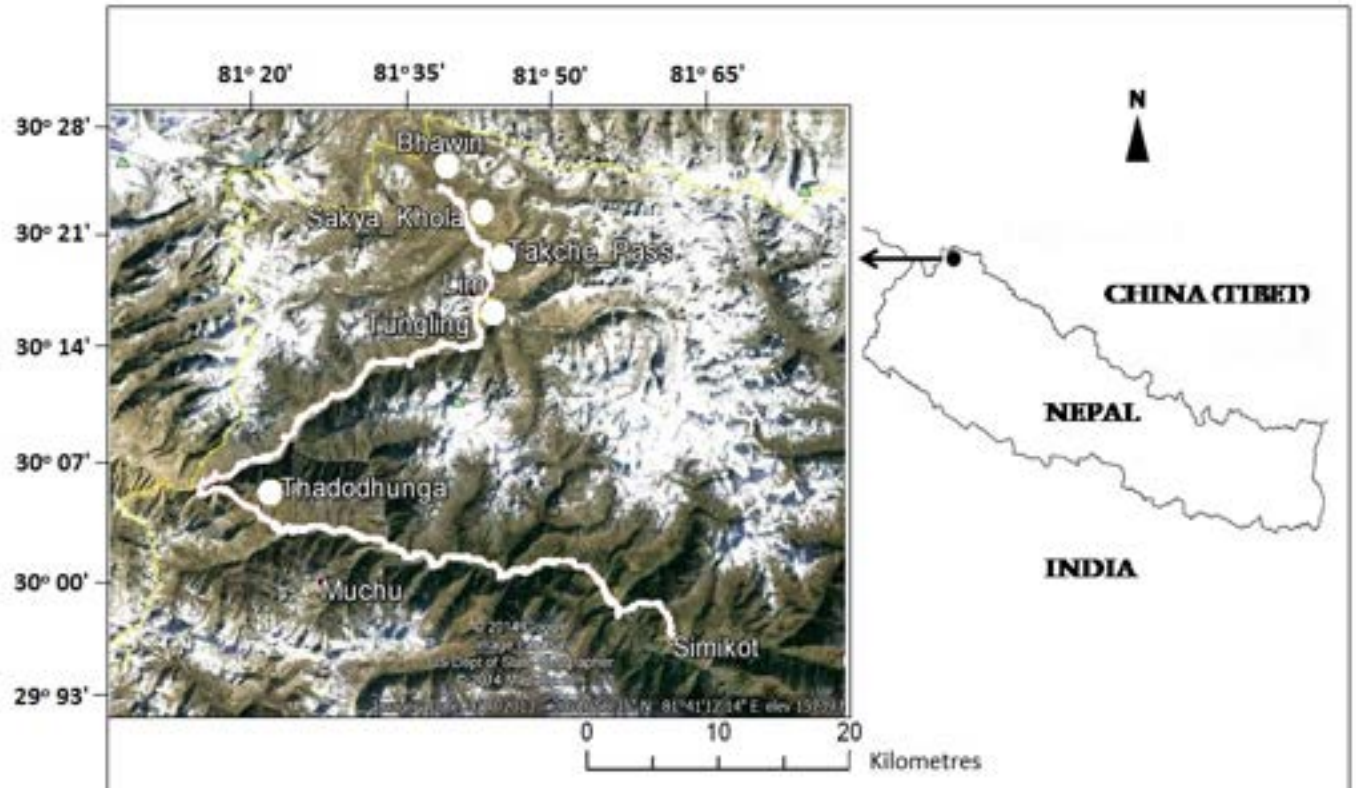


**Fig. 1.** Humla district, Nepal, showing area visited, route walked (white line) and locations where Mountain Weasel *Mustela altaica* was recorded (white circles).

tail tip) were compared to pictures in Menon (2003) and Baral & Shah (2008). No search was made by night. Coordinates and altitudes of the records were taken by GPS units (Garmin 60 CSx, datum WGS 84). Informal discussions with local herders, hunters and village elders sought ethnobiological information about the species in the area: local name, relation with local culture and people's perception of the species.

## Results

*Observations*

Mountain Weasel was observed nine times (Table 1), involving (based on location; Fig. 1) at least five animals. All sightings were of singletons. Excepting one at 3,970 m, all sightings were above 4,000 m even though search effort below and above 4,000 m was 15 and 18 days respectively. Of the nine observations, five were by morning, two by afternoon (Fig. 5) and two in the evening. This pattern coincided with local pika *Ochotona* activity, mostly from after sunrise to late morning (pers. obs.). Plateau Pika *O. curzoniae* was seen only above 4,000 m while Royle's Pika *O. roylei* was frequently observed below this.

The first Mountain Weasel was sighted running towards a makeshift shed of stones, used for domestic goats. It climbed atop a wall and looked at the study team, about 20 m away, with curiosity (Fig. 2). As the team approached, the Weasel climbed down the wall, entered a crevice on another wall and then peeped out apparently to check whether the people were still there. After around five minutes, it ran from that wall into *Caragana* bushes. The second Weasel observed (Fig. 3) was carrying something, probably a rat *Rattus*, in its mouth. On seeing us nearby, it went behind a house. The

**Table 1.** Mountain Weasel *Mustela altaica* sightings in Humla district, Nepal, May–June 2013.

| Location | Coordinates; altitude (m) | Date; time | Habitat |
|---|---|---|---|
| Thadodhunga | 30°07′20″N, 81°24′23″E; 3,970 | 25 May; 08h00 | *Caragana* bushes |
| Tungling | 30°15′20″N, 81°39′18″E; 4,100 | 4 June; 07h00 | Settlement with *Caragana* |
| Tungling | 30°15′20″N, 81°39′18″E; 4,100 | 5 June; 05h45 | Settlement with *Caragana* |
| Takche pass | 30°18′04″N, 81°40′24″E; 4,600 | 5 June; 09h00 | Alpine steppe |
| Bhawin | 30°23′05″N, 81°37′37″E; 4,890 | 5 June; 19h30 | Alpine steppe |
| Sakya khola | 30°20′22″N, 81°39′32″E; 4,700 | 9 June; 11h00 | Alpine steppe, river bank |
| Bhawin | 30°23′05″N, 81°37′37″E; 4,890 | 14 June; morning | Alpine steppe |
| Bhawin | 30°23′05″N, 81°37′37″E; 4,890 | 15 June; 18h00 | Alpine steppe |
| Bhawin | 30°23′05″N, 81°37′37″E; 4,890 | 21 June; 14h00 | Alpine steppe |

fourth individual, at 4,600 m, was basking on the sun; it ran when it noticed us taking pictures. After five minutes of 'hide and seek' it crossed a small creek and climbed a nearby hill. In the fifth sighting, the animal was near our camp, possibly looking for prey. Upon observing the team, it reached the next side of the valley. After 10 minutes' observation it vanished over the top of the hill. The individual observed at Sakya khola was running, jumping, entering and emerging from burrows, but ran away when we approached within 5–8 m (Fig. 4). It seemed as if it liked being observed by people provided they kept a distance.

**Fig. 2.** Mountain Weasel *Mustela altaica*, Thadodhunga, Humla district, Nepal, 25 May 2013 (Photo: Yadav Ghimirey).

*Ethnobiology*

Discussion with locals while watching live Mountain Weasels and with dead ones in view (see below) showed that the species is known as *Dheularkya* in Limi VDC. This name might apply to all weasel species in the area, although discussions with local people suggested that no others occur. Mountain Weasel generates mixed responses: perceived useful because it kills rodent pests, people fear that these little predators eat dried meat stored in houses. Overall, it is unpopular in Humla, where dried meat is the most important protein source, reflecting the lack of readily available fresh meat. Local people believe that hanging a dried Mountain Weasel above the main entrance (Fig. 6) will stop the death of new-born children. This belief reportedly becomes very important if more than one new-born child dies in a house. Two dried Mountain Weasels were seen in the village of Halji. This belief might apply to all weasel species in Nepal because weasel species seem to lack specific local names.

**Fig. 3.** Mountain Weasel *Mustela altaica*, Takche pass, Humla district, Nepal, 5 June 2013 (Photos: Yadav Ghimirey).

**Fig. 4.** Mountain Weasel *Mustela altaica*, Sakya khola, Humla district, Nepal, 9 June 2013 (Photo: Yadav Ghimirey and Bidhan Adhikary).

**Fig. 5.** Mountain Weasel *Mustela altaica*, Bhawin, Humla district, Nepal, 21 June 2013 (Photo: Raju Acharya).

**Fig. 6.** Dried Mountain Weasel *Mustela altaica* kept above the main entrance of a house in the village of Halji, Humla district, Nepal, 28 May 2013 (Photo: Raju Acharya).

## Discussion

Mountain Weasel seems to be the most common, perhaps only, weasel species in Humla. Nine sightings involving at least five Mountain Weasels were made over 38 days. Distances between the locations (over 4½ km) showed that these individuals are different. The observations suggest that the species emerges early in the morning and remains in the open to look for prey, probably pikas. Bischof *et al*. (2014) found a spatial overlap of 96% of Mountain Weasel with pikas. In the Tibetan plateau, Mountain Weasel may be threatened because of the poisoning of pikas (Smith & Foggin 1999). Such behaviour was not observed in Humla district, so might be absent there.

The species's ethnobiology seems never to have been reported in any part of its wide world range. The child mortality rate is high in Humla, at 28.47 per 1,000 per annum (ACF 2007), suggesting some risk for Mountain Weasel. However, the readiness with which it can be seen around habitations and its confiding nature suggests this is not at present a significant threat, at least in the surveyed part of Humla. Effective health services in Nepal are also expanding to the remote Himalayan areas in Nepal currently. As a result, killing of Mountain Weasel can be expected to decrease even in areas where such superstitious beliefs are prevalent. Mountain Weasel seems to face no threats in this area other than killing through superstition.

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# The southernmost record of Small-toothed Ferret Badger *Melogale moschata* – further evidence of syntopy by two ferret badger species

A. V. ABRAMOV[1,3] and V. V. ROZHNOV[2,3]

## Abstract

A Small-toothed Ferret Badger *Melogale moschata* specimen collected from a hunter's snare in Chu Yang Sin National Park, Dak Lak province, near 12°23′N at 1,380 m asl, on 11 April 2012 is the first confirmed record of the species from southern Vietnam and the southernmost in the world. Large-toothed Ferret Badger *M. personata* was found in the same part of the park only 1.5 km away, at 1,000 m asl. Together, these records testify to the syntopy of the two species.

*Keywords*: altitude, Chu Yang Sin National Park, habitat, Large-toothed Ferret Badger, *Melogale personata*, Mustelidae, Vietnam

**Ghi nhận cực nam của Chồn bạc má bắc *Melogale moschata* – thêm chứng cứ về sự đồng phân bố của hai loài chồn bạc má.**

## Tóm tắt

Một tiêu bản Chồn bạc má bắc *Melogale moschata* thu được từ bẫy thợ săn tại Vườn Quốc gia Chư Yang Sin, tỉnh Đăk Lăk, gần vĩ độ 12°23′N tại đô cao 1.380 m so với mặt biển vào ngày 11/04/2012 là ghi nhận chắc chắn đầu tiên của loài này tại miền nam Việt Nam và là ghi nhận ở điểm xa nhất phía nam trong vùng phân bố toàn cầu của loài. Chồn bạc má nam *M. personata* cũng được ghi nhận tại vườn cách điểm ghi nhận Chồn bạc má bắc chỉ 1,5 km tại độ cao 1.000m. Các ghi nhận đồng thời này chứng minh sự giao thoa về phân bố của hai loài.

The genus *Melogale* includes four or five species – Large-toothed Ferret Badger *M. personata*, Small-toothed Ferret Badger *M. moschata*, Javan Ferret Badger *M. orientalis*, Bornean Ferret Badger *M. everetti* (Wozencraft 2005) and the enigmatic form *M. cucphuongensis* (Nadler *et al*. 2011). Large-toothed Ferret Badger and Small-toothed Ferret Badger are widely distributed in continental South and South-east Asia but camera-trap records or field observations are not currently identifiable to species. The only reliable way to distinguish the species visually is by cranial and dental characters. Both species are recorded from North-east India, Myanmar, Vietnam, Laos and southern China (IUCN 2014). Each species's distribution in this region of sympatry is poorly known. In Vietnam, most *M. moschata* records are from the north and centre (Fig. 1), whereas *M. personata* has been found in the centre and south (Rozhnov 1994a, 1994b, Kuznetsov 2006, Roberton 2007, Dang *et al*. 2008).

Small-toothed Ferret Badger's southern limit in Indochina is poorly known. Long & Minh (2006: 41) reported one from Dong Giang district, Quang Nam province (15°47′55.8″N, 107°40′11.6″E), stating "the animal … is housed in the Vietnam National University Museum in Hanoi (specimen number 1057)". We could not find this specimen in the Museum, so could not check its identification. Kuznetsov (2006) listed *M. moschata* for Buon Luoi (14°20′N, 108°36′E) in An Khe district, Gia Lai province, but without specimen confirmation. Rozhnov (1994a, 1994b) mentioned two *M. personata* skulls for Buon Luoi. Two ferret badgers from An Khe district in the Institute of Ecology and Biological Resources (IEBR) collection, Vietnam Academy of Science and Technology, Hanoi, are *M. personata* (A. V. Abramov *et al*. unpubl. data). According to Dang *et al*. (2008), the southernmost record of *M. moschata* for Vietnam is from Phong Nha – Ke Bang National Park (NP) in Quang Binh province. This is probably the southernmost specimen-validated locality for *M. moschata* in the world: a skull (M.1043) from Minh Hoa district, Quang Binh province

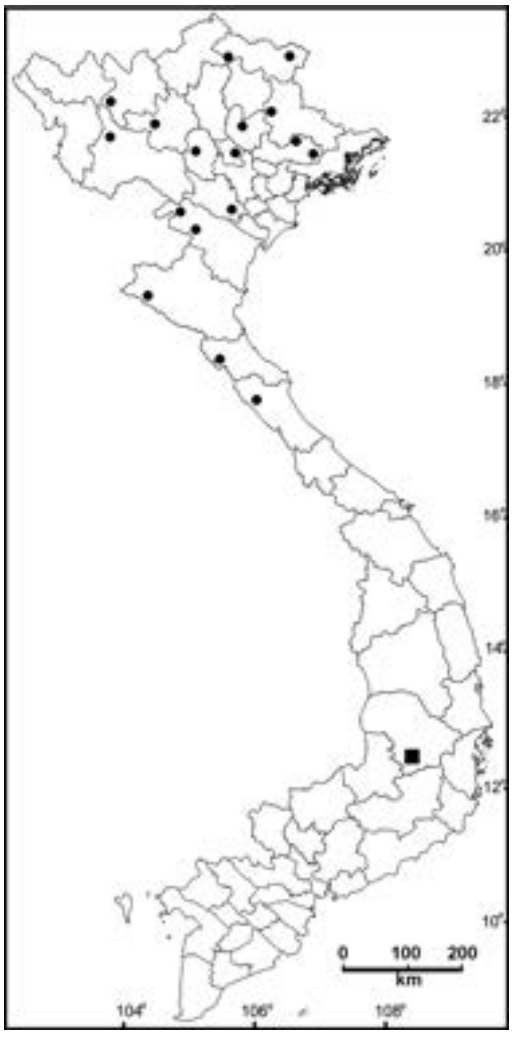


**Fig. 1.** Distribution of Small-toothed Ferret Badger *Melogale moschata* in Vietnam. Circles are localities from Dang *et al*. (2008), the square is the new finding in Chu Yang Sin National Park.

**Fig. 2.** Mummified body of Small-toothed Ferret Badger *Melogale moschata* in a hunter's snare, Chu Yang Sin National Park, southern Vietnam, 11 April 2012 (Photo: A. V. Alexandrova).

(near 17°40′N), in the Vietnam National University Museum, Hanoi (A. V. Abramov *et al*. unpubl. data). The southernmost *M. moschata* record in Laos, Vietnam's western neighbour, is a skull found in southern Nakai–Nam Theun National Protected Area (NPA) at 17°45′20″N, 105°37′05″E (Robichaud 2010).

The Joint Vietnam–Russian Tropical Research and Technological Centre surveyed biodiversity in the Chu Yang Sin NP in 2012–2014. The park, in the north of the Dalat Plateau, Dak Lak province, Vietnam, covers 58,947 ha of broadleaf evergreen forest at altitudes of 600–2,442 m. The park and the adjacent Bi Doup–Nui Ba NP comprise the largest protected area on the Dalat Plateau. BirdLife International (2010) listed *M. personata* for the park, but this is based on hairs found at a hunters' camp and identified only provisionally as this species (Le Trong Trai *in litt*. 2014).

On 11 April 2012 a neglected hunting line with wire snares was found on a mountain slope in submontane mixed forest (12°23′18″N, 108°20′23″E) at 1,380 m asl (derived from a Garmin GPSmap 62s; datum WGS84). Most snares were broken or tripped, but one held a mummified ferret badger (Fig. 2). This specimen was identified as *M. moschata*, based on cranial characters (Fig. 3A), including small teeth and the large infraorbital foramina. Its baculum's trifid distal end (Fig. 3C) is typical for *M. moschata* (Thomas 1922, Pocock 1941, Baryshnikov & Abramov 1997).

Another ferret badger, found on 28 March 2013 near a forest road, was a starveling adult male with no wounds; it probably died of disease. This record (12°23′48″N, 108°20′59″E; 1,000 m asl) is in the same small river valley and 1.5 km from the *M. moschata* of 2012. This ferret badger was *M. personata*, based on cranial characters (Fig. 3B) including large teeth and

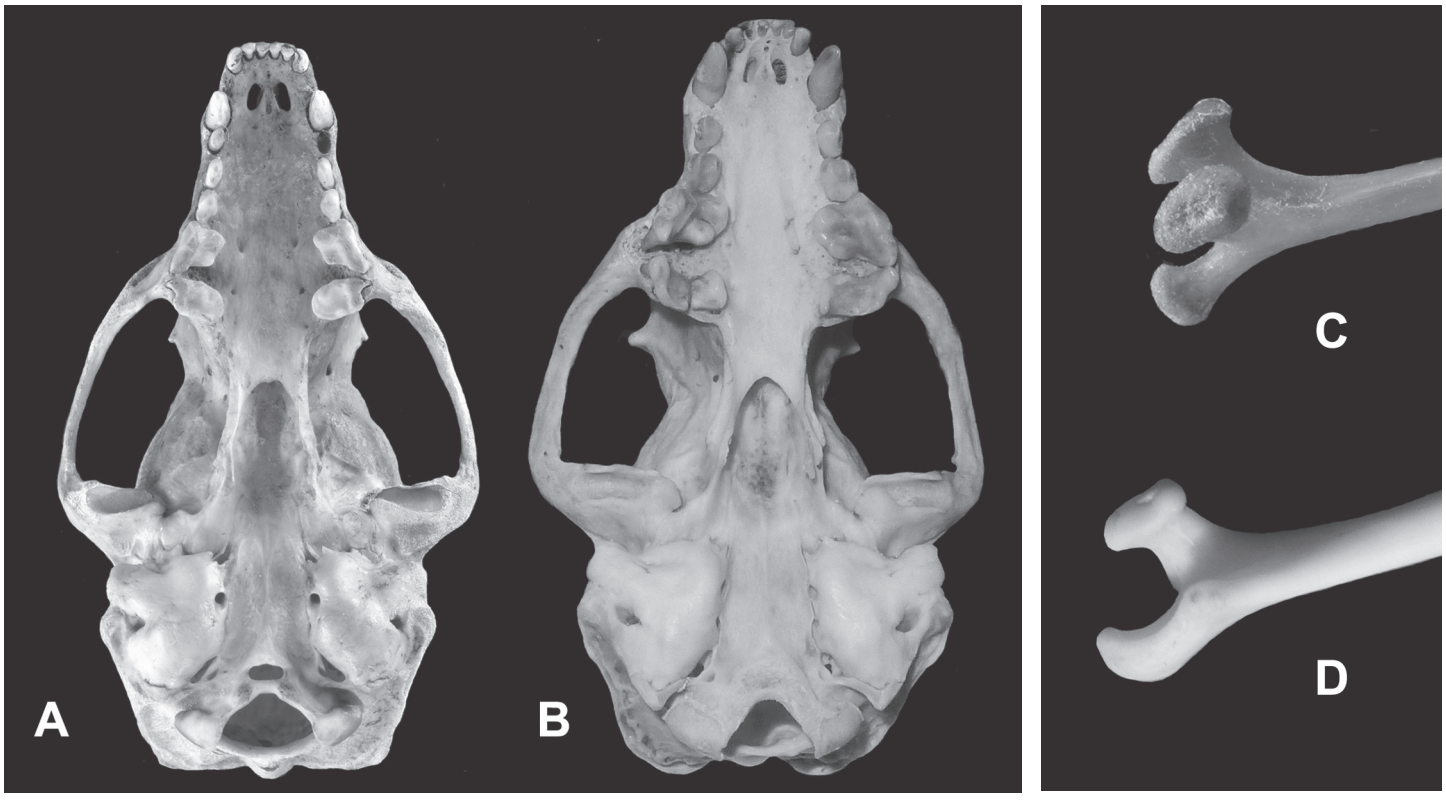


**Fig. 3.** Small-toothed Ferret Badger *Melogale moschata* (A – skull, C – head of baculum) and Large-toothed Ferret Badger *M. personata* (B – skull, D – head of baculum) from Chu Yang Sin National Park, southern Vietnam.

small infraorbital foramina, and on the baculum with its bifid distal end (Fig. 3D) as is typical for *M. personata* (Thomas 1922, Pocock 1941, Baryshnikov & Abramov 1997).

Both were found in the evergreen submontane forest mainly of broadleaf trees with a few Dalat Pines *Pinus dalatensis*. Both were too decomposed for a useful inspection of pelage features.

The *M. moschata* record from Chu Yang Sin NP is more than 600 km south of the previous southernmost Vietnamese, and world, record, from Phong Nha – Ke Bang NP. It confirms the species's presence in the Dalat Plateau (the southernmost highland region of the Annamite mountain chain that stretches along much of Vietnam's western border). Some other mammals of this size-class have only recently been found to live so far south in Vietnam, e.g. Owston's Civet *Chrotogale owstoni* (Dang & Le 2010) and Yellow-bellied Weasel *Mustela kathiah* (Abramov *et al*. 2013), indicating general level of past underrecording in the Dalat Plateau.

Many more records based on at least dental, cranial and, where possible, bacular, examination are still needed to clarify distribution and ecological range of *M. moschata* in Indochina.

Although these two ferret badger species are known to be widely sympatric in Indochina, their abilities for coexistence and ecological niche partition are poorly understood. Coudrat & Nanthavong (2013) reported remains of one animal of each species in Nakai–Nam Theun NPA, Central Laos, 12 km apart, at 867 and 980 m asl, suggesting some level of syntopy. Finding the two species in even closer geographical and altitudinal proximity further supports their syntopy. Additional ecological surveys in localities holding both species may yield clues on the ecological niche separation between these closely relatives. Indeed, there remain so few precisely located records of each that it cannot be excluded that they are widely syntopic.

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# Stripe-necked Mongoose *Herpestes vitticollis* in Odisha, eastern India: a biogeographically significant record

Anup K. NAYAK[1], Manoj V. NAIR[2] and Pratyush P. MOHAPATRA[3]

## Abstract

The occurrence of Stripe-necked Mongoose *Herpestes vitticollis* in the Similipal Hills, Odisha, India, has been confirmed by camera-trapping. This record extends the earlier known distribution range of this species, from southern and central Western Ghats in southwest India, far to the north of the Eastern Ghats and hence constitutes a biogeographically significant record.

*Keywords*: camera-trap, extension of known range, locality record, northernmost occurrence, Similipal

## ଓଡ଼ିଶାରେ ବେକ–ଦାଗିଆ ପାହାଡ଼ି ନେଉଳର ଉପସ୍ଥିତି ଜୈବ ଭୌଗଳିକ ଦୃଷ୍ଟିକୋଣରୁ ଏକ ମହତ୍ୱପୂର୍ଣ୍ଣ ଉପଲବ୍ଧି

ଓଡ଼ିଶାର ଶିମିଳିପାଳ ଜଙ୍ଗଲରେ ବେକ–ଦାଗିଆ ପାହାଡ଼ି ନେଉଳର ଉପସ୍ଥିତି ସ୍ୱଂୟଚାଳିତ ଚିତ୍ର ଉତ୍ତୋଳକ ମାଧ୍ୟମରେ ପ୍ରମାଣିତ ହୋଇଅଛି । ଏହା ପୂର୍ବରୁ ଏହି ପ୍ରଜାତି କେବଳ ପଶ୍ଚିମ ଭାରତର ପର୍ବତ ମାଳାରୁ ଜଣାଥିବା ହେତୁ ପୂର୍ବଭାରତୀୟ ପର୍ବତ ମାଳାର ଉତ୍ତର ଭାଗରେ ଏହା ମିଳିବାର ସୂଚନା ଜୈବ ଭୌଗଳିକ ଦୃଷ୍ଟିକୋଣରୁ ମହତ୍ୱପୂର୍ଣ୍ଣ ଅଟେ ।

Stripe-necked Mongoose *Herpestes vitticollis*, the largest mongoose in Asia, is found in southwest India and Sri Lanka (Mudappa 2013). In India, its stronghold is believed to be the forested Western Ghats (Pocock 1941, Prater 1971, Corbet & Hill 1992, Van Rompaey & Jayakumar 2003, Mudappa 2013, Menon 2014). However, there is a report well outside the range of other records, from Horsley Konda (tentative location: 13°39′N, 78°25′E; perhaps about 750 m asl) in the Eastern Ghats (Allen 1911). As a sight-record without specimen, Allen (1911) himself expected, in keeping with the norms of the time, that his observation would be taken as unconfirmed. Thus, it was not mentioned even in Pocock's (1941) comprehensive review. Van Rompaey & Jayakumar (2003) considered Allen's record doubtful on grounds of habitat. Much further northeast, the species was reported by Mishra *et al*. (1996) from the state of Orissa (now called Odisha). They considered it restricted in the state to Similipal forest of Mayurbhanj district and Bhitarkanika mangroves of Kendrapara district. A later review of Orissa's small carnivores, Acharjyo (1999), doubted these reports given that specimens were not obtained. Nor has the species found a place in the check-lists of Similipal Tiger Reserve (Anon. 1999). Hence, as of now, it is thought to be confined in India to the Western Ghats (Mudappa 2013, IUCN 2014, Menon 2014).

Six records (Table 1, Fig. 1) now confirm Stripe-necked Mongoose occurrence in Similipal Tiger Reserve (Similipal TR), Odisha, eastern India. The Similipal Hills (21°56′N, 86°00′E), in Mayurbhanj district of Odisha, border the states of Jharkhand and West Bengal and harbour within their limits both a tiger reserve (of 2,750 km$^2$) and a biosphere reserve (of 5,569 km$^2$). The terrain is undulating at 300–1,200 m asl. Forest

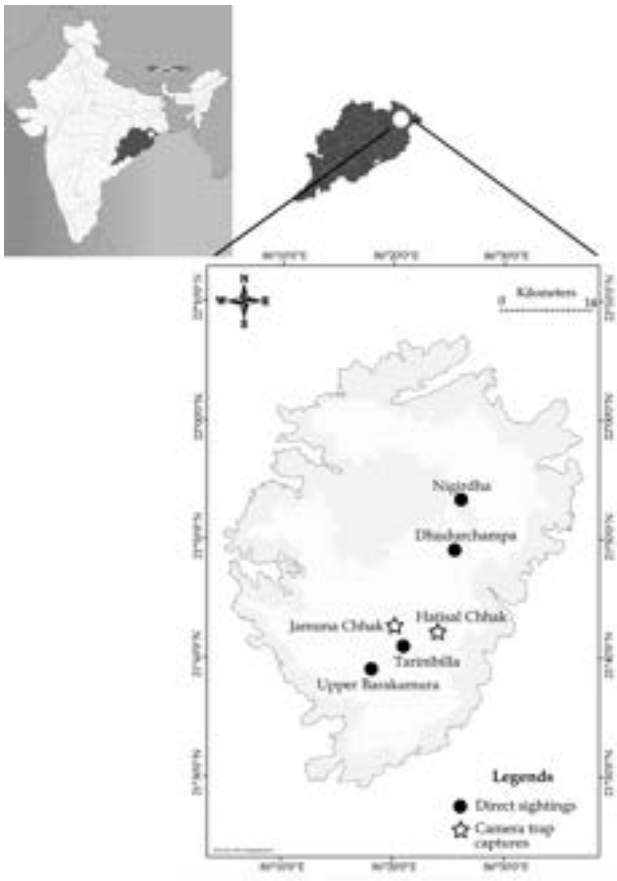


**Fig. 1.** Locality records of Stripe-necked Mongoose *Herpestes vitticollis* in Similipal Tiger Reserve, Odisha, India.

**Table 1.** Stripe-necked Mongoose *Herpestes vitticollis* records in Similipal Tiger Reserve, Odisha, India.

| Locality[1] | Range[2] | Date, time | Coordinates; altitude (m); habitat[3] |
|---|---|---|---|
| Nigirdha | Nawana (N) | Not noted | 21°53′34.0″N, 86°26′14.7″E; 828; MDDSF |
| Dhudurchampa | Nawana (S) | Not noted | 21°51′28.03″N, 86°26′02.26″E; 844; MDDSF |
| Hatisal Chhak* | Jenabil | 5 Feb 2012, 13h17 | 21°42′38.58″N, 86°24′37.47″E; 781; MDDSF |
| Jamuna Chhak* | Jenabil | 21 Oct 2013, 07h10 | 21°42′49.27″N, 86°20′14.95″E; 907; MDDSF |
| Tarinibilla | UBK | 21 Jan 2007, 08h14 | 21°40′51.7″N, 86°20′58.8″E; 980; DSEF |
| Upper Barakamura | UBK | 20 Apr 2008, 13h44 | 21°39′09″N, 86°18′40.6″E; 900; DSEF |

[1]Camera-trap records are asterisked (*); the others are direct sightings.
[2]UBK = Upper Barakamura range.
[3]Coordinates and altitudes were obtained from Garmin 72 Handheld GPS units under the datum WGS 84. MDDSF = moist-deciduous dense Sal forest; DSEF = dense Semi-evergreen forest.

ranges from dry deciduous and moist deciduous to semi-evergreen. Some consider Similipal as part of the Eastern Ghats (Sinha 1971), while others treat it as the southeastern extension of the Chota Nagpur plateau (Ray 2005). The area falls under the province of Chhotanagpur in the Deccan Peninsula biogeographic zone of Rodgers & Panwar (1988).


**Fig. 2.** Stripe-necked Mongoose *Herpestes vitticollis*, Hatisal Chhak, Jenabil Range, Similipal Tiger Reserve, Odisha, India, 5 February 2012.

**Fig. 3.** Stripe-necked Mongoose *Herpestes vitticollis* from Jamuna Chhak, Jenabil Range Similipal Tiger Reserve, Odisha, India, 21 October 2013.

During mammal observations in Similipal TR between 2006 and 2009, MVN twice saw large mongooses in the Upper Barakamura range: a fleeting glimpse of one crossing the Tarinibila road, and a distant sighting of a duo walking along the forest trail at Upper Barakamura. These were then thought to be exceptionally large Ruddy Mongooses *H. smithii*, primarily because of their black-tipped tails. With hindsight, the animals were *H. vitticollis*. The existence of *H. vitticollis* was confirmed by two images taken during extensive camera-trapping in Similipal TR during 2012 and 2013, at Jamuna and Hatisal (Figs 2–3). The photographs were incidental outcomes of camera-trapping primarily to estimate Tiger *Panthera tigris* numbers. No baits or lures were used. Most camera-traps were placed along main forest roads, while a few were placed on subsidiary feeder roads, stream courses and along existing animal trails. The records were in moist deciduous forest and semi-evergreen forest patches where human disturbance is minimal (Fig. 1). Most of the direct sightings were during daylight near hill streams or while the animals crossed forest roads.

Other small carnivores occurring in Similipal TR are Ratel *Mellivora capensis*, Indian Grey Mongoose *Herpestes edwardsii*, Small Indian Mongoose *Herpestes auropunctatus*, Common Palm Civet *Paradoxurus hermaphroditus*, Small Indian Civet *Viverricula indica* and Asian Small-clawed Otter *Aonyx cinereus* (pers. obs.).

These Stripe-necked Mongoose records from Similipal TR suggest that systematic surveys in and near the Eastern Ghats might find this mongoose elsewhere in the hill range. They lend support to Allen's (1911) sight-record from Horsley Konda also in the Eastern Ghats, albeit 8° of latitude south of Similipal TR. Of the two known subspecies, the camera-trapped individuals resemble, as would be expected, the paler northern subspecies *H. v. inornatus*, not the darker richly coloured southern subspecies *H. v. vitticollis*. Similipal TR lies over seven degrees of latitude (almost 800 km) north of the northernmost historical specimen record of the species (and 1,400 km in direct northeast line): from Chipageri (then, Chipgeri), Karnataka, in the Western Ghats at about 14°49′N, 74°55′E; Pocock 1941, Van Rompaey & Jayakumar 2003) and over 4° north of the recent records in west-central Maharashtra (Punjabi *et al*. 2014). These Stripe-necked Mongoose records echo recent extensions of known range such as for Asian Small-clawed Otter (Mohapatra *et al*. 2014), where species earlier thought to be disjunct in or endemic to the Western Ghats are discovered in the Eastern Ghats and parts of Deccan plateau. Hence this report is noteworthy in terms of a biogeographic perspective.

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# A recent record of Stripe-backed Weasel *Mustela strigidorsa* from Yunnan province, China

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## Abstract

The current distribution and status of Stripe-backed Weasel *Mustela strigidorsa* in China is little reported. In April 2014, we observed an individual in old-growth evergreen broadleaf forest in the Tengchong area of Gaoligonshan National Nature Reserve, western Yunnan, China. The location is very close to Kachin State of northern Myanmar, from where there are several records.

*Keywords*: Gaoligonshan National Nature Reserve, habitat, Honghe Autonomous Prefecture, Tengchong county

**纹鼬在中国云南省的一个近期纪录**

**摘要**

纹鼬(*Mustela strigidorsa*)被中国物种红色名录列为濒危物种，但除了一些采集记录外我们对其几乎一无所知，近年有关此物种的信息更为缺乏。今年4月，我们在云南高黎贡山国家级自然保护区腾冲分局的大塘地区原始常绿阔叶林内观察到一只纹鼬，现把相关信息简单报道。

Stripe-backed Weasel *Mustela strigidorsa* Gray, 1853 occurs along the foothills of the eastern Himalayas in North-east India, northern Myanmar and southwestern China, as well as Vietnam, Lao PDR and Thailand (Abramov *et al*. 2008). In China it has been recorded from south-western Guangxi and southern and western Yunnan provinces, extending northeast to Guizhou province up to 26°10′N (Zhang *et al*. 1997, Wang 2003, Abramov *et al*. 2008). Despite being listed as Endangered in the China Species Red List (Wang & Xie 2004), very little is known about the species in China with hardly any recent information available. A review of records across the species's range suggested that it is not as rare as previously believed (Abramov *et al*. 2008).

During April 2014, a team from Kadoorie Conservation China conducted a rapid biodiversity survey of the Tengchong area of Gaoligongshan National Nature Reserve (NNR), Yunnan province, China. Gaoligongshan NNR, with three geographically separate sections, the northern 'Gongshan section', the middle 'Lushui section' and the southern 'Baoshan section', is Yunnan's largest protected area, of about 4,055 km$^2$. Tengchong adjoins Kachin state of Myanmar draining the River Irrawaddy (= Ayeyarwady). It makes up the western half of the north–south running Gaoligongshan in the 1,245 km$^2$ Baoshan section (24°56′–26°09′N, 98°34′–98°50′E).

On 28 April 2014 at 12h30, when conducting ornithological survey along a well-forested stream in gentle terrain, JZ observed a weasel in riparian evergreen broadleaf forest at about 2,190 m asl (based on Google Earth) at co-ordinates 25°45′11″N, 98°42′15″E (WGS 84) at Datang forest, Jietou township, Tengchong county about 8 km from the international border with Myanmar. The nearest Burmese town is Chipwi of Myitkyina district, Kachin state. Kachin state has one of the most "impressive series of records" for Stripe-backed Weasel (Abramov *et al*. 2008: 253). The Datang area holds extensive old-growth evergreen broadleaf forest up to 30 m tall. The forest is humid with tree trunks almost completely covered by mosses and liverworts; thick undergrowth, sometimes predominantly dwarf bamboo *Fargesia*, carpeted the forest floor (Fig. 1).

An animal was detected moving through thick herbaceous undergrowth about 1 m from a 3 m-wide gentle stream. JZ stood still upon detecting the movements and a weasel appeared about 50 cm from him, on the forest trail with its head and anterior body clearly seen. The weasel looked up momentarily and retreated into the undergrowth when it noticed him. It moved through the undergrowth and reappeared 2 m from him when crossing the forest trail, allowing another brief but good look. The head-and-body length was about 30 cm and the basic dorsal colour uniformly chestnut brown; a thin light yellowish median dorsal stripe was clearly visible. The venter of such a low-stature animal could not be observed given the angle of observation. Careful comparison with literature and photographs confirmed the animal was a Stripe-backed Weasel. Siberian Weasel *M. sibirica* has been recorded in Gaoligongshan NNR (Xue 1995) and Yellow-bellied Weasel *M. kathiah* might also occur there; JZ has seen both species in other parts of China. The sighting location is over 6 km from the nearest permanent human settlement, with minimal human disturbance.

Little is known about the natural history of Stripe-backed Weasel in China. Few previous Chinese records have much location and habitat detail, but in Honghe Autonomous Prefecture along the Red River in southern Yunnan, a specimen was collected at 1,600 m asl at Laowuzhai, a border village (at 22°36′N, 102°59′E) in Jinping County (Wang 1987) near Lai Chau province, Vietnam. Google Earth indicates the landscape of Laowuzhai to be a mosaic of farmland, shrubland and forest, with natural vegetation contiguous with good quality high-altitude forest of the transboundary Mt Xilong (Phu Si Lung in Vietnamese). In other range states, the species has

**Fig. 1.** Old-growth evergreen broadleaf forest of Datang, Tengchong section, Gaoligongshan NNR, Yunnan, China, 25 Sept 2014 (Photo: Chan P. L. Bosco).

been recorded from a wide range of habitats and altitudes, and is said to be diurnal and often unafraid/unaware of people (Abramov *et al*. 2008, Streicher *et al*. 2010). This sighting fits the altitude and habitat requirements, as well as habits, described previously. It apparently represents the first confirmed record from Tengchong county, although the species has been recorded widely in southern and western Yunnan including the Gaoligonshan area (Wang 2003, Abramov *et al*. 2008, Wang Y. X. *in litt*. 2014). With widespread conversion of hill forest to permanent cash crops (especially rubber and cardamom) outside protected areas throughout its range in China, a re-assessment of its current distribution and status there is warranted.

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# A Yellow-throated Marten *Martes flavigula* feeding on a Red Muntjac *Muntiacus muntjak* carcase

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## Abstract

On 5 December 2012 we observed a Yellow-throated Marten *Martes flavigula* and a Changeable Hawk Eagle *Nisaetus cirrhatus* feeding on a recently dead Red Muntjac *Muntiacus muntjak* in Huai Kha Khaeng Wildlife Sanctuary, western Thailand. It seems unlikely that the Marten had killed the deer. It perhaps came across the carcase shortly after it died, possibly from a snake bite.

*Keywords*: Changeable Hawk Eagle, deer, feeding, Huai Kha Khaeng Wildlife Sanctuary, *Nisaetus cirrhatus*, predation, scavenging, Thailand

## Introduction

Yellow-throated Marten *Martes flavigula* has a wide distribution in tropical Asia (including the Greater Sundas) and extends to the northeast Palaearctic (Corbet & Hill 1992). It is often said to be a voracious predator. For example, Pocock (1941: 336) cited local reports given to J. M. D. Mackenzie (in Wroughton 1916b) that "three or four will attack an unarmed man". Specific verifiable evidence for such extreme claims is lacking. However, it is known to feed, both on the ground and in trees, on a wide variety of vertebrates, invertebrates, fruit, honey and even food waste (e.g. Heptner *et al*. 1967, Parr & Duckworth 2007, Zhou *et al*. 2011).

## Observations

On 5 December 2012, shortly after 14h00, at the Sab Faa Pha substation of Huai Kha Khaeng Wildlife Sanctuary, Uthai Thani, Thailand (15°32′26″N, 99°17′26″E), we heard loud yelping noises coming from a nearby stream. From a bridge we could see, about 100 m downstream, a Yellow-throated Marten standing ankle-deep in water on something, mostly submerged, mid-stream. Over 20 minutes the Marten continually tugged at the item in the water, dunking its head momentarily then shaking it vigorously as does a dog after coming out of water. It interspersed these movements with occasional jumps to the bank where it rubbed its neck strenuously against a nearby tree trunk before jumping back onto the object in the stream. It appeared reluctant to immerse itself: it always jumped to and from the bank, about 1 m, rather than wading or swimming (Fig. 1). At about 14h30 we waded down the stream, which was no more than 30 cm deep, and was mostly shallower. As we approached the scene the Marten ran off and a Changeable Hawk Eagle *Nisaetus cirrhatus* flew from nearby and close to the ground to a tall tree about 40 m away, where it perched and watched us intently.

The object was a freshly dead Red Muntjac *Muntiacus muntjak*, lying on its side almost totally immersed. Both hind legs were stiff at the body joint but the forelegs were still fairly easy to bend. The only damage visible was (i) a slight tear in the skin around the base of the ear, presumably caused by the Marten tugging at it as we had seen, and (ii) two pairs of small puncture wounds and bruising at the top inside of the left foreleg (Fig. 2). We pulled the carcase onto a shingle bank in the stream and attached a camera-trap (Stealth Cam) to a tree about 6 m from the carcase and then withdrew from the area at 15h15. Not all activity was recorded: the camera took pictures inconsistently, whilst at night the flash failed to work. However, the digital images captured showed the Eagle returned to the carcase 20 min after we left and it remained there fending

**Fig. 1.** Yellow-throated Marten *Martes flavigula* jumping to stream-bank from Red Muntjac *Muntiacus muntjak* carcase, Huai Kha Khaeng Wildlife Sanctuary, Thailand, 5 December 2012.

**Fig. 2.** Possible viper bite on foreleg of dead Red Muntjac *Muntiacus muntjak*, Huai Kha Khaeng Wildlife Sanctuary, Thailand, 5 December 2012.

**Fig. 3.** Changeable Hawk Eagle *Nisaetus cirrhatus* fending off Yellow-throated Marten *Martes flavigula* from Red Muntjac *Muntiacus muntjak* carcase, Huai Kha Khaeng Wildlife Sanctuary, Thailand, 5 December 2012.

**Fig. 4.** Yellow-throated Marten *Martes flavigula* feeding on Red Muntjac *Muntiacus muntjak* carcase, Huai Kha Khaeng Wildlife Sanctuary, Thailand, 5 December 2012.

off the Marten with outstretched wings between 15h35 and 15h40 (Fig. 3). Between 15h52 and 16h02 we photographed the Marten from the bridge upstream, feeding in the groin area of the carcase (Fig. 4). Between 16h54 and 18h06, after which it became too dark to see, camera-trap images show the Eagle feeding on the dead Muntjac. During the night the carcase was dragged across the stream and the following morning a Eurasian Wild Pig *Sus scrofa* attended for over 10 min up to 10h47. The camera-trap took no further images. When we visited the area in mid-afternoon, the carcase had been removed and could not be found. No further observations were made.

## Discussion

It is unclear how the deer was killed. Although fresh, it had probably been dead at least two hours, because rigor mortis had started to set in. This can occur 2–6 hours after death (T. Hornsey *in litt*. 2014). This lapse of time and the lack of external injuries suggest that the Marten (or even a group of Martens – although in such a case it is unclear why all but one would have left) had not killed the deer, because it would be unlikely to wait so long before attempting to feed on it. The puncture wounds and bruising on the deer's foreleg are consistent with the bite of a snake, in particular a viper rather than a cobra or krait (B. L. Stuart *in litt*. 2014). Although the deer would not have been prey for such a snake, the deer might have disturbed it accidently, causing it to strike. The Marten might then have come across the freshly dead deer or been attracted by the Eagle, if that had found it first. The calls that we heard presumably came from the Marten, directed at the Eagle. Camera-trap photographs show the Eagle apparently fending off the Marten later that day (Fig. 3).

Siberian Musk-deer *Moschus moschiferus* forms a major part of Yellow-throated Marten diet in winter in Russia (Heptner *et al*. 1967). The importance of ungulates is not clear in its tropical range. Pocock (1941) mentioned reports of its killing at least young of muntjacs in Myanmar and the Himalayas. Wroughton (1916a: 485) included a report from a Mr Gent of a "pair" of Martens "running down" a muntjac fawn in India. A group of Yellow-throated Martens was recorded chasing a muntjac also in India (Naniwadekar *et al*. 2013), but the outcome was not determined. Sathyakumar (1999) reported this Marten chasing Himalayan Tahr *Hemitragus jemlahicus*, Alpine Musk-deer *Moschus chrysogaster* and Himalayan Goral *Naemorhedus goral*, but again without seeing the result. The frequency and success of such predation attempts in tropical forests remains unknown. Sathyakumar (1999) also cited a report of Himalayan Tahr in Marten faeces, although whether this resulted from predation or scavenging is presumably difficult to tell.

Other *Martes* species have been reported to scavenge regularly on carcases (Jędrzejewski 1993, Selva *et al*. 2005). However, the only claim of Yellow-throated Marten scavenging perhaps comes from Pocock's (1941: 336) statement that "in the Naga hills it is said to feed on human corpses exposed in the open". Given the species's dietary flexibility (Parr & Duckworth 2007 and references therein, Zhou *et al*. 2011), scavenging might be expected to be common. The apparent lack of explicit observations warrants further investigation.

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# First record of Steppe Polecat *Mustela eversmanii* in Nepal

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## Abstract

A photo-documented record of Steppe Polecat *Mustela eversmanii* in the Trans-Himalayan range of Upper Mustang, Annapurna Conservation Area, Nepal, is the first record of Steppe Polecat in Nepal; probably the southernmost from anywhere in the world; and, at 5,050 m, is apparently the highest altitude at which this species has ever been recorded. The other southernmost historical records in Asia lack precise localities.

*Keywords*: Annapurna Conservation Area, camera-trap, extension of known range, highest altitude record, Mustelidae, Trans-Himalaya

**नेपालमा पहिलो पटक रेकर्ड** गरिएको स्टीप पोलक्याट ***Mustela eversmanii***

**सारांश**

नेपालको अन्नपूर्ण संरक्षण क्षेत्र अन्तर्गत हिमाल पारी मुस्ताङ् जिल्लामा स्टीप पोलक्याट *Mustela eversmanii* को यो तस्विर रेकर्ड गरिएको हो । एसियाली क्षेत्रमा वासस्थानको यकिन प्रमाणिक आधार नभएको उक्त प्रजाति उपल्लो मुस्ताङ्को ५,०५० मिटर उचाइमा पहिलो पटक फेला परेको हो । सम्भवत, हालसम्म भएका रेकर्डहरूमध्ये यो नै उक्त प्रजातिको सबै भन्दा बढी उचाइमा गरिएको रेकर्ड हो।

Steppe Polecat *Mustela eversmanii* Lesson, 1827 is a medium sized mustelid occurring in much of central and eastern Europe, central Asia, southern Russia, Georgia, Mongolia and China (Tikhonov *et al*. 2008). It inhabits relatively open, dry habitats including steppes, semi-deserts, pastures and cultivated fields (Mitchell-Jones *et al*. 1999, Tikhonov *et al*. 2008, Šálek *et al*. 2013). It is stated to occur at altitudes up to 800 m in Europe and to 2,600 m in central Asia (Tikhonov *et al*. 2008). Steppe Polecat feeds on birds, reptiles, insects, fruit and, particularly, rodents (Wolsan 1993, Wang *et al*. 2006, Lanszki & Heltai 2007). The few historical records from the southern margin of its Asian range all lack spatial precision: one from Ladakh in Jammu & Kashmir, India; one from "Himalayas"; and two from Utsang, Tibet (Pocock 1941). Utsang was a large province occupying most of the current Tibet Autonomous Region (Xizang province). For Xizang, Wang (2003) listed occurrence in the east (Changdu [probably modern Chamdo; far from Nepal]) and south (Lhasa). No records from South Asia (i.e. Pakistan, India, Nepal, Bhutan and Sri Lanka) other than that from Kashmir were traced by Mudappa (2013). The species is listed as Least Concern on *The IUCN Red List of Threatened Species* (Tikhonov *et al*. 2008), although European populations have declined significantly over the past century (Šálek *et al*. 2013). The global conservation status of Steppe Polecat is difficult to assess because its ecology, abundance and distribution in many regions remain poorly known (Šálek *et al*. 2013). This note reports the first record of Steppe Polecat in Nepal.

As part of long-term ecological research into Snow Leopard *Panthera uncia* and Grey Wolf *Canis lupus* in the central Himalayas, Nepal, a Reconyx HC550 HyperFire camera-trap was set for 43 days in the Dharkeko pass (29.17356°N, 84.13422°E; datum WGS84) at 5,050 m asl (Fig. 1). The location and altitude were obtained using a Garmin *M/N* GPSmap 62sc GPS. Three photographs of a medium-sized carnivore obtained at 00h49 on 23 June 2014 (Fig. 2) were identified as a Steppe Polecat based on pelage features (i.e. dark on the upper/undersides and clearly paler flanks contrasting with a dark rump, tail and feet; a pale muzzle and hint of a darker mask, white fringes to the ears, and no sign of pale on the chin or throat) that collectively rule out all other small carnivores in the region (D. P Mallon, Prof. K. B. Shah and A. V. Abramov *in litt*. 2014). This is probably the most southerly record of Steppe Polecat in the world, although because the potentially southernmost historical records in Asia lack precise localities, this cannot be confirmed. At 5,050 m, this is at almost twice the highest occurrence traced by Tikhonov *et al*. (2008).

The habitat of the Dharkeko pass is mostly high-altitude Tibetan desert steppe (Fig. 3). The vegetation is dominated by *Carex*, *Kobresia pygmaea*, *Kobresia felicina*, *Stipa*, *Astragalus*, *Lagotis kunawurensis*, *Thymus linearis*, *Tanasetum nubigenum* and *Potentilla microphylla*. The southern and northern flanks of the Dharkeko pass consist mainly of highly broken cliffs. The pass is a summer grazing pasture intersected by livestock trails used by domestic yaks, jhopas (yak–cow hybrids) and horses. It also links to the vast landscape that adjoins the Tibetan Autonomous Region of the People's Republic of China. Small mammals present in the area are Woolly Hare *Lepus oiostolus*, Tibetan Dwarf Hamster *Cricetulus alticola*, Large-eared Pika *Ochotona macrotis* and various species of mice and voles. Tibetan Dwarf Hamster was also camera-trapped in the Dharkeko pass, in cliffs and rocky areas: it had not previously been documented in the upper Mustang of the Annapurna Conservation Area, although local people claim that it is quite common in the region. Along the Dharkeko pass trail, we obtained several photographs of Grey Wolf, Red Fox *Vulpes vulpes*, Brown Bear *Ursus arctos* and Snow Leopard.


**Fig. 1.** The location where the Steppe Polecat *Mustela eversmanii* was camera-trapped in the Upper Mustang of Annapurna Conservation Area, Nepal, on 23 June 2014.

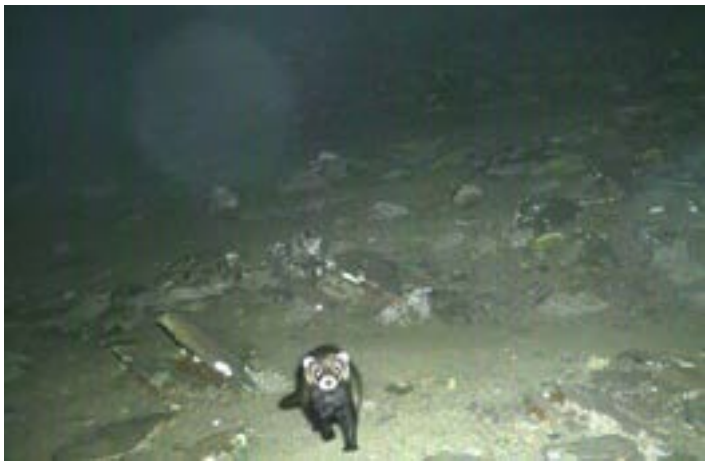

**Fig. 2.** Steppe Polecat *Mustela eversmanii* camera-trapped in the Upper Mustang of Annapurna Conservation Area, Nepal, 23 June 2014.


**Fig. 3.** Habitat where the Steppe Polecat *Mustela eversmanii* was camera-trapped in the Upper Mustang of Annapurna Conservation Area, Nepal.

The camera-trap pictures of Steppe Polecat were shown to twelve villagers of Lomanthang. People residing in the upper Mustang region are of Tibetan origin and speak the Lhowa language. Nine were unaware of the presence of the species, but three identified it as a 'kwak'. One, Thokme Lhowa, said that kwak was believed to originate from domestic cats left in caves by lamas who meditated there in the past. These cats' descendants are believed to be cave dwellers that prefer steep cliffs. They are seen very rarely because of their nocturnal habits. This existence of this myth implies that Steppe Polecat is not a vagrant to the region. It is plausible that the species inhabits other mountain protected areas in Nepal. Intensive camera-trapping coupled with genomic studies (reflecting the large distance from the Nepal record to confirmed occurrence

elsewhere) in the future might improve the knowledge of the species's population status, distribution and habitat.

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# A recent record of Pine Marten *Martes martes* from the Caspian region of Iran

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## Abstract

In March 2014 a Pine Marten *Martes martes* was video-recorded in a forest southeast of Neka city, northern Iran. To our knowledge, this is the first verifiable record of a free-living Pine Marten in Iran. All previous confirmed records of Pine Marten in Iran were from the south-eastern Caspian coast. Together with a recent unpublished record from Gilan province, this video supports the earlier speculations that this species's Iranian distribution extends, at least, throughout the Caspian forests in the northern foothills of Alborz Mountains.

*Keywords*: Alborz Mountains, distribution range, Hyrcanian deciduous forest, locality record, Mustelidae, northern Iran

# گزارش جدیدی از حضور سمور جنگلی *Martes martes* در جنگل‌های هیرکانی شمال ایران

## چکیده

اوایل اسفندماه ۱۳۹۲ از یک سمور جنگلی در حوالی روستای درویش‌خیلک در جنوب شرقی شهر نکا فیلم‌برداری شد. این گزارش، نخستین سند قطعی از یک سمور جنگلی زنده در داخل زیستگاه خود در ایران است. همه گزارش‌های حضور تاییدشده گذشته از سمور جنگلی در استان گلستان بوده‌است. این فیلم به همراه گزارش انتشارنیافته دیگری از استان گیلان، با نظریه پراکنش سمور جنگلی در حداقل سرتاسر زیستگاه‌های جنگلی هیرکانی نیم‌رخ شمالی رشته‌کوه البرز هم‌خوانی دارد.

Pine Marten *Martes martes* is a forest-specialist mustelid of the Palaearctic region, with a broad distribution range from Ireland and Scandinavia to western Siberia (Proulx *et al.* 2004, Kranz *et al.* 2008). By contrast, records across the southern parts of its geographical distribution in southwest Asia are scarce. Kranz *et al.* (2008) considered Iran to be the southernmost country within the species's range. Pine Marten records from Iran comprise a handful of historical ones from the southeastern Caspian coast (Fig. 1). Ellerman & Morrison-Scott (1951) noted an undated specimen from Astarabad (now Gorgan), Golestan province, in the Natural History Museum, U.K. Misonne (1959) reported a skin of unknown origin from Bandar Shah (now Bandar Torkaman), a port city approximately 16 km from any forest habitat. Lay (1967) collected a Pine Marten skin obtained from a forest approximately 18 km east of Gorgan (Fig. 1).

The intervening 47 years have seen no new Pine Marten records published for Iran (Harrington & Dareshuri 1976, Etemad 1985, Firouz 2005, Karami *et al*. 2008, Ziaie 2008). However, unverified reports exist from hills south of Tonekabon city, Mazandaran province (Ziaie 2008) and, a road-kill, within Golestan National Park in 2011 (Safaei *et al*. 2012) (Fig. 1). The latter was probably a misidentified Stone (= Beech) Marten *Martes foina*. The provincial wildlife authority has no record of the supposed incident (Mahmoud Shakiba, Golestan Department of the Environment (DoE), Golestan, Iran, verbally 2014). In October 2009 a decomposing carcase was discovered by local wildlife authorities in Gasht-e Rudkhan and Siah-Mazgi Protected


**Fig. 1.** Pine Marten *Martes martes* occurrence records along the Hyrcanian forests (shaded dark grey) of the northern slope of the Alborz Mountains, northern Iran. Circles: historical records in Golestan province; dark polygon: unpublished record from Gilan province; asterisk: the record of Pine Marten here reported, Geli Khak, Mazandaran province; question mark: Ziaie's (2008) unverified report (see text for details). Inset shows approximate location of Alborz and Zagros Mountains in north and northwest to southwest Iran, respectively.

**Fig. 2.** The Pine Marten *Martes martes* in Geli Khak Forest, vicinity of Darvish Khilak of Neka county, March 2014 (Photos: D. Abpeykar).

Area (36°56′–37°11′N, 49°03–20′E), the first confirmed record from Gilan province (www.farsnews.com/newstext.php?nn=8807130930) (Appendix 1).

Since 2011, one of us (KB) and a documentary filmmaker, Ali Ahmadi Zarrinkolayi (AAZ), have attempted to document wilderness in Mazandaran province. In May 2011, AAZ met Davoud Abpeykar (DA), a local shepherd passionate about the region's wildlife. AAZ purchased a handycam video camera for DA and trained him to record freely every wildlife species or interesting scene he encounters during his daily work.

In early March 2014, DA visited the village of Darvish Khilak (36°33′47″N, 53°28′56″E), approximately 20 km southeast of Neka city. Northward within a nearby forest locally known as Geli Khak, he sighted a medium-sized animal on a mature Hornbeam *Carpinus betulus* L. While the animal looked unaware of his presence, DA recorded this observation for 2:41 minutes. Almost one month later, AAZ & KB met DA and reviewed his video records. We easily recognised this Pine Marten from its typical *Martes* body characteristics and the yellow neck-patch (Fig. 2). This video is not only the first confirmed record of the Pine Marten in Mazandaran province, but also the first verifiable evidence of a free-living Pine Marten in its natural habitat in Iran.

The Pine Marten appears to be resting and remains still on the tree. Then it suddenly notices DA and flees after a few seconds. DA could not recall the exact place, date and time of this observation. The approximate location was 36°34′07″N, 53°29′50″E, at 420 m asl judging from Google Earth. Geli Khak Forest is part of a relatively large midland forest block of the central Hyrcanian region that expands along the Neka Rud (River) east to Golestan province. This temperate broadleaf mixed forest has remained almost unlogged during the past decade because of restrictions on timber harvest following the 1999 flood. Nevertheless, forest-dependant agro-pastoralist communities are patchily present at low density. Dominant trees are Hornbeam, Chestnut-leaved Oak *Quercus castaneifolia* C. A. Mey, maples *Acer* spp. and Caucasian Elm *Zelkova carpinifolia* (Pall.) C. Koch. Average annual rainfall is around 950 mm and annual temperature averages 17.5 °C, resulting in a semi-humid temperate climate (www.mazandaranmet.com/page.php?p=researches).

The historical and recent records in the northern slopes of the Alborz Mountains support Lay's (1967) suggestion that current Pine Marten distribution in Iran extends longitudinally through the Caspian deciduous forests. However, farther westward in the Iranian Caucasus and down along the dry deciduous forests of Zagros Mountains, Pine Marten occurrence remains questionable. Misonne (1959) relayed reports that fur dealers in Esfahan city regularly traded Pine Marten skins purportedly from the Zagros region. Verifiable records from this part of the country, as well as from northern Iraq (Iraqi Kurdistan; Amr 2009), remain lacking, meaning that Pine Marten occurrence along the Zagros Mountains remains hypothetical.

Pine Marten is said to be generally associated with trees and forest patches (Proulx *et al.* 2004, Mergey *et al.* 2011). Its presumed rarity in Iran might simply reflect that less than 8% of the country holds natural forest (c. 133,640 km$^2$; Anon. 2008 cited in Sagheb-Talebi *et al.* 2013). Yet, the arboreal and elusive nature of Pine Marten and lack of any field surveys targeting it may also be linked to the current paucity of information from Iran.

Pine Marten is commonly considered to be one of the most forest-dependant mammals of the Palaearctic (Proulx *et al.* 2004). In Europe deforestation and anthropogenic fragmentation of forest constrain its distribution, density and gene flow (e.g. Kurki *et al.* 1998, Mergey *et al.* 2011, Ruiz-Gonzalez *et al.* 2014). During the past century, Iran has lost two-thirds of its forest through intensified human-derived deforestation (Sagheb-Talebi *et al.* 2013). Even worse is that presently only 0.65% of Iran's natural forests receive any level of legal protection (Sagheb-Talebi *et al.* 2013). Destruction and degradation of forest are therefore potentially threatening the Pine Marten in Iran.

Confirmation of Pine Marten presence in Iran has proven difficult because of both morphological similarities with the apparently much more abundant Stone Marten (Proulx *et al.* 2004, Ziaie 2008) and lack of interest among Iranian biologists. A survey of Iranian biologists and local DoE offices might reveal further records of Pine Marten in Iran, all of which would be noteworthy.

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## Appendix 1

Pine *Marten Martes* martes carcase discovered in Gasht-e Rudkhan & Siah-Mazgi Protected Area, Gilan province, October 2009, the first confirmed record of the species in Iran for over 40 years (Photo: Gilan Department of the Environment).

# Use of raised plastic water-pipes by Common Palm Civet *Paradoxurus hermaphroditus* for habitat connectivity in an anthropogenic environment in West Java, Indonesia

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## Abstract

Common Palm Civet *Paradoxurus hermaphroditus* is a small nocturnal carnivore ranging across South and Southeast Asia that adapts well to human habitats. A single camera-trap recorded several instances of Common Palm Civets crossing a water-pipe in an agroforest in West Java, Indonesia. Water-pipes might be used because of low arboreal habitat connectivity there. Such use is further evidence of the species's high tolerance to human activity. Its widespread overlap with people must place it on the front line for the civet-trade demand, yet there is no information of whether this is having any effect on the wild population. An island-wide population survey to help understand changes in wild populations is warranted as a result of recently increased trade in the species.

*Keywords*: agroforest, camera-trap, conservation, fragmentation, movements, synanthropy

## Pemanfaatan pipa air plastik tergantung oleh musang luwak *Paradoxurus hermaphroditus* sebagai penghubung antar habitat pada wilayah hunian manusia di Jawa Barat-Indonesia

## Abstrak

Musang luwak *Paradoxurus hermaphroditus* merupakan karnivora kecil nokturnal yang tersebar dari wilayah selatan hingga tenggara benua Asia, yang telah mampu beradaptasi dengan baik terhadap lingkungan kehidupan manusia. Sebuah perangkap kamera merekam beberapa kejadian dari musang luwak yang menyebrangi pipa air tergantung menuju wilayah seberang di Jawa Barat, Indonesia. Digunakannya lintasan ini dikarenakan rendahnya jalur penghubung yang ada. Penggunaan jalur ini menunjukkan tingginya tingkat adaptasi satwa terhadap kehidupan di lingkungan manusia. Ketersinggungan kehidupan satwa ini dengan manusia perlu memperhatikan akan kebutuhan hidupnya, dan belum ada keterangan bagaimana pengaruhnya terhadap populasi di alam. Survey terhadap populasi yang terpecah akan membantu dalam memahami perubahan populasi di alam dan merupakan jaminan keberlanjutan kehidupannya sebagai akibat dari meningkatnya perdagangan jenis satwa ini.

## Introduction

Civets (Viverridae) are small nocturnal carnivores found in Asia and Africa. Common Palm Civet *Paradoxurus hermaphroditus* ranges across South and Southeast Asia to southern China and is found on many islands of the Greater Sundas, including the Indonesian island of Java (Jennings & Veron 2009). Reflecting its wide distribution, large population size and adaptability to altered habitats, it is listed as Least Concern on *The IUCN Red List of Threatened Species* (IUCN 2013). Common Palm Civet occurs in a wide range of habitats up to 2,400 m altitude (Heaney *et al*. 1998). These include primary and secondary evergreen and deciduous forests, plantations, logged forest and human settlements (e.g. Stuebing & Gasis 1989, Duckworth 1997, Krishnakumar & Balakrishnan 2003, Meijaard *et al*. 2005, Chua *et al*. 2012). It is highly frugivorous and an important seed disperser (Nakashima & Sukor 2010), but it also consumes small vertebrates and invertebrates. It is solitary and largely arboreal, sleeping during the day in trees or in dwellings such as houses and farm sheds (Rabinowitz 1991, Jennings & Veron 2009).

Despite its wide distribution, knowledge of Common Palm Civet behavioural ecology is still limited. Radio-tracking in Thailand and Nepal indicates that forest-dwelling Common Palm Civets are relatively reliant on arboreal pathways (Rabinowitz 1991, Joshi *et al*. 1995, Jennings & Veron 2009). Even less is known about how they survive in human-altered habitats. Nakashima *et al*. (2013) found the availability of day-beds and fruit to be important factors affecting civet survival in such environments. Fragmentation of land habitats is extensive throughout most of the world, with its negative effects well documented (e.g. Saunders *et al.* 1991). The island of Java in particular has experienced vast deforestation in the past 200 years: now only 10% of the island is forested (Nijman 2013). To exemplify how Common Palm Civet adjusts to anthropogenic habitats, we report on its use of water-pipes as pathways in a largely deforested agroforest in West Java.

## Study site

Cipaganti is a small village located on the foothills of an active volcano, Mt Papandayan, in West Java, Indonesia. Agriculture is a major source of income, predominantly rice supplemented by other crops. Therefore, research is performed within a mosaic of crop fields and villages, at 1,350–1,480 m altitude. The vegetation is characterised by introduced species that sparsely intersperse crop fields. Common crops include coffee, tea, chilli, carrot, cabbage and tomato. Other vegetation, mostly

introduced, includes *Eucalyptus*, *Calliandra calothyrsus* and several forms of bamboo. Rampant selective harvesting and large-scale clearing of bamboo and *C. calothyrsus* significantly limits canopy connectivity. For large-scale farming throughout the region, water-pipes have been installed by local farming communities, supplying water from distant ponds to the crop fields. The undulating terrain means water-pipes are often raised up to 12 m above the ground.

## Methods

An ongoing Javan Slow Loris *Nycticebus javanicus* study placed a camera-trap at 7°16′49″S, 107°45′45″E (1,450 m asl) facing a water-pipe. This water-pipe was 142 m long × 32 mm outer diameter, with a 2.5 mm wall of hard, smooth PVC-style plastic. A thin metal wire ran along and about 2–3 cm above the water-pipe. These characters are typical of long water-pipes in this region. A Cuddeback 1187 IR Attack motion-sensor camera-trap was set 1.5 m off the ground, on a *Eucalyptus* trunk for seven nights from 19 February 2014. Three other camera-traps were active nearby during this period; one on a tree (2.5 m off the ground, model: Cuddeback 1187) and two at ground-level (model: Bushnell Trophy Camera Brown 119496). All camera-traps, once triggered, recorded one still image followed by a ten-second video. They reset after a lag of 30 seconds.

## Results

The camera-trap facing the water-pipe recorded 29 photographs. In the same period, the other three camera-traps took none. The unit facing the water-pipe recorded seven instances of Common Palm Civet (Fig. 1) using the water-pipe to cross an open field. Twice in May 2014, during further camera-trapping at this water-pipe, a female and offspring moved on the pipe together, hopping over each other and grooming. All civets showed extreme agility on the water-pipe. They mounted and descended the water-pipe via trees. The quality of the camera-trap photographs does not permit the identification of individual civets, so it is unclear how many civets were photographed. There were five photographs of Javan Slow Loris, but none of any other mammal, crossing the water-pipe.


**Fig. 1.** Common Palm Civet *Paradoxurus hermaphroditus* walking on a water-pipe within a eucalyptus plantation. Cipaganti, Java, Indonesia, 17 February 2014 at 20h35.

## Conclusions and recommendations

Common Palm Civet is recorded regularly at Cipaganti, mostly in trees (Rode-Margono *et al*. 2014), but also frequently moving along the ground. Although often photographed above ground in trees (e.g. Low 2010), water-pipe use seems previously undocumented. The frequency at which photographs and video footage were taken combined with the animals' agility suggests that such use is common. This seems to be an adaptation to mosaic vegetation with limited arboreal connectivity. Placing camera-traps off the ground increases the chances of discovering arboreal civets. For instance, Wahyudi & Stuebing (2014) recorded Common Palm Civet only in trees during a 4½-year camera-trap study in East Kalimantan. Similar results were found at Cipaganti: the ground-level camera-traps recorded no civets despite three times the number of camera-trap-nights during the same period.

Once, a Slow Loris on the water-pipe was followed by a Common Palm Civet travelling in the same direction within one minute. We have seen no small carnivore at our site predate a Loris, although the Loris's size (900–1,100 g) suggests it could be possible prey for Common Palm Civet. Water-pipes might represent a vulnerable location for potential civet prey.

Palm civets use many different man-made structures. Common Palm Civet has been recorded to use telephone cable lines in Malaysia (Azlan 2003) and power lines in Singapore (Tan 2012), both of which are often thinner and less stable than are water-pipes. Additionally, it uses drains and sleeps on rooftops (SAFE undated). Small-toothed Palm Civet *Arctogalidia trivirgata* has been seen on roadside wires through forest (Duckworth & Nettelbeck 2008) and ropes on a ship (Sterndale 1884). The use of wildlife bridges to enhance habitat connectivity and to prevent road kill and electrocution of (semi-) arboreal mammals has been widely documented (Weston 2003, Das *et al*. 2009, Teixeira *et al*. 2013). In Cipaganti, species such as rats (Muridae) and treeshrews *Tupaia* have been recorded using rope and rubber bridges suspended for Javan Slow Loris, but, surprisingly, to date no Common Palm Civet use has been observed (unpublished data).

Morphological adaptations might facilitate the use of water-pipes and other artificial pathways by Common Palm Civet. Arboreal carnivores have elongated manual phalanges enhancing their ability to grasp substrates whilst climbing (Samuels *et al*. 2012). Membranes between their digits increase the area of contact between the underside of their paws and the substrate surface. Furthermore, their low centre of gravity would enhance the animals' stability when walking along unstable or thin substrates.

The use of water-pipes by Common Palm Civet is further evidence of its heavy tolerance to human activity. Its widespread urban and suburban occurrence must place it on the front line for the civet-trade demand, yet there is no information of whether this is having any effect on the wild population. Common Palm Civet is an increasingly common sight in wildlife markets in Indonesia (Shepherd 2008, Nijman *et al*. 2014) where it is sold as pets and to supply farms producing

*kopi luwak* (civet coffee). An island-wide Common Palm Civet population survey would help understand changes in wild populations as a result of trade. This should preferably cover a variety of sites from synathropic to remote ones.

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# Ruddy Mongoose *Herpestes smithii*: a new species for Nepal

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## Abstract

Ruddy Mongoose *Herpestes smithii* was recorded for the first time in Nepal, at Banke National Park in January 2014. It was recorded in only one of 96 camera-trap stations. This suggests its low density and/or localised distribution but also hints that it might occur in other parts of the Banke–Bardia–Katerniaghat–Suhelwa complex. The newly established Banke NP harbours some threatened and charismatic species within diverse ecosystems. It now has the role to preserve this species new to Nepal as well.

*Keywords*: Balapur, Banke National Park, camera-trapping, extension of known range, habitat, locality record

Three species of mongoose are well known to occur in Nepal, all also inhabiting India: Small Indian Mongoose *Herpestes* (*javanicus*) *auropunctatus,* Indian Grey Mongoose *H. edwardsii* and Crab-eating Mongoose *H. urva* (Baral & Shah 2008, Thapa 2014). Ruddy Mongoose *H. smithii* is known from Sri Lanka and peninsular India, in the forests of the Western and Eastern Ghats north to Bihar and to the open thorn forests of Rajasthan (Pocock 1941, Dookia 2013, Mudappa 2013). This note records the first record of Ruddy Mongoose from Nepal.

A Ruddy Mongoose was photographed by Bushnell Infrared camera-trap (Trophy Cam HD) within Banke National Park (Banke NP) on 11 January 2014 at 14h38 (temperature 13° C). The camera-trap station was at Changi, near Lutepani (28°10′42.00″N, 81°49′13.75″E; 235 m) in a fire-line trail through mixed deciduous forest with open scrub forest to the south (Figs 1–3). The station lay at the base of the Chure hill range, approximately 4.7 km from the nearest village (Balapur). The location and altitude were recorded by a hand-held GPS unit (WGS 84 datum). Morphologically, Ruddy Mongoose resembles Indian Grey Mongoose closely but is distinguished by its distinct black tail-tip of 2–3 inches, darker feet and slightly larger size (Prater 1971). The black tail tip is readily visible in the camera-trap photographs.


**Fig. 1.** Location of Ruddy Mongoose *Herpestes smithii* camera-trap record in the western Terai Arc Landscape, Banke National Park, Banke district, Nepal, on 11 January 2014.

**Fig. 2.** Ruddy Mongoose *Herpestes smithii* camera-trap photograph from Banke National Park, Nepal, on 11 January 2014.

The record came from research into the population dynamics of Tiger *Panthera tigris* and its prey in the recently (2010) gazetted Banke NP (550 km$^2$), a joint operation by the Department of National Parks and Wildlife Conservation (Government of Nepal [GoN]), Department of Forests (GoN) and WWF Nepal, directly involving the local communities in field survey. Banke NP contains Chure (Sivalik) hill ranges to the north and bhabhar forests to the south, intersected by intermittent rivers with two, the Thuria and Khairi khola, meeting the main river, the Rapti, to the south. A 2 × 2 km grid across the park deployed 96 camera-trap stations for a 57-day period, all placed on trails commonly used by Tigers for movement. No baits or lures were used.

This locality record of Ruddy Mongoose in Banke NP lies approximately 27.75 km from the Indian border at Rupaidiya (Uttar Pradesh). It is the northernmost record in the world, the most northerly traced by Dookia (2013) being from Sariska NP, Rajasthan, north-west India, at about 27°30′N. The nearest previous Ruddy Mongoose record to Banke NP appears to be that from Bihar at about 24°N (Dookia 2013). The Banke NP record suggests that Ruddy Mongoose might also occur in oth-

**Fig. 3.** Overview of Banke National Park, Nepal (left), and a fire-line trail through mixed deciduous forest in the park similar to where the Ruddy Mongoose was camera-trapped (right).

er parts of the Banke–Bardia–Katerniaghat–Suhelwa complex. However, the species was camera-trapped in only one station of 96, suggesting that its distribution in this area is localised and/or its density is very low.

Ruddy Mongoose is said to be reclusive in contrast to Indian Grey and Small Indian Mongooses, usually using more secluded dry open scrub forests (Prater 1971). Recent records of Ruddy Mongoose in two parts of India with few or no previous records came from scrub and dry thorny forests (Dookia 2013, Sreehari *et al*. 2013). The Banke NP Ruddy Mongoose record was also in a dry region. Furthermore, the record comes from the periphery of the park's central zone: the sector least disturbed by people, with healthy forests of dense canopy and profuse ground vegetation with higher prey and predator density (Dhakal *et al*. 2014). Banke NP also holds the localised Four-horned Antelope *Tetracerus quadricornis*. Four Tiger individuals have been recorded so far (Dhakal *et al*. 2014). With the forest patches of Banke district finally turning into a national park and the prey and predator density slowly recovering, the promise the park has for small carnivores is a better one. Regular monitoring of high-profile species like Tiger provides an opportunity to monitor these little-known small carnivores too.

## Acknowledgements

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# The first locality records of Banded Civet *Hemigalus derbyanus* and Masked Palm Civet *Paguma larvata* from Brunei Darussalam

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## Abstract

The first locality records of Banded Civet *Hemigalus derbyanus* and Masked Palm Civet *Paguma larvata* for Brunei were in Ulu Temburong in January 1984. A compilation of Bornean carnivore records in 2011 traced no others of either species from the country.

*Keywords*: Borneo, distribution, extension of known range, spotlighting, Ulu Temburong

Brunei Darussalam covers 5,765 km$^2$ (0.77%) of Borneo, the fourth largest island in the world. Its mammals were little collected in the 19th and early 20th centuries compared with nearby Sabah and Sarawak, now states of Malaysia. There are relatively few mentions of the country in the authoritative records compilations of Medway (1977) and Payne *et al*. (1985). The last few decades have seen greatly increased survey effort in Borneo, but Brunei remains comparatively under-surveyed. A recent compilation of national records of South-east Asian mammals (Shepherd & Shepherd 2012: 140–169) does not list for Brunei many species that might be assumed to occur there, based on records from Sarawak and Sabah in habitat similar to, and in many cases contiguous with, that of Brunei. National boundaries often have little significance to understanding a species's natural history, but wildlife management, national laws, international treaties and species accounts on *The IUCN Red List of Threatened Species* (IUCN 2014) depend on correct country-specific documentation of species occurrence.

In January 1984, I participated in 'Exercise Temburong Ringer' in the Ulu Temburong (= the upper reaches of the River Temburong), Brunei Darussalam (Bennett *et al*. 1987). The mammal survey revealed two species of small carnivore for which a Borneo-wide records compilation, the 'Borneo Carnivore Symposium 2011' (see Shepherd *et al*. 2011) traced no other records from Brunei: Banded Civet *Hemigalus derbyanus* and Masked Palm Civet *Paguma larvata*. The Masked Palm Civet record was specifically mentioned by Payne *et al*. (1985) and Brunei is included in that species's range by the *IUCN Red List* (IUCN 2014), but the Banded Civet record has been widely overlooked. This note therefore places the two observations on formal record.

The survey area was located in rugged terrain well beyond any access by road or river: the team had to use helicopter for arrival and departure. Habitat had not been significantly disturbed. The occasional evidence of hunting parties found indicated only very light use. Consequently many species prone to shyness in hunted areas were confiding. However, over the international border chain-saws were audible from Bukit (= hill) Tidal on the Brunei–Sarawak border, with forest logged to within 3.5 km of Bukit Tidal. Dogs, presumably of hunting parties, could be heard barking from the Sarawak forest. The survey's base-camp was located on the east bank of the Sungei (= River) Temburong, 1 km south of Kuala Temawai, within the 460 km$^2$ Batu Apoi Forest Reserve at about 4°23′30″N, 115°16′45″E (about 1,200 feet [370 m] asl). Surveys were conducted east to the summit of Bukit Tidal (1,181 m), mostly between 380 and 685 m along a 4-km loop trail cut for the purpose. A 500-m section of the trail was walked with spotlights on six nights; mist and heavy rain forestalled such survey on the other nights. Eleven morning daytime transects along 2 km the trail for intensive observation were supplemented with many ad hoc walks at other times and on other sections, including four visits to the summit of Bukit Tidal. Observations were made over 10–31 January. The ruggedness of the terrain, adverse weather and consequently low and inefficient survey by spotlighting mean that the nocturnal mammal community was far from completely inventoried.

A Banded Civet was observed one night by spotlight near the top of a ridge. It gave a prolonged, close, unobscured view as it walked across the forest floor and then started leaning up a tree as if investigating something. These views left its identity in no doubt, since the only other potential striped civet-like animal was Banded Linsang *Prionodon linsang*, but the brown body colour and lack of spots on the legs confirmed the identity as a Banded Civet. A Masked Palm Civet was trapped by some colleagues and released, also allowing a clear view and unambiguous identification. The only other small carnivore confirmed during the short survey was Yellow-throated Marten *Martes flavigula* (Bennett *et al*. 1987).

The occurrence of Banded Civet and Masked Palm Civet in Brunei is entirely to be expected given their general distributions and habitat use in Borneo as given in Medway (1977) and Payne *et al*. (1985). The apparent lack of subsequent records from Brunei highlights the opportunities for further discoveries there. Expanded surveys may be particularly valuable for conservation given the occurrence in Brunei of the globally threatened Hose's Civet *Diplogale hosei*, endemic to Borneo (Francis 2002, Yasuma 2004).

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# The first record of Indonesian Mountain Weasel *Mustela lutreolina* from northern Sumatra, Indonesia

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## Abstract

An Indonesian Mountain Weasel *Mustela lutreolina* was camera-trapped at 2,596 m in the eastern part of Leuser Landscape, Sumatra, Indonesia. This is the first record from the northern half of Sumatra. It is only the second photograph of a wild individual. It is now safe to assume that the species can be found at appropriate altitudes throughout the Bukit Barisan mountain-range, which spans the latitudinal range of Sumatra. Variation in the pelage coloration emphasises the need to review the taxonomy of the species. The survey also camera-trapped Collared Mongoose *Herpestes semitorquatus*, one of few Sumatran records and, at 666 m asl, the highest on the island by almost 400 m.

*Keywords*: Collared Mongoose, Data Deficient species, extension of known range, habitat, *Herpestes semitorquatus*, Leuser Landscape, locality record, pelage morphology

## Temuan Pertama Pulusan Gunung *Mustela lutreolina* dari Bagian Utara Sumatera, Indonesia

## Abstrak

Pulusan gunung telah terdokumentasi pada ketinggian 2,596 m di bagian timur Kawasan Ekosistem Leuser, Sumatera, Indonesia. Foto tersebut merupakan temuan pertama yang berasal dari Sumatera bagian utara dan foto kedua individu liar. Temuan ini memperkuat asumsi bahwa spesies ini dapat ditemukan pada ketinggian yang sesuai di rangkaian Bukit Barisan, yang merentang dari Utara hingga Selatan pulau Sumatra. Pulusan gunung menunjukkan variasi warna rambut yang menekankan kebutuhan tinjauan ulang taksonomi spesies ini. Terdokumentasi juga di survey ini garangan ekor panjang *Herpestes semitorquatus*, satu dari sedikit catatan yang ada dari pulau Sumatera. Spesies ini ditemukan pada ketinggian 666 m dpl sehingga merupakan catatan tertinggi keberadaannya di Sumatra dibandingkan catatan sebelumnya hingga lebih dari 400 m.

*Kata kunci*: catatan setempat, habitat, Garangan Ekor Panjang, *Herpestes semitorquatus*, Kawasan Ekosistem Leuser, morfologi warna rambut, perluasan area jelajah yang telah diketahui, spesies dengan sedikit data

Indonesian Mountain Weasel *Mustela lutreolina*, restricted to Java and Sumatra, Indonesia, is little known in distribution, population and ecology. Hence, its threats cannot be meaningfully assessed so it is categorised on *The IUCN Red List of Threatened Species* as Data Deficient (Duckworth *et al*. 2008) until further study allows an informed judgement. The paucity of *M. lutreolina* records indicates how difficult this species is to find using conventional survey techniques. Whether this is because there is not much study specifically for it, as suggested 25 years ago (Schreiber *et al*. 1989), or because of a real rarity is unclear. The first *M. lutreolina* specimen from Sumatra was from Bengkulu district in 1865 (van Bree & Boeadi 1978). Since then, four other records have been made on the island: specimens from Gunung Dempo in 1936 (Lunde & Musser 2003) and 1942 (van Bree & Boeadi 1978); and single field sightings in Kerinci Seblat in each of July 1995 (Holden 2006) and June 2008 (Eaton 2009). Its occurrence in Java is confirmed from nine records from as far back as 1916 in Cibodas, West Java, to a record in 1958 from the same location (Meiri *et al*. 2007). There seem to be no more recent records. All records from both Java and Sumatra suggest that *M. lutreolina* is restricted to high altitudes above 1,400 m (van Bree & Boeadi 1978, Holden 2006, Meiri *et al*. 2007).

This note describes the first record of *M. lutreolina* in the relatively well surveyed Leuser landscape. This confirms its occurrence in the northern half of Sumatra, about five degrees of latitude north of the previous northernmost record (that of Eaton [2009] at 1°41′50″S, 101°17′40″E). It is now safe to assume that the species can be found at appropriate altitudes throughout the Bukit Barisan mountain-range, which spans the latitudinal range of Sumatra.

A camera-trap provided two photographs (six seconds apart) of *M. lutreolina* (Fig. 1) in the eastern part of Leuser Landscape, inside the designated Gunung Leuser National Park (NP) at 3.29942°N, 98.24914°E (WGS84; 2,596 m asl; derived from a DEM layer) (Fig. 2) on 15 February 2013 at 12h40. This altitude matches previous records at 1,400–3,000 m asl (Meiri *et al*. 2007). The photographs show an animal with general shape and posture shown only, among the mammals of Sumatra, by weasels *Mustela*. Two weasel species are known from the island: *M. lutreolina* is typically dark brown in colour, with a thin tail (van Bree & Boeadi 1978, Eaton 2009), while Malay Weasel *M. nudipes* is typically (but with some variation) bright orange with a whitish head, and has a 'feathery' tail (Brongersma & Junge 1942, Ross *et al*. 2012). The tail morphology fits *M. lutreolina*, not *M. nudipes*. Although the Leuser animal is not the typical colour of either species, Jeremy Holden (*in litt*. 2014) confirms that it looks similar in colour to his field sighting identified as *M. lutreolina*. Identification as *M. lutreolina* is further confirmed by William Duckworth and Alexei Abramov (*in litt*. 2014). The family Holden (2006) observed in Kerinci Seblat was in alpine *Vaccinium* scrub a few hundred meters

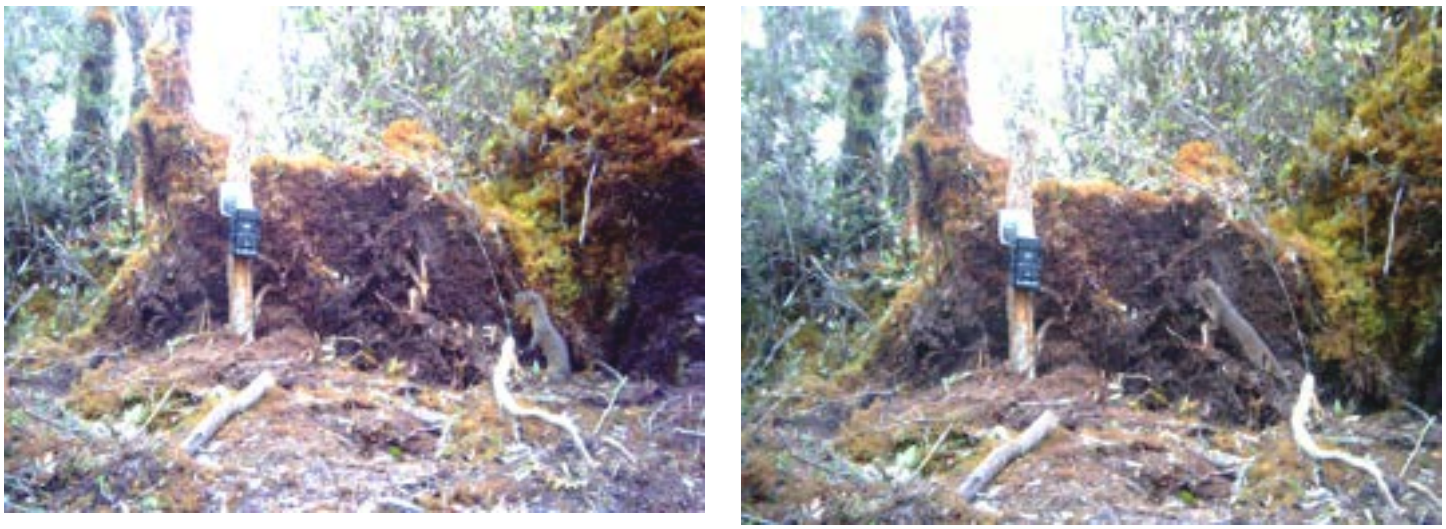

**Fig. 1.** The Indonesian Mountain Weasel *Mustela lutreolina* camera-trapped at 2,596 m asl in Gunung Leuser National Park, Sumatra, Indonesia, 15 February 2013.

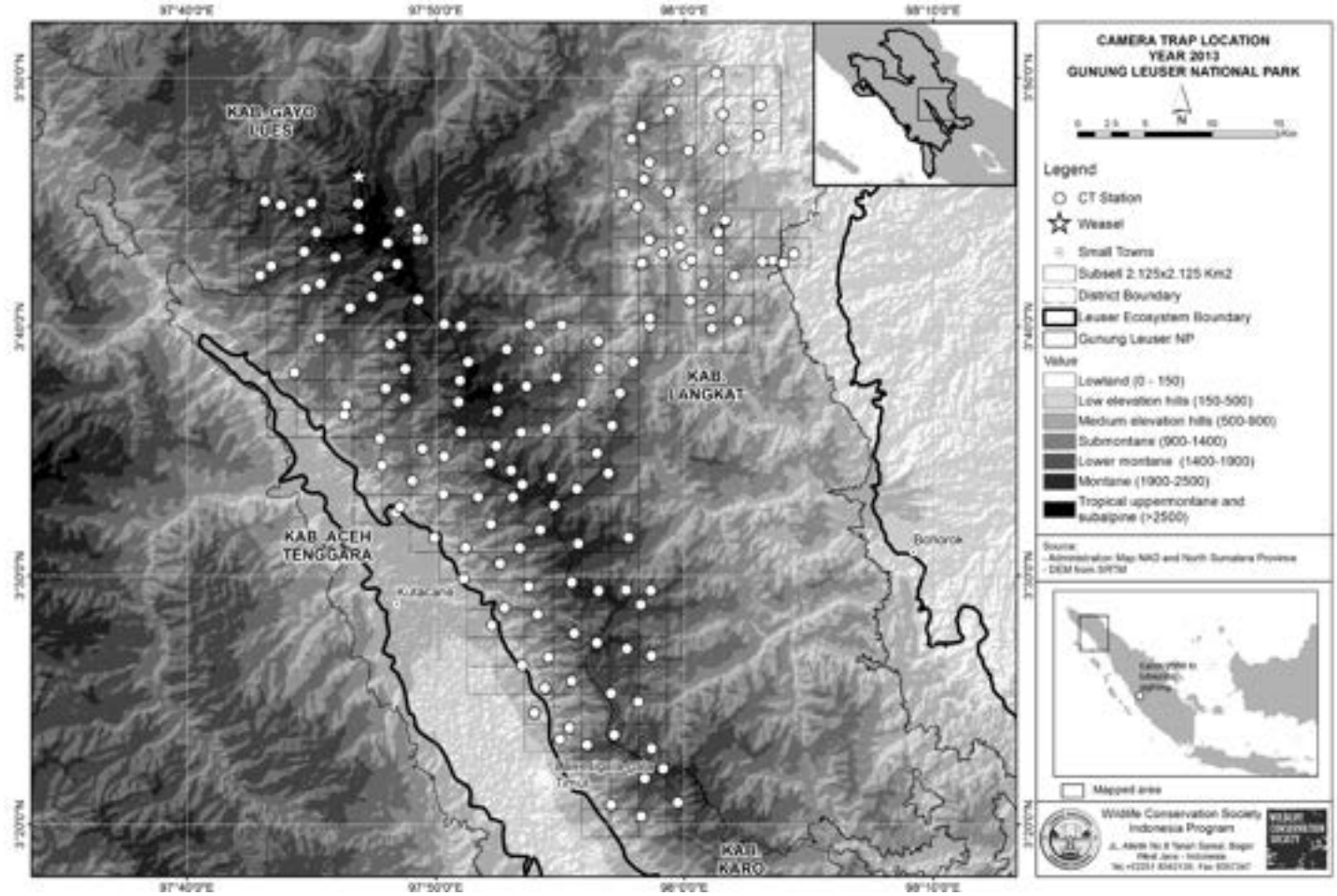


**Fig. 2.** Camera-trap arrangement within Leuser Landscape, 2013. The camera-trap station recording the Indonesian Mountain Weasel *Mustela lutreolina* is marked with star. The previous northernmost record on Sumatra (Eaton 2009) is marked with a white circle on the inset.

above the tree line. The Leuser photographs come from similar habitat, at high elevation above the tree line.

Gunung Leuser NP is nested within the vast Leuser Landscape in northern Sumatra (27,000 km$^2$), selected for conservation and restoration of the Leuser biodiversity and ecosystem as mandated by the Presidential Decree No. 33/1998. Together with the Ulu Masen Landscape to the north-west, the area forms the largest natural forest area and biodiversity resource surviving in Sumatra, the Leuser–Ulu Masen Ecosystem. Gunung Leuser NP has a rugged forest interior bordered with human-dominated areas. it supports various habitats from lowland forest at 5 m asl to the subalpine zone of Gu-

nung Leuser at 3,445 m. Gunung Leuser NP has been chosen as a UNESCO heritage site, in part because it teems with rich post-Pleistocene biodiversity.

The weasel was camera-trapped during WCS's January–July 2013 capture–recapture study of Sumatran Tiger *Panthera tigris* in the eastern part of Gunung Leuser National Park (Fig. 2). The camera-traps (Panthera camera V4) were set without baits or lures, in pairs at 144 stations giving an average camera-trap-day density of 300/100 km$^2$ across 1,337 km$^2$ (minimum convex polygon). The camera-traps were set to detect Tiger on trails, mounted on tree trunks with the sensor directed perpendicular to the animal trail at height of ~45 cm above the ground and 4–5 m from the trail. The surveyed habitat is mostly mountainous with an altitude range of 116–2,973 m asl. Of 144 stations, 78 (54.16 %) were at or above 1,500 m and thus firmly in the potential altitudinal zone of this weasel. The camera-trap stations separated by altitudinal zonation (Laumonier 1997) into: lowland 2.52% (below 150 m), low elevation hills 15.72% (150–500 m), medium elevation hills 18.24% (500–900 m), sub-montane 13.84% (900–1,400 m), lower montane 15.72% (1,400–1,900 m), montane 25.16% (1,900–2,500 m), and tropical upper-montane and subalpine 8.81% (above 2,500 m). The study area has little anthropogenic influence because of its rugged terrain and difficulty of access.

This is the first ever camera-trap photograph of *M. lutreolina*. The weasel seems to have been interested in the equipment and climbed the background of one camera-trap's mount. This might have increased this small animal's chance of triggering the camera-trap, specifically set at a height for detecting Tiger and possibly not optimal for weasels. Although *M. nudipes* is known from Gunung Leuser NP (Duckworth *et al*. 2006), none was camera-trapped during the survey, consistent with the general rarity of records of the species by this method (Duckworth *et al*. 2006, Ross *et al*. 2013).

All *M. lutreolina* specimens from Java apparently have pelts dark brown (glossy dark russet) in colour (van Bree & Boeadi 1978). All Sumatran specimens are also this colour: the two from Gunung Dempo (van Bree & Boeadi 1978, E. Westwig *in litt*. 2014) and the one from Bengkulu (Dammerman 1940). One sighting in Kerinci Seblat was also brown (Eaton 2009). But the other sighting from Kerinci Seblat (Holden 2006) and this record are of animals greyish in pelage. Although some of the colour of the Leuser animal might be photographic artefact, the tones of the background do not suggest that this could be the sole reason for its greyness, while Holden's (2006) description of a field sighting as slate-grey confirms that the species can, on Sumatra, be this colour. The extent, if any, of seasonal variation in pelage colour in this species has not been investigated. There are so few specimens from Java that it is possible that grey animals occur there as well and by chance have not been collected. Nonetheless, it is tempting to wonder whether there could be any taxonomic significance to this potential variation in pelt colour between Java and Sumatra: Lunde & Musser (2003) already noted some possible differences in other features between the specimens from the islands. The existance of wider variation in pelage colour emphasises the value of taxonomic review which will, however, be difficult until more material is available.

At least one other small carnivore record from this survey is of high significance: Collared Mongoose *Herpestes semitorquatus* was camera-trapped twice through three photographs taken at one camera-trap station (3.29051°N, 98.09631°E; 666 m asl): a duo on 26 July 2013 at 14h28 and a single on 2 July 2013 at 21h03. The animals are foraging in the ground (Fig. 3). There are very few records of this species from Sumatra; all previous ones with elevation information come from below 300 m (Holden & Meijaard 2012).

**Fig. 3.** Two Collared Mongooses *Herpestes semitorquatus* camera-trapped at 666 m asl in Gunung Leuser National Park, Sumatra, Indonesia, 26 July 2013.

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# Current distribution and conservation status of small carnivores in Thailand: a baseline review

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## Abstract

The status and distribution of small carnivores in Thailand are poorly documented even though parts of the country fall within a global core area for small carnivore conservation. Small carnivore records were compiled from most camera-trap programmes in Thailand during 1996–2013, from 21 survey areas with a total effort of about 80,000 camera-trap nights. Some records from this period generated by other methods were also collated, mainly from the authors, their correspondents through social networks, and the literature. Most photographic records were validated by independent reviewers. Of 24 species of small carnivore known from Thailand, nine were not camera-trapped by any contributing survey. No 1996–2013 records were traced from anywhere in Thailand for one species, Siberian Weasel *Mustela sibirica*, nor any from the 21 survey areas for another, Hairy-nosed Otter *Lutra sumatrana*. Six of these nine (three weasel *Mustela* species, Asian Small-clawed Otter *Aonyx cinereus*, Small-toothed Palm Civet *Arctogalidia trivirgata* and Otter Civet *Cynogale bennettii*) were recorded by other surveyors and/or other means in at least one of the 21 camera-trap survey areas; another (Eurasian Otter *L. lutra*) had been camera-trapped in one such area shortly before 1996. Conventional camera-trapping evidently has limited ability to detect these seven species. The number of camera-trap stations with records varied widely across species, presumably reflecting differences in species abundance and behaviour, patterns of survey effort, random chance and perhaps other factors. Common Palm Civet *Paradoxurus hermaphroditus*, Large Indian Civet *Viverra zibetha*, Hog Badger *Arctonyx collaris*, Crab-eating Mongoose *Herpestes urva* and Yellow-throated Marten *Martes flavigula* were camera-trapped in most survey areas. Hog Badger and Large Indian Civet are healthier in status in Thailand than in some neighbouring countries, consistent with longer-term and greater commitment to protected areas and wildlife laws in the country. The three species of highest priority for national conservation action, Hairy-nosed Otter, Otter Civet and Large-spotted Civet *Viverra megaspila*, are threatened mainly by conversion and degradation of their habitats, forested coastal wetlands (the former two) and forest on gentle-terrain under 300–400 m asl (the latter). Immediate habitat protection is required. Among eight species of less clear conservation status, three species of otter, Binturong *Arctictis binturong* and Banded Civet *Hemigalus derbyanus* are arguably of higher action priority because all are considered globally threatened. Rapid conversion of natural habitats threatens these species' survival in Thailand. Comprehensive survey of semi-natural wetlands is probably the highest national survey priority for small carnivores (including cats [Felidae]). Any surveys, particularly in the north and any research, even of common species, would add to the knowledge base from which to conserve Thai small carnivores. Available resources for small carnivore in Thailand should be directed towards the priority species and habitats wherever possible.

*Keywords*: altitudinal distribution, camera-trapping, conservation, habitat use, locality records, protected areas, social network

**สถานภาพและการแพร่กระจายของสัตว์ผู้ล่าขนาดเล็กในประเทศไทย**

**บทคัดย่อ**

ประเทศไทยตั้งอยู่ในศูนย์กลางพื้นที่ที่มีความสำคัญระดับโลกต่อการอนุรักษ์สัตว์ผู้ล่าขนาดเล็ก ถึงกระนั้นองค์ความรู้ ความเข้าใจทางด้านสถานภาพและการแพร่กระจายของสัตว์ในกลุ่มนี้ยังขาดความชัดเจนค่อนข้างมาก ข้อมูลที่เผยแพร่ในรายงานฉบับนี้ ได้มาจากการรวบรวมข้อมูลการสำรวจด้วยกล้องดักถ่ายภาพอัตโนมัติจาก 21 พื้นที่ ซึ่งประกอบไปด้วยอุทยานแห่งชาติ เขตรักษาพันธุ์สัตว์ป่า และพื้นที่ที่ไม่ใช่พื้นที่อนุรักษ์ ที่ทำการสำรวจในระหว่างปีพ.ศ. 2539 – 2556 รวมจำนวนวันสำรวจด้วยกล้องดักถ่ายภาพอัตโนมัติทั้งสิ้นประมาณ 80,000 วัน นอกจากนั้นยังรวบรวมข้อมูลการพบเห็นโดยตรงผ่านเครือข่ายสังคมออนไลน์ (Facebook) และข้อมูลที่มีการตีพิมพ์เผยแพร่มาก่อนแล้ว ภาพจากกล้องดักถ่ายและที่ได้รับจากเครือข่ายออนไลน์เกือบทั้งหมดได้ผ่านการตรวจสอบความถูกต้องในการจำแนกชนิดจากผู้เชี่ยวชาญอิสระ จากจำนวนสัตว์ผู้ล่าขนาดเล็กทั้งหมด 24 ชนิดที่มีรายงานการปรากฏในประเทศไทย มี 9 ชนิดที่สำรวจไม่พบด้วยกล้องดักถ่ายภาพอัตโนมัติ จากข้อมูลที่รวบรวมมาทั้งหมดในช่วงเวลาดังกล่าว ไม่พบหลักฐานการปรากฏของเพียงพอนเหลือง (*Mustela sibirica*) และไม่พบหลักฐานการปรากฏของนากจมูกขน (*Lutra sumatrana*) ใน 21 พื้นที่ อย่างไรก็ตามมีการสำรวจพบสัตว์ผู้ล่าขนาดเล็กด้วยวิธีการอื่นๆ รวมทั้งจากการศึกษาอื่นๆ จำนวน 6 ชนิด จาก 9 ชนิดข้างต้น ได้แก่ เพียงพอน (*Mustela*) ทั้ง 3 ชนิด นากเล็กเล็บสั้น (*Aonyx cinereus*) อีเห็นหน้าขาว (*Arctogalidia trivirgata*) และอีเห็นน้ำ (*Cynogale bennettii*) ทั้งนี้มีการสำรวจพบนากยูเรเซีย (*L. lutra*) ในพื้นที่หนึ่งจาก 21 พื้นที่ด้วยกล้องดักถ่ายภาพอัตโนมัติก่อนปีพ.ศ. 2539 ทั้งนี้สะท้อนให้เห็นถึงข้อจำกัดของการสำรวจสัตว์ผู้ล่าขนาดเล็กด้วยกล้องดักถ่ายภาพอัตโนมัติอย่างน้อยที่สุดกับ 7 ชนิดดังกล่าว สัตว์แต่ละชนิดมีการกระจาย (จำนวนจุดติดกล้องที่ถ่ายภาพได้) แตกต่างกันค่อนข้างมาก ซึ่งอาจมีสาเหตุมาจากความชุกชุมและพฤติกรรม รวมถึงการออกแบบการศึกษา ความบังเอิญ และปัจจัยอื่นๆ ที่ไม่เป็นที่แน่ชัด

อีเห็นข้างลาย (*Paradoxurus hermaphroditus*) ชะมดแผงหางปล้อง (*Viverra zibetha*) หมูหริง (*Arctonyx collaris*) พังพอนกินปู (*Herpestes urva*) และหมาไม้ (*Martes flavigula*) เป็นสัตว์ที่สำรวจพบด้วยกล้องดักถ่ายภาพอัตโนมัติจากเกือบทุกพื้นที่ หมูหริ่งและชะมดแผงหางปล้องในประเทศไทยมีสถานภาพที่ดีกว่าประเทศเพื่อนบ้าน ในภูมิภาคนี้ โดยเปรียบเทียบ ทั้งนี้น่าจะมีสาเหตุมาจากการที่ประเทศไทยมีการบังคับใช้กฎหมายเพื่อสงวนและคุ้มครองสัตว์ป่ามาอย่างยาวนานกว่าประเทศอื่นๆ สัตว์ผู้ล่าขนาดเล็ก 3 ชนิดที่ต้องได้รับการการอนุรักษ์อย่างเร่งด่วนที่สุด ได้แก่ นากจมูกขน อีเห็นน้ำ และชะมดแผงสันหางดำ (*V. megaspila*) เนื่องจากการสูญเสียถิ่นที่อยู่อาศัย ซึ่งได้แก่ พื้นที่ชุ่มน้ำตามแนวชายฝั่ง และป่าที่ราบต่ำ (ต่ำกว่า 300-400 เมตร) ด้วยเหตุนี้การปกป้องคุ้มครองถิ่นที่อยู่อาศัยจึงเป็นสิ่งจำเป็นเร่งด่วน สัตว์ผู้ล่าขนาดเล็กที่มีสถานภาพด้านการอนุรักษ์ยังไม่ชัดเจน มีจำนวน 8 ชนิด ได้แก่ นาก 3 ชนิด หมีขอ (*Arctictis binturong*) และอีเห็นลายพาด (*Hemigalus derbyanus*) อย่างไรก็ตามควรมีการศึกษาอย่างเร่งด่วน เพราะสัตว์กลุ่มนี้มีความเสี่ยงต่อการสูญพันธุ์ในระดับโลก

เนื่องจากพื้นที่ชุ่มน้ำเป็นถิ่นที่อยู่อาศัยที่สำคัญของสัตว์ผู้ล่าขนาดเล็กหลายชนิดที่มีสถานภาพถูกคุกคามในระดับโลก (รวมทั้งสัตว์ในกลุ่มแมวป่า [Felidae] ด้วย) ดังนั้นควรได้รับความสำคัญในลำดับสูงสุดในการสำรวจเพื่อประเมินสถานภาพของสัตว์ผู้ล่าขนาดเล็ก อย่างไรก็ตามการสำรวจในพื้นที่อื่นๆ โดยเฉพาะทางภาคเหนือก็มีความจำเป็นเช่นกัน ถึงแม้ว่าจะเป็นการสำรวจชนิดพันธุ์ที่พบเจอได้ทั่วไป แต่จะมีส่วนช่วยเพิ่มพูนองค์ความรู้พื้นฐานในการอนุรักษ์สัตว์ผู้ล่าขนาดเล็กของประเทศไทยต่อไป ในการสนับสนุนการศึกษาวิจัยสัตว์ผู้ล่าขนาดเล็ก ควรพิจารณาให้ความสำคัญกับชนิดพันธุ์และถิ่นที่อยู่อาศัยที่ถูกคุกคาม

## Introduction

Globally, there are about 165 species of 'small' carnivores in the nine families Mustelidae, Mephitidae, Procyonidae, Ailuridae, Nandiniidae, Prionodontidae, Eupleridae, Viverridae and Herpestidae (Schipper *et al*. 2008). Almost half these species inhabit tropical and subtropical Asia. In Thailand, 24 species (Table 1) have been recorded from four of the families: Mustelidae (weasels, martens, badgers and otters), Prionodontidae (linsangs), Viverridae (civets) and Herpestidae (mongooses) (Lekagul & McNeely 1977, Supparatvikorn *et al*. 2012). Almost half the species (11) are categorised on *The IUCN Red List of Threatened Species* (IUCN 2013) in categories other than Least Concern. This proportion drops to about two-thirds (seven out of 20) if otters (one Endangered, two Vulnerable and one Near Threatened) are excluded from the comparison. Of the other species, one is Endangered, three Vulnerable, two Near Threatened and one Data Deficient. This number of non-Least Concern species indicates the value of comprehensive synthesis of available information on their conservation status (distribution, abundance, trends in distribution and abundance, threats, and conservation measures required).

Yet the conservation status of small carnivores in Thailand is much less well documented than it is for large carnivores, the bears [Ursidae], Dhole *Cuon alpinus* and larger cats, Clouded Leopard *Neofelis nebulosa*, Leopard *Panthera pardus* and Tiger *P. tigris*. In contrast to Myanmar (Than Zaw *et al*. 2008) and Lao PDR (Duckworth 1997), Thailand lacks a location-specific compilation of records for each small carnivore species, even though parts of Thailand (along with northern Vietnam and parts of each of Lao PDR and China) fall within an area considered by Schreiber *et al.* (1989) to be a global core area for small carnivore conservation. Schreiber *et al*. (1989) called for surveys in Thailand, particularly for Otter Civet *Cynogale bennettii*, Stripe-backed Weasel *Mustela strigidorsa*, Spotted Linsang *Prionodon pardicolor* and Large-spotted Civet *Viverra megaspila*. These have not occurred, although some ecological research ranging from cursory surveys to intensive study of radio-collared individuals has been conducted on Thai small carnivores (Simcharoen 1990, Simcharoen *et al.* 1999, Rabinowitz 1991a, 1991b, Rabinowitz & Walker 1991, Kruuk *et al*. 1993, 1994, Conforti 1996, Grassman 1998, Kanchanasaka 1998, 2000, 2001a, 2001b, 2003, Austin & Tewes 1999, Austin 2002, Grassman *et al*. 2005a, Chutipong *et al.* 2014). Distributions of Thai small carnivores remain known mainly from incidental records generated during studies of other animals (particularly Tiger); records during general faunal surveys, the broad remit of which prevents focus on particular species; and leisure-time natural-history observations. This information has hitherto been highly dispersed with much of it not in the public domain at all.

The basis for understanding mammal species occurrence across most of the tropical world was laid by museum collecting expeditions mostly during 1850–1970. Thailand was fairly widely collected, with specimens dispersed across many institutions and countries and records published in many sources, but information related to many specimens never yet published at all (Thonglongya 1974). Generalised maps of each species's geographic range in Thailand (Lekagul & McNeely 1977, Kanchanasakha *et al*. 1998, Parr 2003, Francis 2008) do not locate individual records, but are coarse-scale representations that mix records and inference. These maps, therefore, should not be cited as proof of species occurrence in any given area. Moreover, Lekagul & McNeely (1977) is now almost 40 years old: many major changes in habitat and human activity in the interim (Woodruff 1990, Royal Forest Department 2013) will surely have driven large changes in population and even distribution of some small carnivore species in Thailand.

Little camera-trapping occurred in Thailand before 1996 (e.g. Conforti 1996, covering a 1994–1995 survey). The present compilation collates small carnivore records from most camera-trap programmes in Thailand from 1996 to 2013 inclusive. Some records generated within the review period by other methods have been included, from the authors, their correspondents and the literature. Camera-trapping allows independent verification of identification; specimen collection and live-trapping (with photography) also allow for this but these practices are now rare. Species-level identifications through other methods (e.g. direct observations by day and night; indirect methods such as sign surveys and reports from local people) are frequently inaccurate: sources such as protected-area species lists contain many implausible 'records'. Records of other species from this compilation are presented by Tantipisanuh *et al.* (2014b; non-*Panthera* cats [Felidae]) and Jenks *et al.* (2012b; Dhole).

It was beyond the scope of this review to examine the historical sources containing Thai records of small carnivores. Many are cited by Thonglongya (1974), Lekagul & McNeely (1977) and Van Rompaey & Colyn (1996). Such a compilation, extending to unpublished museum specimens, remains a

**Table 1.** Small carnivores confirmed to occur in Thailand[1].

| Species | Global *Red List* status[2] | Thai Red List status[2] | National protection level[3] | Biogeography[4] | Identification[5] |
|---|---|---|---|---|---|
| MUSTELIDAE | | | | | |
| Yellow-bellied Weasel *Mustela kathiah* | LC | NE | - | N | Review |
| Siberian Weasel *Mustela sibirica* | LC | VU | Protected | W | N/A |
| Malay Weasel *Mustela nudipes* | LC | VU | Protected | S | Review |
| Stripe-backed Weasel *Mustela strigidorsa* | LC | EN | Protected | N | Review |
| Yellow-throated Marten *Martes flavigula* | LC | (LC) | Protected | WS | Accept |
| Hog Badger *Arctonyx collaris* | NT | (LC) | Protected | NS | Accept |
| Large-toothed Ferret Badger *Melogale personata* | DD | (LC) | Protected | N | Review |
| Eurasian Otter *Lutra lutra* | NT | EN | Protected | WS | N/A |
| Hairy-nosed Otter *Lutra sumatrana* | EN | CR | Protected | S+ | N/A |
| Smooth-coated Otter *Lutrogale perspicillata* | VU | VU | Protected | WS | Review |
| Asian Small-clawed Otter *Aonyx cinereus*[6] | VU | (LC) | Protected | WS | Review |
| PRIONODONTIDAE | | | | | |
| Banded Linsang *Prionodon linsang* | LC | VU | Protected | S | Review |
| Spotted Linsang *Prionodon pardicolor* | LC | EN | Protected | N | Review |
| VIVERRIDAE | | | | | |
| Large Indian Civet *Viverra zibetha* | NT | (LC) | Protected | NM | Review |
| Large-spotted Civet *Viverra megaspila* | VU | EN | Protected | NM | Review |
| Small Indian Civet *Viverricula indica* | LC | (LC) | Protected[7] | WS | Review |
| Common Palm Civet *Paradoxurus hermaphroditus* | LC | (LC) | - | WS | Review |
| Masked Palm Civet *Paguma larvata* | LC | (LC) | - | WS | Accept |
| Binturong *Arctictis binturong* | VU | (LC) | Protected | NS | Accept |
| Small-toothed Palm Civet *Arctogalidia trivirgata* | LC | (LC) | - | NS | Review |
| Banded Civet *Hemigalus derbyanus* | VU | EN | Protected | S | Review |
| Otter Civet *Cynogale bennettii* | EN | CR | Protected | S | N/A |
| HERPESTIDAE | | | | | |
| Small Asian Mongoose *Herpestes javanicus* | LC | (LC) | Protected | WS | Review |
| Crab-eating Mongoose *Herpestes urva* | LC | (LC) | Protected | NM | Accept |

[1]Species-level taxonomy follows Corbet & Hill (1992), with sequence modified to reflect the assignment of linsangs to their own family (Gaubert & Cordeiro-Estrela 2006). Least Weasel *Mustela nivalis*, Small-toothed Ferret Badger *Melogale moschata* and Short-tailed Mongoose *Herpestes brachyurus* have also been reported for Thailand, but there is no credible evidence of their occurrence (see text).
[2]Global *Red List* status and population trends are taken from IUCN (2013; also in Schipper *et al*. 2008). Thai Red List status is taken from Nabhitabhata & Chan-ard (2005), with (LC) listings in parentheses because these have been inferred; the species are not included in the source. CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient (explained in Schipper *et al*. 2008); NE = Not Evaluated.
[3]The Wild Animal Reservation and Protection Act 2003, from which the national protection status was taken, has identified 15 species under 'reserved' category and 1,302 species under 'protected' category which, in both categories, include 20 of the 24 small carnivore species.
[4]Biogeography. M = Thai–Malay peninsula (only used for species found nowhere else in the Sundaic subregion); N = non-Sundaic South-east Asia, often including southern China and the eastern and even central Himalaya; S = Sundaic South-east Asia; W = wide-ranging outside Sundaic South-east Asia, i.e. more than N; + = marginal expansion from stated code.
[5]Identification: for species marked 'Review', the identification of all photographs assigned to these species by the contributing datasets was checked by a group of the authors and often others; for species marked 'Accept', images were not comprehensively reviewed; species marked N/A had no photographs for review.
[6]*Aonyx cinerea* in Corbet & Hill (1992), but this is incorrect (Schipper *et al*. 2008).
[7]Captive breeding is allowed.

priority, especially for better documenting the past distributions of small carnivores in Thailand.

## Thailand

Thailand lies in Southeast Asia. Its 513,115 km$^2$ of land comprise varied habitats from sea level to 2,565 m, including areas with a long, harsh dry season, those with only a short, benign dry season, and all intervening stages. It spans latitudes 5°37'N to 20°30'N (*c*. 1,500 km). Most of the country falls in the Indochinese subregion (southern China, eastern South Asia and mainland Southeast Asia except the southern part of the Thai–Malay peninsula) as defined by Corbet & Hill (1992: their Map 2), including mountains that are outliers of the eastern Himalayas in the north. The southern peninsula (shared with Myanmar and Malaysia) lies in the Sundaic

subregion. Sundaic and Indochinese faunas differ distinctly. Some Sundaic influences extend north to about 15–16°N, while some Indochinese species occur south right through Thailand into Malaysia, but many species have range boundaries in the Thai part of the peninsula (Woodruff & Turner 2009). Thailand was divided into six faunal regions by Kloss (1915). These are still used extensively, with only minor amendment (e.g. Lekagul & Round 1991), in faunistic studies (Fig. 1).

Land habitats include evergreen/semi evergreen forest, mixed deciduous forest, dry dipterocarp forest, scrub, wetlands (of many types) and agriculture. These main habitat types vary with elevation, although relationships between elevation and Thai mammal distributions are poorly known (Steinmetz *et al*. 2008). Thailand has no strictly marine small carnivores, so marine habitats are not considered here. Nearly all the land was forested before anthropogenic clearance. Since the 1950s most of Thailand's formerly large, little-degraded tracts of mostly natural vegetation have become dominated by agriculture (including tree plantations), settlements and industry. "Lowland rainforest, freshwater swamp forest and mangrove forest have been almost completely destroyed" (Woodruff 1990: 164).

Thailand's human population was estimated at 64.5 million in 2012, growing at 0.5% per year (www.nso.go.th). Strong economic development over the last 40 years has brought all-weather paved roads to most of the country. In combination with the long land border with Malaysia, Myanmar, Lao PDR and Cambodia, this gives high market connectivity to the insatiable Chinese and Vietnamese wildlife meat markets. Thailand is repeatedly found to be a major route for illegal international wildlife trade (e.g. van Dijk & Palasuwan 2000, Nijman & Shepherd 2007, 2010, Nijman 2010, Shepherd & Tansom 2013). A huge regional trade in wildlife, including small carnivores, supplies the luxury restaurant trade in countries such as China and Vietnam (e.g. Srikosamatara *et al.* 1992, Nooren & Claridge 2001, Bell *et al*. 2004, Lau *et al.* 2010, Xu & Compton 2010). Hunting, although largely not quantified, has been and remains prevalent throughout most of Thailand (see below).

The country has an extensive protected area system (426 areas; those classified under national legislation as wildlife sanctuaries, national parks and non-hunting areas), although not one evenly spread across its regions. These protected areas total 103,810 km$^2$ in size and hold most of the country's natural and semi-natural land habitats. However, approximately 25% are small (less than 200 km$^2$) (Tantipisanuh & Gale 2013), particularly when considering landscape sizes likely to be needed for viable carnivore populations in such habitats (perhaps, several hundred square kilometers, although no species is well enough studied for precise prediction). Of the total land in protected areas, 16% is below 250 m, 46% is at 0–500 m and 90% is at or below 1,000 m. There are some globally outstanding large protected area complexes, notably the Western Forest Complex of 17 protected areas totalling 18,000 km$^2$ (e.g. Prayurasiddhi *et al.* 1999). However, some large (over 3,000 km$^2$) protected area complexes have been internally fragmented by infrastructure projects, leading potentially to loss of mammal species (e.g. Kanchanasaka 2001a).

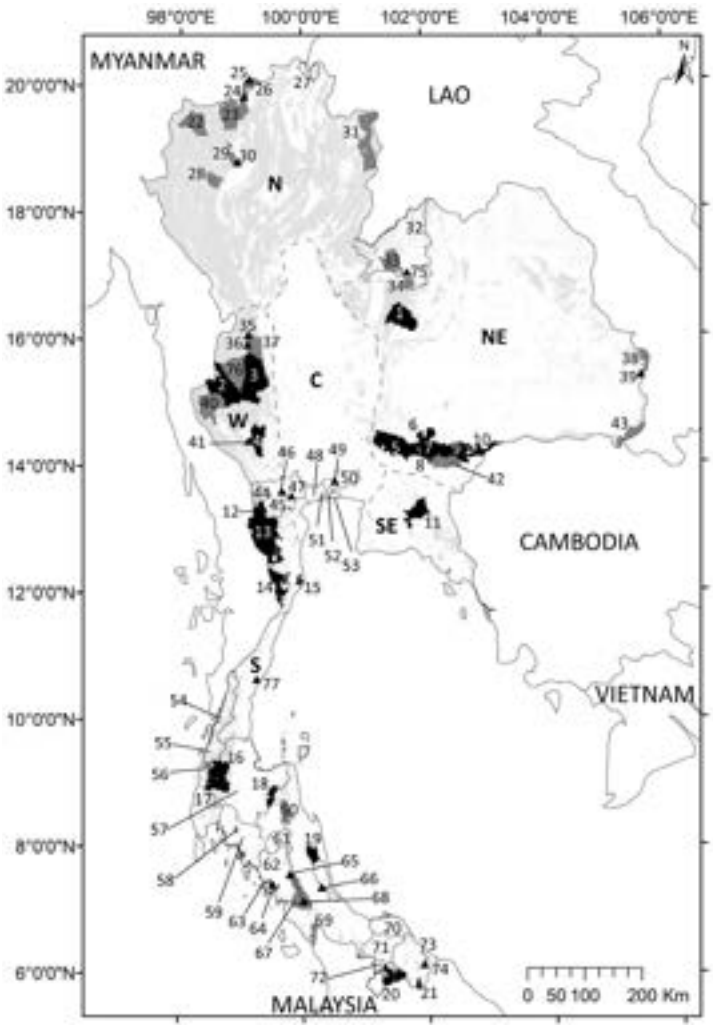


**Fig. 1.** Thailand, showing locations of the 21 camera-trap survey areas contributing records to this review (ID: 1–21) and other locations mentioned in the text (ID: 22–74). The map is divided into six regions following Lekagul & Round (1991). The survey area IDs are as follows: (1) Phu Khieo WS, (2) Thung Yai Naresuan WS – West, (3) Huai Kha Khaeng WS, (4) Salakpra WS, (5) Khao Yai NP, (6) Sakaerat BR, (7) Thap Lan NP, (8) Huai Samong proposed dam area, (9) Dong Yai WS, (10) Ta Phraya NP, (11) Khao Ang Rue Nai WS, (12) Maenam Pachi WS, (13) Kaeng Krachan NP, (14) Kuiburi NP, (15) Khao Sam Roi Yot NP, (16) Khlong Saeng WS, (17) Khao Sok NP, (18) Tai Rom Yen NP, (19) Thale Noi NHA, (20) Bang Lang NP, (21) Hala-Bala WS, (22) Lum Nam Pai WS, (23) Doi Chiang Dao NP, (24) Doi Lang NP, (25) Doi Ang Khang (part of Doi Phahompok NP), (26) Doi Phahompok NP, (27) Chiang Saen district, (28) Doi Inthanon NP, (29) Doi Suthep-Pui NP, (30) Chiang Mai Zoo, (31) Doi Phu Ka NP, (32) Loei province, (33) Phu Luang WS, (34) Phu Kradung NP, (35) Chong Yen, Mae Wong NP, (36) Doi Mokoju, Mae Wong NP, (37) Mae Wong NP, (38) Pha Taem NP, (39) Gaeng Pitsamai, Mekong River, (40) Khao Laem NP, (41) Sri Na Karin dam, (42) Pang Sida NP, (43) Phu Jong Nayoi NP, (44) Suan Phueng district, (45) Ratchaburi province, (46) Khao Prathub Chang Wildlife Breeding Center, (47) KMUTT Ratchaburi campus, (48) Samutsakhon province, (49) Dusit zoo, (50) Bangkok, (51) Khok Kham sub-district, (52) Bangkhuntien district, (53) Phrasamutchedi district, (54) Bang Non sub-district, (55) Ranong province, (56) Sri Phang-nga NP, (57) Surat Thani province, (58) Khao Phanom Bencha NP, (59) Krabi province, (60) Khao Luang NP, (61) Thung Song district, (62) Trang province, (63) Hat Chao Mai NP, (64) Trang river bank, (65) Khao Chong district, (66) Pa Phru – Pa Hala-Bala Wildlife research station, (67) Khao Bantad WS, (68) Phu Pha Pet cave, (69) Thale Ban NP, (70) Pattani province, (71) Yala province, (72) Than To district, (73) Pru Toh Daeng WS, (74) Ban Pa Wai, (75) Suan Hin Pha Ngam Park, Loei province, (76) Thung Yai Naresuan WS – East, (77) Khao Dinso, Chumphon province. Light grey in the background represents the remaining forested area which includes all stages of forests (primary and secondary) but not abandoned land.

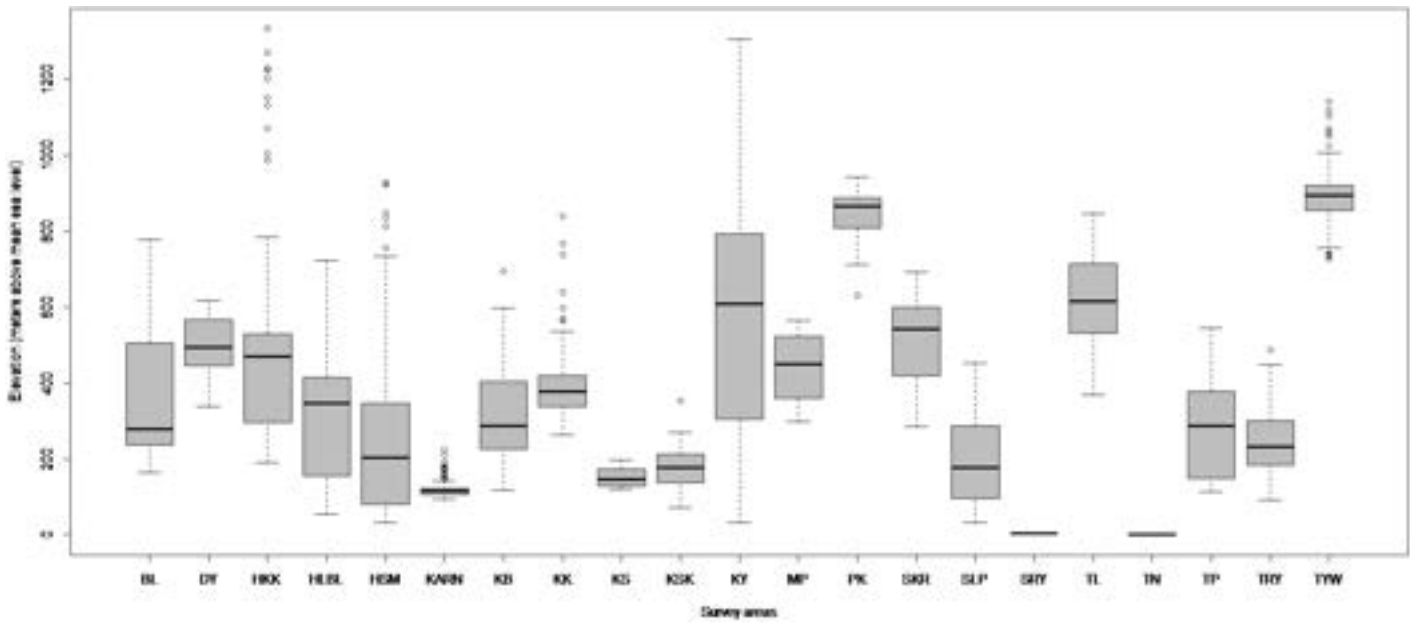

**Fig. 2.** Elevational coverage of camera-trap stations at each of the 21 Thai survey areas (all surveys within area combined) contributing records to this review. The box encompasses 50% of the stations, the dark horizontal line indicates median (50th percentile), the vertical lines show the 10th and 90th percentiles, and dots above and below the vertical lines are outliers. Abbreviations for survey area names are given by Table 3. Out of 1,952 camera-trap stations, 62% were below 500 m.

## Survey areas

Camera-trap results are collated here from 21 survey areas, 19 based in and around government-declared protected areas comprising wildlife sanctuaries (WS), national parks (NP) and non-hunting areas (NHA), one in a biosphere reserve (BR) and one at a proposed dam construction area adjacent to a national park. Of Thailand's six zoogeographic regions (Fig. 1), none of these surveys was in the North or the Central Plains and only one area (Khao Ang Rue Nai WS) was in the Southeast. Of the seven survey areas in the Northeast, four were contiguous: most of the Northeast was not surveyed. And of the seven survey areas in the West, five were included in two clusters. The six areas in the peninsula (= South) included three aggregations, but survey effort was small in all but Hala-Bala WS. Profiles of each protected area, including size, elevation range and habitats are in Table 2, with further details of the surveys and areas in the table's references.

The elevation range camera-trapped in each survey area varied considerably (Fig. 2). For example, camera-trap stations in Khao Yai NP (combined) covered a wide range from 32 to 1,306 m asl; those of Phu Khieo WS and Thung Yai Naresuan WS – West concentrated at elevations above 600 m; and coverage of Khao Ang Rue Nai WS, Khao Sok NP and Khlong Saeng WS tended to be below 350 m asl. This pattern is partly because protected areas differ in their elevational spread.

The forest-type classification for each camera-trap station was based on field assessment in five survey areas. Classifications for the rest were derived from a forest map (year 2000) provided by the Department of National Parks, Wildlife and Plant Conservation (DNP). Some of these when triangulated (by surveyors of the areas in question) turned out to be incorrect. There is no formal, quantified accuracy assessment for the DNP forest map (Tantipisanuh & Gale 2013). Thus, even the indicative habitat types for these camera-trap stations ('evergreen', 'deciduous', 'secondary growth [evergreen or deciduous]' and '[abandoned] plantations') are sometimes in error. For example, three stations within Banded Linsang range were classified by the GIS as deciduous forest; these would probably have constituted the first records anywhere in the species's range in such habitat. All three when checked with the surveyors were in fact evergreen forest. And the results for Large-spotted Civet from the GIS were particularly unreliable, with 25 of 58 (43%) at significant variance with observer assessments. Moreover, the spatial scale of classification can be inappropriate. For example, stations identified as 'evergreen forest' include those in small patches of open scrub or grassland (as demonstrated by several cases of directly checking with observers for records of species not usually found within evergreen forest).

Overall, approximately 58% of the total 1,952 camera–trap stations were in evergreen forests (hill/montane evergreen from 1,000 m asl and above; dry evergreen and moist evergreen below that), about 29% were in deciduous forests (mixed deciduous and dry dipterocarp), 8% were in secondary growth (of perhaps dry forests), 2% were secondary growth regenerated from evergreen (including past logged), 2% were in non-plantation agricultural areas and the remaining 1% were in plantations (including abandoned plantations).

## Methods

A meeting in Bangkok on 26–27 November 2009 collated Thai records of all species in the order Carnivora that are typically under 15 kg when adult, then discussed their conservation and research needs in the country (Chutipong *et al*. 2010, 2011). These records, collated from 16 survey areas, formed the basis of the present review. They were supplemented with further surveys so that the review covers January 1996 – December

**Table 2.** Background information about the 21 Thai camera-trap survey areas contributing camera-trap records to this review.

| Survey area | Code | Year | # camera-trap-nights (stations) | Spatial coverage (km²) | Target[1] | Source[2] | Citation[3] |
|---|---|---|---|---|---|---|---|
| NORTHEAST | | | | | | | |
| Phu Khieo WS | PK1 | 1998 | 479 (15) | 18 | Tiger & large mammals | AJL | Lynam *et al*. 2001 |
| Phu Khieo WS | PK2 | 2001–2002 | 751 (44) | 116 | Small carnivores | LIG | Grassman *et al*. 2006 |
| Khao Yai NP | KY1 | 1999– 2002 | 6,091 (143) | 976 | Tiger & large mammals | AJL | Lynam *et al*. 2006 |
| Khao Yai NP | KY2 | 2003– 2007 | 6,232 (216) | 2,211 | Carnivores | KEJ | Jenks & Damrongchainarong 2006, Jenks *et al.* 2011 |
| Sakaerat BR | SKR | 2010– 2011 | 1,965 (117) | 37, 34 | Galliforms | SS | Suwanrat *et al*. 2014 |
| Thap Lan NP | TL1 | 1999 | 187 (6) | 18 | Tiger & large mammals | AJL | Lynam *et al*. 2006 |
| Thap Lan NP | TL2 | 2012– 2013 | 8,526 (23) | 249 | Bears | DN | Ngoprasert & Gale in prep. |
| Huai Samong proposed dam area | HSM | 2013 | 1,938 (96) | 60 | Mammals | DNP | DNP 2013 |
| Dong Yai WS | DY | 2012 | 657 (21) | 61 | Cats | MCB | Baker 2014 |
| Ta Phraya NP | TP1 | 1998 | 677 (22) | 101 | Tiger & large mammals | AJL | Lynam *et al*. 2006 |
| Ta Phraya NP | TP2 | 2009– 2012 | 2,236 (83) | 498; 314 | Cats | MCB | Baker 2014 |
| SOUTHEAST | | | | | | | |
| Khao Ang Rue Nai WS | KARN1 | 2008– 2010 | 5,751 (275) | 730 | Dhole | KEJ | Jenks *et al.* 2012a |
| Khao Ang Rue Nai WS | KARN2 | 2010 | 541 (21) | 260 | Cats | MCB | Baker 2014 |
| WEST | | | | | | | |
| Thung Yai Naresuan WS – West | TYW | 2007–2012 | 11,518 (196) | 29; 48; 46 | Small carnivores | WC | Steinmetz *et al*. 2008*, 2010*, Chutipong *et al.* 2014 |
| Huai Kha Khaeng WS | HKK1 | 1999– 2001 | 1,880 (183) | 106; 81 | Muntjacs | RSu | Simcharoen *et al*. 1999*, Sukmasuang & Kutintara 2000 |
| Huai Kha Khaeng WS | HKK2 | 2010– 2011 | 3,069 (113) | 373 | Cats | MCB | Baker 2014 |
| Salakpra WS | SLP | 2012– 2013 | n/a (51) | 50 | Carnivores | KS | Mitchell 2013* |
| Maenam Pachi WS | MP | 2005 | 80 (4) | 10 | Fishing Cat | PBC | Cutter 2005a–d |
| Kaeng Krachan NP | KK1 | 2001 | 806 (22) | 191 | Tiger & large mammals | AJL | Ngoprasert & Lynam 2002 |
| Kaeng Krachan NP | KK2 | 2003– 2004 | 6,893 (72) | 34 | Leopard | DN | Ngoprasert 2004, Ngoprasert *et al.* 2007 |
| Kuiburi NP | KB | 2007– 2011 | 5,056 (77) | 159; 176; 188 | Tiger & large mammals | RSt | Steinmetz *et al.* 2009, 2011, 2013 |
| Khao Sam Roi Yot NP | SRY | 2009– 2010 | 1,176 (4) | 3 | Fishing Cat | PBC | Cutter 2009 |
| SOUTH | | | | | | | |
| Khlong Saeng WS | KS1 | 1996 | 35 (1) | tiny | Tiger & large mammals | AJL | Lynam 1996 |
| Khlong Saeng WS | KS2 | 2003– 2004 | 113 (6) | 29 | Fishing Cat | PBC | Boontua 2004 |
| Khao Sok NP | KSK1 | 1996 | 246 (10) | 8 | Tiger & large mammals | AJL | Lynam 1996 |
| Khao Sok NP | KSK2 | 2004 | 9 (1) | tiny | Fishing Cat | PBC | Boontua 2004 |
| Tai Rom Yen NP | TRY | 2013 | 669 (33) | 180 | Asian Elephant & large mammals | FKH | - |
| Thale Noi NHA | TN | 2007 | 114 (1) | tiny | Fishing Cat | PBC | Cutter 2007 |
| Bang Lang NP | BL | 1998 | 706 (24) | 28 | Tiger & large mammals | AJL | - |
| Hala-Bala WS | HLBL1 | 1997 | 820 (36) | 30 | Tiger & large mammals | AJL | - |
| Hala-Bala WS | HLBL2 | 2004– 2007 | 10,643 (19) | 3 | Mammals, birds | SK | Kitamura *et al*. 2010 |
| Hala-Bala WS | HLBL3 | 2005 | 3,824 (16) | 22 | Mammals | HLBL | - |

n/a = not available.

[1]Scientific names of target animals: Tiger *Panthera tigris*, galliforms (Galliformes), bears (Ursidae), cats (Felidae), Dhole *Cuon alpinus*, muntjacs *Muntiacus*, Fishing Cat *Prionailurus viverrinus* and Asian Elephant *Elephas maximus*.

[2]Purveyor, not necessarily originator; DNP: Wildlife Research Division, Department of National Parks, Wildlife and Plant Conservation; HLBL: Hala-Bala Wildlife Research Station, Department of National Parks, Wildlife and Plant Conservation.

[3]Asterisked (*) sources give general background to the PA, not to the specific camera-trap survey.

2013 inclusive and 21 areas. The organisers contacted all people known to have undertaken extensive camera-trapping in Thailand in this period, although a few declined to share their records.

A questionnaire circulated before the meeting asked for camera-trap records of all carnivores except bears, coupled with basic information about each camera-trap survey (survey dates, total survey effort in camera-trap-nights and precise position of each camera-trap station) and the date, time (if available) and station of all photographic records of small carnivores. For two days preceding the meeting, eight surveyors, including several from outside Thailand with extensive regional experience, reviewed the identification of the camera-trap photographs collated. Images of species with little risk of confusion were reviewed extensively but not comprehensively (Table 1). Those of species with at least fair potential for confusion were all checked, by at least two people independent of the survey team. Records of these species received after the meeting were also validated by at least three reviewers independent of the survey team.

Twelve organisations pooled their records, from a total of 21 survey areas (Table 2; Fig. 1). Some survey areas received only one or two brief surveys (Maenam Pachi WS, Khao Sam Roi Yot NP, Khao Sok NP, Khlong Saeng WS, Thale Noi NHA), whereas others, notably Khao Yai NP, were surveyed in multiple years, sometimes by multiple teams and agencies. Some of these protected areas were camera-trapped by other initiatives before or during the review period, for example the surveys of Kanchanasaka (1998) in Thung Yai Naresuan WS – West, Austin & Tewes (1999) during 1997–1999 and Suzuki *et al*. (2006) during 2000–2002 in Khao Yai NP, and those of Kanchanasaka (2000, 2001a) in Khlong Saeng WS. Table 2 lists the numbers of camera-trap-nights and of camera-trap stations in each survey area. For camera-traps set in pairs, each pair was treated as one station, with an animal photographed simultaneously by both treated as one record.

Area-specific survey-effort cannot be distilled to a figure allowing anything more than the coarsest and most cautious comparison with other survey areas: surveys varied widely in various essential parameters affecting results, such as duration and season; density and spacing of camera-traps; height above ground of the camera-trap; use of baits and lures; camera-trap microhabitats (such as on/off trails, beside/away from surface water); duration of station-use; and model of camera-trap used and its age/reliability. This reflects the various surveys' different objectives (in only two was the focus the small carnivore community), constraints and personal choice. In most areas, most camera-trap effort was in evergreen rather than deciduous forest, with most in forest rather than scrub, plantations or grassland. However, five surveys targeted Fishing Cat *Prionailurus viverrinus* in wetland habitats (Maenam Pachi WS, Khao Sam Roi Yot NP, Khlong Saeng WS, Khao Sok NP and Thale Noi NHA). This wide variation across survey areas in camera-trap survey effort and style precludes detailed between-area analyses of small carnivores recorded: differences found might well reflect quirks of survey style and chance rather than anything biologically meaningful. While records of a given species at a given survey area confirm its presence, a lack of records cannot be taken as evidence of its absence.

In 2009, a Facebook social networking site called 'Small Carnivore Conservation Project (SCCP) – Thailand' (https://www.facebook.com/groups/128334450533090/) began, to compile occurrences of small carnivores. Members of the group can share their information e.g., photographs, videos, news or links to other relevant sources. In total there are, to date, 70 reports (photograph and/or videos) of wild small carnivores (including dogs [Canidae] and cats [Felidae]), from 29 reporters. These 70 reports have all been validated by three independent reviewers. Only one of the 25 reporters (excluding reporters only of wild dogs and cats) did not submit a follow-up response with details such as date, locality, forest type, elevation and animal behaviour.

Records with no specimen or photograph for third-party examination have been added only after careful consideration. Missing camera-trap photographs of species in a survey area were discounted except when other records of the species from that survey area and of similar elevation and habitat were validated. Few photographs had to be discarded. Direct sight-records not validated by photographs have been included only for observers demonstrably familiar with the species of Thailand (through extensive examination of museum skin specimens and/or camera-trapping with only very few questionable identifications). Sign records are included only for otters, only from few surveyors and marked explicitly as such. No species-level identifications based on local reports are included.

## Species accounts

The photograph validation process showed that most species identifications by most contributors of camera-trap photographs were correct (95% of 1,911 photographs, including cats and dogs, were correct). Large Indian Civet *Viverra zibetha* had the highest rate of identification error (*c.* 1%). Table 3 shows the species recorded in each survey area, by all methods. Appendix 1 gives greater detail on the camera-trap records for each species from the contributing datasets. Appendix 2 gives elevational information for these records. Appendix 3 details the individual records (all sources) for species excepting seven widely and frequently camera-trapped and/or observed: Yellow-throated Marten *Martes flavigula*, Hog Badger *Arctonyx collaris*, Large Indian Civet, Small Indian Civet *Viverricula indica* (although the authors' incidental records are detailed), Common Palm Civet *Paradoxurus hermaphroditus*, Masked Palm Civet *Paguma larvata* and Crab-eating Mongoose *Herpestes urva*. Appendix 4 lists records of particular significance received after the text was in near-final form.

Twenty-four species of small carnivore have been reliably recorded in Thailand. Nine of these were not camera-trapped by any of the contributing surveys. Of these nine, no records at all were traced during the review period from anywhere in Thailand for one species, Siberian Weasel *Mustela sibirica*, nor any from the 21 survey areas for another, Hairy-nosed Otter *Lutra sumatrana*; six (three weasel *Mustela* species, Asian Small-clawed Otter *Aonyx cinereus*; Small-toothed Palm Civet *Arctogalidia trivirgata* and Otter Civet) were recorded by other surveyors and/or other means in at least one of the 21 camera-trap survey areas during the period; and the ninth, Eurasian Otter *Lutra lutra*, had been camera-trapped in

**Table 3.** The occurrence of small carnivores[1] in 21 camera-trap survey areas[2] in Thailand during 1996–2013.

| Species | NE | | | | | | | SE | W | | | | | | | S | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PK | KY | SKR | TL | HSM | DY | TP | KARN | TYW | HKK | SLP | MP | KK | KB | SRY | KS | KSK | TRY | TN | BL | HLBL |
| Yellow-bellied Weasel | - | - | - | - | - | - | - | - | D | - | - | - | - | - | - | - | - | - | - | - | - |
| Siberian Weasel | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Malay Weasel | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | D | D | - | - | - | D |
| Stripe-backed Weasel | L,Dp | - | - | - | - | - | - | - | - | Dp | - | - | - | Gp | - | - | - | - | - | - | - |
| Yellow-throated Marten | C | C,Dp | - | C | - | - | C | C | C | C,Dp | C | - | C,Dp | C | - | C* | C | - | - | - | C |
| Hog Badger | C | C | C | C | C | - | C | C | C,D | C | C | - | C,D | C | - | C* | - | C | - | - | - |
| Unidentified ferret badger | L | C | - | - | C,D,Lp | - | C | - | C | C | - | - | - | - | - | - | - | - | - | - | - |
| Eurasian Otter[3] | - | - | - | - | - | - | - | - | - | C*[3] | - | - | - | - | - | - | - | - | - | - | - |
| Hairy-nosed Otter | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Smooth-coated Otter | - | Dp | - | - | - | - | - | C | C | C,Dp,C* | - | - | C* | - | - | C,D,C* | C* | - | - | - | - |
| Asian Small-clawed Otter | - | - | - | - | - | - | - | - | - | C* | - | - | - | - | - | D | C* | - | Dp,Rp | - | Dp |
| Unidentified otter | - | Dp | - | - | - | - | - | - | C | - | - | - | C | - | - | C | - | - | Dp | - | - |
| Banded Linsang | - | - | - | - | - | - | - | - | C | D,C* | C* | - | C,C* | C | - | C,C* | C | - | - | - | C |
| Spotted Linsang | - | - | - | C,C* | - | - | C* | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Large Indian Civet | C | C | C | C | C | C | C | C | C | C,Dp,C* | C | - | C | C | - | C* | - | C | - | - | D |
| Large-spotted Civet | - | C | C | C | C | - | C | C | D | C | C | - | - | C | - | - | - | - | - | - | - |
| Small Indian Civet | L | C,C*,D | C | C | - | - | C | C | C,D,L | C | - | - | L | C | - | - | - | - | - | - | - |
| Common Palm Civet | C | C,Dp | C | C | C | C | C | C | C | C,Dp | C | C | C,Dp | C | - | C*,L | C | C | G | - | C |
| Masked Palm Civet | L | C | - | - | - | - | - | - | C,D | C | - | - | Dp,L | - | - | C*,D,L | C | C | - | - | C |
| Binturong | C,D,L | C,D | - | C | - | - | - | Dp | C,D,L | C*,D[3] | - | - | D[3] | C | - | C*,D | D | Rp | - | - | C,D |
| Small-toothed Palm Civet | L | Dp | - | - | - | - | - | - | D | D | - | - | - | - | - | D,L | - | - | - | - | D |
| Unidentified palm civet | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | C | - |
| Banded Civet | - | - | - | - | - | - | - | - | - | - | - | - | C* | C | - | C,C*,D | C | C* | - | - | C |
| Otter Civet | - | - | - | - | - | - | - | - | - | - | - | - | D | - | - | - | - | - | - | - | - |
| Small Asian Mongoose[4] | L | C*,Dp | C | C | - | - | C | C | - | - | C* | - | - | C,D | C | D | - | - | - | - | - |
| Crab-eating Mongoose | C | C | - | - | - | C | C | C | C | C | C | - | C,Dp | C | - | C,C* | C | - | - | - | C |

[1]Scientific names in Table 1. For each species at each site, the type(s) of record are given: camera-trap photographs from contributing surveys (C); camera-trap photographs from other sources, including late-received (Appendix 4) records (C*); direct sightings (D); live-trapping (L); captive animals (G); dead animals or their remains (R). Records for methods other than C are not comprehensively listed for cells with C records, and some come from slightly before the review period. Non-camera-trap records validated by examination of photographs are suffixed 'p'. Several classes of record are not covered in the table but are provided in the species accounts: (1) records from before the review (pre-1996) period; (2) sign-based records of otters; and (3) incidental records from outside the main 21 survey areas. Some of the late-received (Appendix 4) records come from the main 21 survey areas; these are included in this table.

[2]Contributing surveys are profiled in Table 2. *NE, North-east*: PK, Phu Khieo Wildlife Sanctuary; KY, Khao Yai National Park; SKR, Sakaerat Biosphere Reserve; TL, Thap Lan National Park; HSM, Huai Samong proposed dam area; DY, Dong Yai Wildlife Sanctuary ; TP, Ta Phraya National Park; *SE, South-east*: KARN, Khao Ang Rue Nai Wildlife Sanctuary; *W, West*: TYW, Thung Yai Naresuan Wildlife Sanctuary-West; HKK, Huai Kha Khaeng Wildlife Sanctuary; SLP, Salakpra Wildlife Sanctuary; MP, Maenam Pachi Wildlife Sanctuary; KK, Kaeng Krachan National Park; KB, Kuiburi National Park; SRY, Khao Sam Roi Yot National Park; *S, South*: KS, Khlong Saeng Wildlife Sanctuary; KSK, Khao Sok National Park; TRY, Tai Rom Yen National Park; TN, Thale Noi Non-Hunting Area; BL, Bang Lang National Park; HLBL, Hala-Bala Wildlife Sanctuary.

[3]These records date from just before the review period.

[4]Kitamura *et al*. (2010) listed Small Asian Mongoose for Hala-Bala WS, but this was an error. The species photographed was Crab-eating Mongoose.

one of the areas but shortly before the period. Conventional camera-trapping evidently has limited ability to detect these seven latter species. The numbers of camera-trap stations detecting each of these species differed greatly between surveys (Appendix 1), as did species-specific encounter rates (data not shown). This doubtless reflects a variety of factors: each species's actual abundance, the species-specific efficacy of the camera-trapping (including inherent suitability for each species's natural history and suitability of where, when and how intensively camera-traps were deployed) and random chance.

The species camera-trapped in the most survey areas were Common Palm Civet (in 17 out of 21 survey areas), Large Indian Civet (14), Hog Badger (13), Crab-eating Mongoose (13) and Yellow-throated Marten (12). Large Indian Civet was detected at most camera-trap stations (420 stations out of 1,952 in total), followed by Common Palm Civet (203), Hog Badger (112), Crab-eating Mongoose (105) and Yellow-throated Marten (85).

The species accounts distinguish 'recent' records (those during the review period; 1996–2013 inclusive) from 'earlier' (= pre-1996) records. Localities without date are generally presented under 'earlier records'. Recent records of commonly camera-trapped species generated outside the camera-trap surveys that form the focus of this review were not collated comprehensively: for such species, the incidental recent records presented are mostly confined to those outside the camera-trapped range. Except for species with previous record collations (e.g. Stripe-backed Weasel; Abramov *et al*. 2008), the listing of past records is not intended to be comprehensive; it is usually confined to those previously unpublished and even then may be highly selective.

Yellow-bellied Weasel *Mustela kathiah*

*Recent records* – No camera-trap record of Yellow-bellied Weasel in Thailand was traced. This weasel has only recently been documented in Thailand, from three northern highland localities with one sight record from further south, in Thung Yai Naresuan WS (Supparatvikorn *et al*. 2012). Subsequent to Supparatvikorn *et al*. (2012) are two further records: additional sightings from Doi Inthanon NP (B. Pisanworawit *in litt*. 2013) and a housing area at the Doi Phu Ka NP headquarters (C. Atchariyayart *in litt*. 2013).

*Discussion* – This species's late discovery in the country does not imply rarity or conservation concern (Supparatvikorn *et al*. 2012). Indeed, the regularity and spread of records as the number of capable and active observers in Thailand rises suggests it is not at risk nationally.

Siberian Weasel *Mustela sibirica*

*Recent records* –No record for Siberian Weasel by any method was traced from anywhere in Thailand during the review period.

*Earlier records* – Lekagul & McNeely (1977) mapped this species from the North and North-east, but gave neither specific records, nor indication that they had seen Thai specimens. Nabhitabhata & Chan-ard (2005: 66) listed it at "Chaiyaphum (Phu Khieo WS); Loei (Phu Luang [WS]); Nakhon Ratchasima (Sakaerat BR)", but indicated neither sources nor types of records. Parkarnseri *et al.* (2001) did not list the species as occurring in Sakaerat BR, while recent camera-trap surveys from the other two areas did not detect it. However, other species of South-east Asian weasels are poorly recorded by camera-trapping (see below); presumably this also applies to Siberian Weasel.

*Discussion* – Occurrence of Siberian Weasel in Thailand is somewhat incongruous. It is mainly a Palaearctic species. It is not known from Vietnam (Roberton 2007). The few records from Myanmar are from very high mountains of the northern highlands (Than Zaw *et al*. 2008), where also occur many other montane and/or northern birds and mammals not found in Thailand. Duckworth *et al*. (1999) found only 1–2 records from Lao PDR, both in the central region: a sight-record from hill evergreen forest at 1,200 m and (provisional identification) from karst landscape at only 500 m asl. These are consistent in their distance from the northern highlands and moderate elevation with the Thai localities in Nabhitabhata & Chan-ard (2005), attributes that make the records from Thailand and Lao PDR ecologically anomalous compared with those in the species's main northern highland and Palaearctic range. This weasel's Thai status requires review: it might have specific conservation needs.

Malay Weasel *Mustela nudipes*

*Recent records* – No Malay Weasel camera-trap record was traced from the 21 survey areas. During the review period, individuals were seen in Khlong Saeng WS, Khao Sok NP and Khao Phra Bang Khram WS, and live-trapped in Hala-Bala WS and Pru Toh Daeng (now Chaloem Prakiat HRH Princess Sirindhorn WS) (Kanchanasaka 2001a, Duckworth *et al*. 2006). One was photographed crossing a small stream in evergreen forest at Tum Nung waterfall, Sri Phang-nga NP, Khuraburi, Phang-nga province (W. Tantanawat *in litt*. 2011).

*Earlier records* – NB had two direct sightings in Khao Bantad WS in April 1992, in moist evergreen forest near a waterfall. Duckworth *et al*. (2006) traced only three historical specimens and one pre-1996 sight record from Thailand.

*Discussion* – The northernmost world record of this Sundaic species is that from Ranong province at 10°N (Duckworth *et al.* 2006). The lack of camera-trap records from Thailand fits with a general rarity of recording the species by that method anywhere (Duckworth *et al*. 2006, Ross *et al*. 2013). This hinders speculation on the species's national conservation status.

Stripe-backed Weasel *Mustela strigidorsa*

*Recent records* – No Stripe-backed Weasel camera-trap record was traced from the 21 survey areas. Grassman *et al*. (2002) recorded a live capture and several field sightings from Phu Khieo WS. Abramov *et al*. (2008) traced only 1–2 other Thai localities with records during the period (Doi Phahompok NP, although not dated; and Chong Yen, in Mae Wong NP). Hobcroft (2011) recorded the species from Doi Lang (part of Doi Phahompok NP) and Doi Inthanon NP, two mountains in Chiang Mai province. In 2009, one was live-captured in a house in Ban (= village) Khao Tok Nam, about 1 km outside Kuiburi NP (RSt and N. Seuaturien *in litt*. 2012) (Fig. 3). Also in 2009, a video record from Huai Kha Khaeng WS placed briefly on the internet was examined by WC, DN, RSt and JWD; all agreed it was this species. There are further records from Phu Khieo WS in 2014 (A. Manawong *in litt*. 2014, C. Waradee *in litt*. 2014).

*Earlier records* – Nabhitabhata & Chan-ard (2005) also listed

**Fig. 3.** A live-caught Stripe-backed Weasel *Mustela strigidorsa* from a village close to Kuiburi National Park, Prachuabkirikhan province, Thailand, 11 December 2009 (Photo: Kuiburi NP staff, RSt and N. Seuaturien).

as localities for the species, Doi Ang Khang in Chiang Mai province and Doi Mokoju (in Mae Wong NP) in Khamphaeng Phet province, without detailing the original records. Abramov *et al*. (2008) traced only two pre-1996 records (one in a small hamlet in Nan province, one in Phu Luang WS).
*Discussion* – Only two Thai localities in Abramov *et al*. (2008) or Nabhitabhata & Chan-ard (2005) lie south of Phu Khieo WS, the northernmost of the 21 contributing survey areas: both were in Mae Wong NP at about 16°N and comprised the most southerly records in the world. The 2009 Kuiburi record therefore extends the known range by about four degrees of latitude (444 km). Both Lekagul & McNeely (1977) and Francis (2008) mapped Stripe-backed Weasel in southern Myanmar adjacent to Kuiburi NP, but neither Abramov *et al*. (2008) nor Than Zaw *et al*. (2008) traced any Myanmar record south of 16°05′N. The lack of camera-trap records from Thailand fits with a general rarity of recording the species by this method (Abramov *et al*. 2008). The surprisingly few records from Thailand compared with neighbouring Lao PDR (Streicher *et al*. 2010) suggest that it might be much overlooked in the country. The series of very recent records, doubtless reflecting the increasing number of capable observers in the country, supports this notion.

Yellow-throated Marten *Martes flavigula*
*Recent records* – Yellow-throated Marten was camera-trapped in 12 (57%) of the 21 survey areas, from the most northerly to the most southerly. Sight-records, both above 1,000 m in hill evergreen forest, from Doi Lang (part of Doi Phahompok NP) in 2012 and Doi Inthanon NP in 2013 (A. J. Pierce *in litt*. 2014) come from north of all contributing camera-trap surveys. The many other incidental sightings and live-trappings have not been compiled, given the abundance of camera-trap records.
*Earlier records* – The species was reportedly often found in forest plantation at the third meteorological station of Sakaerat BR (Parkarnseri *et al.* 2001), but camera-trapping across that area (Table 2) did not detect it. A. J. Pierce (*in litt*. 2014) sighted the species in Doi Chiang Dao WS (Chiang Mai province) in 1993. Many other past records exist.
*Discussion* – Yellow-throated Marten seems widespread and common in Thailand, as in neighbouring peninsular Malaysia, Myanmar, Lao PDR and Cambodia (e.g. Duckworth 1997, Than Zaw *et al*. 2008, Holden & Neang 2009, Johnson *et al*. 2009, Schank *et al*. 2009, Hedges *et al.* 2013, Coudrat *et al*. 2014, Gray *et al*. 2014a).

Hog Badger *Arctonyx collaris*
*Recent records* – Hog Badger was camera-trapped in 13 (62%) survey areas. It was also camera-trapped during the period by large cat surveys in Mae Wong NP and Khlong Lan NP (WWF Thailand per RSt 2014) and in Thung Yai Naresuan WS – East (Vinitpornsawan 2013). NB saw a photograph of one, alive, taken by a ranger in a forest remnant near hill evergreen forest within 2005–2006 in Doi Inthanon NP. The few direct sightings during the contributing surveys contrast with the many camera-trap records. DN saw two animals twice in a transition between secondary dry evergreen and mixed deciduous forests near Ban Krang station, Kaeng Krachan NP, by day in 2003. RSt saw singles in Thung Yai Naresuan WS – West (evergreen forest along a small stream, 1997) and Mae Wong NP (grassland at 1,000 m asl, 2013).
*Earlier record* – Boonratana (1988) saw the species in Khao Phanom Bencha NP, at about 8°19′N.
*Discussion* – Historically, Hog Badger occurred south through Thailand almost to the Malaysian border, but reports of its occurrence into Malaysia have never been confirmed (Helgen *et al*. 2008). The lack of records in the review period from south of Tai Rom Yen NP (8°40′N; camera-trapped at three stations) in the southernmost part of its mainland global range (see Helgen *et al*. 2008) perhaps simply reflects low survey effort. Of the six peninsular localities, three (Khlong Saeng WS, Khao Sok NP and Thale Noi NHA) had low survey effort (Table 2), with no small carnivores camera-trapped at all in Thale Noi NHA. Bang Lang NP had a higher survey effort, but only one small carnivore species was detected. Camera-trapping in these four areas might have overlooked Hog Badger. In fact, Kanchanasaka (2001a) camera-trapped it in Khlong Saeng WS, mentioning also footprint records and the use of edge habitats (e.g. scrub, secondary growth and rubber plantations) by the sanctuary boundary.

That there were confirmed records in most survey areas north of Khlong Saeng WS contrasts with both Lao PDR and Myanmar, where recent records of Hog Badger are generally few (Duckworth *et al*. 1999, Than Zaw *et al*. 2008, Johnson *et al*. 2009, Coudrat *et al*. 2014, Gray *et al*. 2014b). Some of these authors wondered whether hunting had caused this patchiness: Hog Badger is large enough to be killed whenever chanced across, active partly by day (boosting the numbers of chance encounters), ground-dwelling, smelly (so readily found by dogs) and neither particularly vigilant nor shy. By contrast, Helgen *et al*. (2008: 369) suggested it might naturally avoid lower elevations. This seems unlikely: in the contributing surveys, 68 of 112 camera-trap stations (61%) detecting Hog Badger lay below 500 m and only 44 (39%) above, a split reflecting overall station distribution (62%: 38%; Fig. 2). And in eastern Cambodia many records come from below 300 m asl (Gray *et al*. 2014a). At least in these countries, Hog Badger evidently occurs naturally and widely in the lowlands. This ongoing lack of lowland records in Lao PDR strengthens the

suggestion that Hog Badger might be readily hunted out from such areas. Whatever the underlying reason for the wide detection of Hog Badger in Thailand compared with its recorded patchiness in Lao PDR and Myanmar, it probably makes Thailand internationally significant for Hog Badger: the species is on *The IUCN Red List of Threatened Species* as (globally) Near Threatened.

Unidentified ferret badger *Melogale*

*Recent records* – Ferret badger was camera-trapped in five (24%) survey areas (and see Appendix 4). A corpse photographed in 2014 from Gaeng (= rapids) Pitsamai on the Mekong river in Khong Jiam district, Ubon Ratchathani province (P. Junmee *in litt*. 2014) perhaps originated from the adjacent Pha Taem NP. During 1998–2002, unidentified ferret badgers were live-trapped five times (an unknown number of individuals) in Phu Khieo WS along main roads, trails and riverbanks in evergreen (two captures) and mixed deciduous (three captures) forests at 700–900 m asl (Grassman *et al*. 2005b, LIG).

*Earlier records* – In the late 1980s, three Large-toothed Ferret Badgers *M. personata* were live-trapped in deciduous forest at 430–570 m on Doi Suthep-Pui NP, behind Chiang Mai zoo and near Palahat Temple (Elliott *et al*. 1989). At Huai Kha Khaeng WS Conforti (1996) camera-trapped (and live-trapped) ferret badger in only one of ten sites and considered it rare.

*Discussion* – Large-toothed Ferret Badger is the only species of ferret badger known from Thailand (Lekagul & McNeely 1977), but Small-toothed Ferret Badger *M. moschata* might also occur (see species account below). Unless skull and dentition are examined, ferret badgers in Thailand should be identified only to genus. As in Thailand, the genus was typically recorded in only a few survey areas, mostly not commonly, in Lao PDR, Myanmar and Cambodia (Duckworth 1997, Than Zaw *et al*. 2008, Johnson *et al*. 2009, Schank *et al*. 2009, Robichaud 2010, Coudrat *et al*. 2014, Gray *et al*. 2014a, 2014b). Camera-trapping sometimes finds the genus commonly, suggesting no inherent problem with detection (Kakati *et al*. 2014) and thus a genuinely patchy and/or low-density distribution in areas such as Thailand. This might indicate low overlap between the genus's habitat use and camera-trapping. Thai ferret badger camera-trap records come from diverse habitats: in Thung Yai Naresuan WS – West, a narrow strip of gallery evergreen amid extensive grassland and mixed deciduous forest; in Huai Kha Khaeng WS and Khao Yai NP from grassland and mixed deciduous forest; in Ta Phraya NP from dry evergreen forest; and in Huai Samong proposed dam area (one record) from mixed deciduous forest abutting a reforestation area. Ferret badger was reportedly seen frequently at Sakaerat BR among thick vegetation around a helicopter landing pad and at Chong-Ang cave amid dry evergreen forest (Parkarnseri *et al*. 2001). Recent camera-trapping surveys in Sakaerat BR failed to detect the genus, even though survey effort was relatively large and extensive. Overall, there has been little camera-trapping in Thailand in the sort of degraded habitats where Kakati *et al*. (2014) had most of their ferret badger records. Without better information (habitat use of the genus and records identified explicitly using skull and dentition), the Thai conservation status of Large-toothed Ferret Badger remains unclear.

Eurasian Otter *Lutra lutra*

*Recent records* – No Eurasian Otter camera-trap record was traced from Thailand in the review period.

*Earlier records* – Eurasian Otter is sympatric with Small-clawed Otter and Smooth-coated Otter in the northern part of the western forest complex (WEFCOM): Huai Kha Khaeng WS (detected by various methods, including a published camera-trap photograph; Kruuk *et al*. 1993, 1994), Thung Yai Naresuan WS (signs; Kanchanasaka 1998) and Mae Wong NP (B. Kanchanasaka *in litt*. 2009). It also occurs in Chiang Saen (Chiang Rai province; a skin seen) and Doi Ang Khang (Chiang Mai province) (B. Kanchanasaka *in litt*. 2009). This distribution resembles that given in Nabhitabhata & Chan-ard (2005).

*Discussion* – Eurasian Otter's current Thai status is not clear. Survey effort likely to generate identifiable otter records has dropped since the early 1990s (Kruuk *et al*. 1993, 1994, Kanchanasaka 1998). This species's status is also uncertain in Myanmar, Lao PDR and Cambodia (Duckworth *et al*. 1999, Poole 2003, Than Zaw *et al*. 2008). Its global *IUCN Red List* categorisation as only Near Threatened reflects its wide Palaearctic distribution; it might be considerably more at risk in Southeast Asia.

Hairy-nosed Otter *Lutra sumatrana*

*Recent records* – No Hairy-nosed Otter camera-trap record was traced from the 21 survey areas. Outside, records come from Pru Toh Daeng forest (Narathiwat province; now Chaloem Prakiat HRH Princess Sirindhorn WS) and Khlong Lam Long in Khao Bantad WS, near the Trang–Phattalung province border (a skull from an animal caught in a fish trap, 2001; Kanchanasaka 2000, 2001b, 2003, 2008, Kanchanasaka *et al*. 2003, Wright *et al*. 2008, Sasaki *et al*. 2009). Both localities have been reported under multiple names in various sources. J. Hall (*in litt*. 2010) visited Pru Toh Daeng in late 2010, saw three animals briefly and was given an estimate by staff that *c*. 20 Hairy-nosed Otters presently live there.

*Earlier records* – There were previous reports from Khlong Saeng WS and Khao Sok NP before the Chiew Lan dam was built (S. Nakasathien in Kanchanasaka *et al*. 2003). An old skin from Surat Thani was examined by Sasaki *et al*. (2009).

*Discussion* – Pru Toh Daeng and surroundings perhaps constitute the most important Thai locality for this otter. Areas nearby in Yala and Pattani provinces are under an insurgency. Its effects on the Pru Toh Daeng population are unclear, but some encroachment has already occurred (Kanchanasaka 2008). Globally, this is among the rarest small carnivores in Thailand (see Wright *et al*. 2008, Sasaki *et al*. 2009, Wilting *et al*. 2010a).

Smooth-coated Otter *Lutrogale perspicillata*

*Recent records* – Smooth-coated Otter was camera-trapped in four survey areas (19%). Recent photographs from the SCCP Facebook group show persistence in Huai Kha Khaeng WS (N. Sukumal *in litt*. 2013) and Khao Yai NP (K. Saralamba *in litt*. 2013). New locality records came from Sri Na Karin Dam (W. Onganunkun *in litt*. 2013) and Khok Kham sub-district, Samutsakhon province (K. Tonsakulrungruang *in litt*. 2013, K. Saralanba *in litt*. 2013). In the Inner Gulf of Thailand, A. Kamjing (verbally 2014) found at least four captive Smooth-coated

Otters, said by at least two owners to have been caught locally. B. Kanchanasaka recorded the species's presence in Khao Sok NP (camera-trapping in 2001–2002; Kanchanasaka *et al*. 2003) and Khlong Saeng WS (Kanchanasaka 2001a). Along Thab Salao stream in Huai Kha Khaeng WS NB saw 2–3 individuals in 2006, 2008 and 2009 and Faengbubpha (2014) had camera-trap and sign (tracks and spraints) records. See also Appendix 4.

*Earlier records* – Earlier camera-trap records come from Huai Kha Khaeng WS (Conforti 1996). During mostly unspecified years of the 1990s, B. Kanchanasaka recorded, using various methods, the species's presence in Khao Yai NP (Lumtakhlong river), Mae Wong NP, Kaeng Krachan NP, the Kwae Yai river in Thung Yai Naresuan WS – West (signs; Kanchanasaka 1998) and Huai Kha Khaeng WS (Kruuk *et al*. 1993, 1994). Nabhitabhata & Chan-ard (2005) listed many localities, without detailing the original records or era of each. NB saw many at several streams in Khlong Saeng WS in 1994, 1996 and 1997. B. Kanchanasaka (*in litt*. 2009) suggested that it is more abundant in West and South Thailand than in the North, where it is scarcer than Eurasian Otter. J. W. K. Parr (*in litt*. 2011) saw the species on a mangrove sandbar north of Krabi town in 1988.

*Discussion* – Major declines in otters of nearby Myanmar, Lao PDR, Cambodia and Vietnam since the early–mid 1990s (Duckworth & Hills 2008 and citations therein) mean that if large populations remain in Thailand (as suggested by the number and spread of recent sight-records, at least locally), they would be globally significant.

Asian Small-clawed Otter *Aonyx cinereus*

*Recent records* – No Small-clawed Otter camera-trap record was traced from the contributing surveys, but an independent study camera-trapped it and found signs in Huai Kha Khaeng WS (Faengbubpha 2014). Kanchanasaka *et al*. (2003) reported it in Khao Sok NP and Khlong Saeng WS during 2001–2002. Recent photograph records via SCCP Facebook come from Hala-Bala WS (N. Sukumal *in litt*. 2013) and Thale Noi NHA (S. Opitakon *in litt*. 2012), including a road-kill female and young. In Bangkhuntien, coastal Bangkok, fishermen reported otters, identified as Small-clawed Otter based on illustrations in Francis (2008), in a group of about ten in mangroves (WC).

*Earlier records* – Small-clawed Otter was confirmed in Huai Kha Khaeng WS by Kruuk *et al*. (1993, 1994) and recorded by signs in the Kwae Yai river in Thung Yai Naresuan WS – West (Kanchanasaka 1998). B. Kanchanasaka (*in litt*. 2009) suggested it was common in coastal South Thailand (e.g. Krabi province) and in the Central Plains (e.g. Samutsakhon province). J. W. K. Parr (*in litt*. 2011) saw it at several mangrove sites in Krabi province in 1988.

*Discussion* – The Bangkhuntien fishermen said the otters threaten their fish farms, so that they shoot them in retribution, but not typically for trade. NB also heard complaints from inner-gulf fish farmers about fish loss to otters, apparently Small-clawed. The resulting persecution might pose a significant threat to otters. Few substantiated records from the 2000s were traced for this species, which has declined steeply in nearby countries (see references under Smooth-coated Otter); if large populations remain in Thailand, they would be of high global significance.

Unidentified otters

Identification of otters to species under field conditions and even of photographs is challenging. Camera-trap records of unidentified otters came from Thung Yai Naresuan WS – West (2007–2008) and Kaeng Krachan NP (Petchburi river; 2003). P. Pathumratanatharn (then head of Khao Prathub Chang Wildlife Breeding Center) received two baby otters from local people of Phrasamutchedi, Samut Prakarn province, in 2005. In the early 1990s, NB found otter footprints along the Prom river, Phu Khieo WS. He also observed footprints, spraints and direct sightings along Trang river bank, Trang province in April 1991.

Banded Linsang *Prionodon linsang*

*Recent records* – Banded Linsang was camera-trapped in six (29%) survey areas, with other recent camera-trap records from Khlong Saeng WS (Kanchanasaka 2001a), Kaeng Krachan NP (Kekule 2004), Huai Kha Khaeng WS (Steinmetz & Simcharoen 2006, Wongchoo 2014) and Thung Yai Naresuan WS – East (Vinitpornsawan 2013). I. Sra-ar (per P. D. Round *in litt*. 2011) photographed one dead in southern Khao Banthad WS (Satun province), on the forest floor near Phu Pha Pet cave. One was photographed in old secondary growth (evergreen) near a stream from Mae Wong NP (U. Dachyosdee *in litt*. 2012). One was observed in Huai Kha Khaeng WS near a small stream in evergreen forest at 926 m (RSu). One was photographed at the forest edge by a stream in Suan Phueng district, Ratchaburi province (W. Taksintum *in litt*. 2013).

*Earlier records* – Nabhitabhata & Chan-ard (2005) listed Than To district, Yala province, for the species, without giving type, date or source of record.

*Discussion* – All Thai records of this Sundaic species come from the Thai–Malay peninsula and contiguous Tenasserim–Dawna mountain range and foothills, doubtless a genuine pattern. These are the northernmost confirmed records in the world, extending to 15°53′N in Mae Wong NP. It perhaps occurs in Myanmar even further north, to about 16°30′N (Steinmetz & Simcharoen 2006). The species inhabits evergreen biomes, perhaps particularly near streams: such areas tend to have humidity similar to the species's Sundaic range (e.g. Steinmetz & Simcharoen 2006). There were few camera-trap records at any given station, as typical of the species (Hedges *et al*. 2013, Chutipong *et al*. 2014) and not necessarily implying rarity. Indeed, the species was found in seven of the ten Thai survey areas within its geographic range (see Appendix 4). All the other three (Tai Rom Yen NP, Thale Noi NHA and Bang Lang NP) had few records of any small carnivores. Conventionally considered rare in Thailand (e.g. Lekagul & McNeely 1977), Banded Linsang has probably simply been under-recorded.

Spotted Linsang *Prionodon pardicolor*

*Recent records* – The contributing surveys camera-trapped Spotted Linsang only in Ta Phraya NP in 2012 (Baker *et al*. 2012) and Thap Lan NP in 2013. Redford *et al.* (2011) found it in Thap Lan NP in 2008 and in Pang Sida NP in 2011.

*Earlier records* – Nabhitabhata & Chan-ard (2005) also listed Lum Nam Pai WS (Mae Hong Son province) and Doi Phu Ka NP (Nan province) without reference to type, date or source of records. There may be only three pre-1996 Thai records: one in TISTR, presented on 25 May 1973 by Samai, with no local-

ity detail (S. Waengsothorn *in litt*. 2007); one in the National Museum of Natural History, Washington D.C., U.S.A., from Khar village #9, Ban Muang, Loei province, collected in August 1958 (A. V. Abramov *in litt*. 2007); and a sighting at Doi Inthanon NP in 1995 (Tizard 2002).

*Discussion* – These very few Thai records contrast with many more from neighbouring Lao PDR and Myanmar (e.g. Duckworth 1997, Than Zaw *et al*. 2008, Johnson *et al*. 2009, Coudrat *et al*. 2014, Gray *et al*. 2014b). Together with records in Cambodia (Holden & Neang 2009), this suggests that Spotted Linsang might be more widespread in Thailand than the few records to date suggest.

Large Indian Civet *Viverra zibetha*

*Recent records* – Large Indian Civet was among the most commonly and widely camera-trapped small carnivores, with records from 14 survey areas (67%). It was camera-trapped also in Thung Yai Naresuan WS – East (Vinitpornsawan 2013). The many incidental sighting and live-trap records have not been compiled, given the abundance of camera-trap records.

*Earlier records* – Boonratana (1988) saw it in Hat Chao Mai NP. Conforti (1996) found it widely in Huai Kha Khaeng WS and Thung Yai Naresuan WS – West, being abundant in all of secondary growth and dry evergreen and dry dipterocarp forests. Simcharoen *et al.* (1999) radio-tracked four in Huai Kha Khaeng WS in 1993–1996; during the dry (fire) season, they tended to use the dry evergreen forest more than deciduous forests, their main habitat in the rest of the year.

*Discussion* – Five of the six survey areas not camera-trapping the species had such low survey effort that few small carnivores were recorded at all (Table 3). The sixth such area, Hala-Bala WS, had 15,287 trap-nights spread across multiple years but about half of this was within only 3 $km^2$, meaning also that the species might have been overlooked. The wide distribution and many records in Thailand echoes Myanmar and Lao PDR in the 1990s–2000s (Duckworth 1997, Than Zaw *et al*. 2008, Johnson *et al*. 2009, Coudrat *et al*. 2014) and, in fewer survey areas, Cambodia (Holden & Neang 2009, Schank *et al*. 2009, Gray *et al*. 2014a). In contrast, this civet seems to be extirpated from southern China (Lau *et al*. 2010) and fragmented in Vietnamese distribution (Willcox *et al*. 2014: Table SOM3). The evidently buoyant Thai population, probably reflecting much lower levels of hunting than in southern China, Vietnam and most of Lao PDR, is probably of international significance.

Large-spotted Civet *Viverra megaspila*

*Recent records* – Large-spotted Civet was camera-trapped in nine (43%) survey areas, supplemented by two direct sightings of singles: in Thung Yai Naresuan WS – West, in mixed deciduous forest mixed with dipterocarp-oak forest with grassy ground cover on gentle terrain at *c.*700 m (N. Seuaturien verbally 2004); from a dirt road about 20 km from the sanctuary and 2 km from Ban Huai Seua (Thong Pha Phum district, Kanchanaburi province) in a mix of teak plantation and mixed deciduous forest at 570 m on gentle terrain, by daylight, perhaps disturbed by a ground fire (WC). Surveys in Huai Kha Khaeng WS during 2005–2009, not in this collation, camera-trapped it, always below 400 m asl, at only c. 3% of 815 stations across mixed deciduous and dry dipterocarp forests (Wongchoo 2014). A camera-trap claim in evergreen forest within 700–900 m asl of Khao Yai NP (Suzuki *et al.* 2006) was a Large Indian Civet (original photograph examined) (but see Appendix 4).

*Earlier records* – Earlier camera-trap records from Huai Kha Khaeng WS, in mixed deciduous forest and riverine scrub, were all from below 350 m (Conforti 1996). Nabhitabhata & Chan-ard (2005) listed one additional locality: Ban Bang Non in Ranong province, without details.

*Discussion* – Some records from Khao Ang Rue Nai WS and Khao Yai NP were detailed in Jenks *et al*. (2010) as were those from Ta Phraya NP in Lynam *et al*. (2005). Across all 21 areas, detections came from 58 camera-trap stations, all below 500 m (average 159 m ± SD 102 m), of which 53 stations were below 300 m. Across its world range, most records with known elevation come from below 300 m or, in areas of gentle terrain, up to 560 m and even at 700–900 m (Duckworth 1997, Austin 1999, Khounboline 2005, Lynam *et al*. 2005, Holden & Neang 2009, Gray *et al*. 2010). The direct sightings in Thung Yai Naresuan WS – West are at unusually high elevations. The animal at 700 m asl gave an excellent view; the observer was already highly familiar with Large Indian Civet and noted the dark line down the dorsal aspect of the tail and the bold flank pattern, has subsequently camera-trapped Large-spotted Civet elsewhere, and has scrutinised the original identification in this light. WC's sighting was prolonged in excellent light down to 10 m. It was made in the full knowledge of identification criteria to check (involving previous study of zoo animals), including the tail pattern and bold flank spotting.

For survey areas with high survey effort and many small carnivore records, e.g. Thung Yai Naresuan WS – West and Kaeng Krachan NP, the paucity of records of the species is consistent with its near-restriction to lowland gentle terrain. In Khao Yai NP, gentle terrain at moderate to low elevations is highly localised. Both stations camera-tapping the species are at the forest edge (a mosaic of deciduous/dry evergreen forest and secondary growth) in the gentle lowlands of the northeast. In Huai Kha Khaeng WS, the two stations recording it were both in level valley-bottoms, even though 28% of the 296 camera-trap stations were below 300 m with 61% below 500 m. Coupled with the few stations there where Wongchoo (2014) recorded Large-spotted Civet, this suggests that much forest even at 200–500 m asl is unsuitable.

Khao Ang Rue Nai WS is unique among the 21 survey areas (and unusual amongst all Thai protected areas) in its extensive, predominant low elevations on gentle terrain. Unsurprisingly most Large-spotted Civet records came from this area (Appendices 1, 3). Detection was not uniform across camera-trap stations, perhaps reflecting low survey effort per station and chance, perhaps in part depressed populations in some areas, especially the west because of hunting (KEJ).

Across all survey areas about half (30; = 52%) the stations detecting the species were in evergreen forest, 14 (24%) in evergreen secondary growth (c. 20 years after logging, Khao Ang Rue Nai WS), eleven in deciduous forest, two in abandoned plantations and one in [abandoned] agriculture at the forest edge. Forest-types derived from GIS were cross-checked with surveyors and 25 of 58 were in error. In Kuiburi NP, the species was camera-trapped in secondary evergreen forest and abandoned plantations (mixed species, e.g. pine, acacia, euca-

lypt) at 160–250 m asl. Gray *et al*. (2010) found the species in two eastern Cambodian survey areas markedly more commonly in deciduous than in evergreen forests. This seems not be so in Thailand: of survey areas where Large-spotted Civet was present, 56% vs 30% of survey effort was in evergreen and deciduous habitats, respectively compared with 76% vs 11% of stations recording this civet.

This relatively large number of recent localities suggests that Thailand may retain larger populations of this species, categorised on the *IUCN Red List* as Vulnerable (IUCN 2013), than feared by Lynam *et al*. (2005) and Gray *et al*. (2010). In most occupied protected areas, populations are likely to be small because low-elevation gentle terrain is only a small part and usually at the edge (Tantipisanuh & Gale 2013). Khao Ang Rue Nai WS is an exception and doubtless holds a population of high global significance.

Small Indian Civet *Viverricula indica*

*Recent records* – Small Indian Civet was camera-trapped in eight survey areas (38%). WC spotlit the species in grassy mixed deciduous forest of Thung Yai Naresuan WS – West and found one outside the Khao Yai NP boundary close to an agricultural edge. Three animals were live-trapped in Thung Yai Naresuan WS – West, two in gallery evergreen forest surrounded by extensive mixed deciduous/dry dipterocarp forests and one in secondary evergreen forest (WC). The species was not camera-trapped in Phu Khieo WS but was live-trapped there 10 times, all in mixed deciduous forest at c. 700–900 m (Grassman *et al*. 2005b, LIG). A similar situation occurred in Kaeng Krachan NP: the species was never camera-trapped, but was live-trapped in a small (*c*. 1 km$^2$) grass field amid evergreen forest near Ban Krang camping area (Grassman 1997). Austin & Tewes (1999) saw it regularly in open and edge habitat of Khao Yai NP. They camera-trapped it once in open shrubs and 13 times in semi-evergreen or mixed deciduous forest, suspecting that the preponderance of records in forest reflected high survey effort, not the true pattern of habitat use.

*Earlier records* – Conforti (1996) camera-trapped it in Huai Kha Khaeng WS and/or Thung Yai Naresuan WS. Several were spotlit in degraded areas around Khao Yai's HQ in 1995 (JWD).

*Discussion* – Of the 34 camera-trap stations recording the species, 24 (71%) were in degraded and/or regenerating evergreen forest (secondary growth) and eight in deciduous forests (mixed and dry dipterocarp with extensive grass e.g. in Thung Yai Naresuan WS –West). In Huai Kha Khaeng WS and Thung Yai Naresuan WS, Conforti (1996) found it commonly in secondary forest and dry dipterocarp forest, occasionally in mixed deciduous forest and riverine scrub, but never in evergreen forest. However, a radio-tracked individual in this area had a home-range centred in dry dipterocarp forest during December–February, but during March–May, when such habitat was heavily burnt, moved into dry evergreen forest (Rabinowitz 1991a, 1991b). The rather small number of camera-trap records in Thailand reflects findings in Lao PDR and Myanmar (e.g. Duckworth 1997, Than Zaw *et al*. 2008, Johnson *et al*. 2009, Coudrat *et al*. 2014, Gray *et al*. 2014b). In Cambodia, where camera-trapping has been much more used in open deciduous forest, this species has been commonly camera-trapped in some areas (e.g. Holden & Neang 2009, Schank *et al*. 2009, Gray *et al*. 2014a). Rather than being a cause for conservation concern, the scarcity of camera-trap records in Thailand is probably an indication of the use of edge, degraded and deciduous habitats by this species (as supported by the direct sighting localities), where camera-traps were not often set, especially during studies focused on Tiger. Its adaptability is well indicated by its ongoing abundance in parts of southern China where most other small carnivores have become very rare (Lau *et al*. 2010) and in the evergreen Western Ghats, southern India, it is more frequent in fragmented than in contiguous forest (Mudappa *et al*. 2007). Closer to Thailand, it remains abundant in a small peri-urban park of secondary vegetation in Yangon, Myanmar (Su Su 2005). In this context it is surprising that camera-trapping at three peninsula areas (Khao Sam Roi Yot NP, Thale Noi NHA and Maenam Pachi WS) with only fragmented and degraded remnants of natural vegetation (Cutter & Cutter 2009), did not detect the species. The species is kept captive in Ratchaburi and Chiang Mai provinces for collection of its anal gland secretions, for use in the perfume industry (NB). The number of civets removed from the wild is unknown, as is the impact the practice has on wild populations. The Chiang Mai animals are claimed to be captive bred by the Chiang Mai Zoo (WC).

Common Palm Civet *Paradoxurus hermaphroditus*

*Recent records* – Common Palm Civet was camera-trapped in 17 (81%) survey areas. All four where the species went undetected (Khao Sam Roi Yot NP, Thale Noi NHA, Khlong Saeng WS and Bang Lang NP) had low and/or spatially restricted survey effort (Table 2). In one, Thale Noi NHA, Cutter (2007) saw three captives reportedly caught in an adjacent rubber plantation. The many incidental sightings and live-trappings have not been compiled, given the abundance of camera-trap records.

*Earlier records* – In Huai Kha Khaeng WS and Thung Yai Naresuan WS, Conforti (1996) found it widely and commonly.

*Discussion* – Common Palm Civet is also widespread and common in nearby countries, including heavily degraded, fragmented areas, e.g. oil palm plantation (Duckworth 1997, Su Su 2005, Than Zaw *et al*. 2008, Holden & Neang 2009, Johnson *et al*. 2009, Schank *et al*. 2009, Lau *et al*. 2010, Coudrat *et al*. 2014, Gray *et al*. 2014a). In this context it is surprising that camera-trapping at Khao Sam Roi Yot NP in fragmented and degraded remnants of natural vegetation (Cutter & Cutter 2009), did not find it. Currently, the species has no evident conservation needs in Thailand. Genetic and dental analyses suggest that the current 'species' might comprise several cryptic species, of which two might inhabit Thailand (Patou *et al*. 2010). Camera-trap pictures might be difficult to distinguish. Records in Patou *et al*. (2010) suggest that neither is likely to be threatened at present. However, effects on wild populations of the rapid spread of keeping caged Common Palm Civets for various purposes (e.g. Nijman *et al*. 2014) are poorly known.

Masked Palm Civet *Paguma larvata*

*Recent records* – Masked Palm Civet was camera-trapped in six (29%) survey areas and at Thung Yai Naresuan WS – East (Vinitpornsawan 2013). Spotlighting provided many sightings, notably in Thung Yai Naresuan WS – West (WC) and Khlong Saeng WS (AJL). The species was not camera-trapped in Phu Khieo WS (Grassman *et al.* 2006), but was live-trapped

(Grassman *et al.* 2005b). In Kaeng Krachan NP, one was trapped and radio-tracked (Grassman 1998) and one was photographed in 2011 foraging near a restaurant at Ban Krang camping area (W. Onganunkun *in litt*. 2013), although earlier camera-trapping had not found the species. One was photographed at Krung Ching waterfall, Khao Luang NP (Nakhon Sri Thammarat province) in evergreen forest (W. Latchanon *in litt*. 2014).

*Earlier records* – In Huai Kha Khaeng WS and Thung Yai Naresuan WS, Conforti (1996) found it widely and commonly, mainly in evergreen forests, as previously noted by Rabinowitz (1991a) in Huai Kha Khaeng WS. Boonratana (1988) saw it in Khao Phanom Bencha NP. It is reportedly common at Sakaerat BR in dry evergreen forest (Parkarnseri *et al.* 2001), but camera-trapping in 2010–2011 did not find it.

*Discussion* – The rather low proportion of survey areas with camera-trap records echoes a review from Myanmar (Than Zaw *et al*. 2008), presumably reflecting its extensive arboreal habits. In Thailand, it was not camera-trapped in Phu Khieo WS, Sakaerat BR or Kaeng Krachan NP where other methods found it; in several Myanmar survey areas hunters' kills confirmed its presence where camera-trapping had not found it (Than Zaw *et al*. 2008). Thus, it was plausibly under-recorded in the 21 Thai survey areas, wherein all camera-traps were set at or near ground level.

Of the 53 camera-trap stations detecting Masked Palm Civet, seven were below 300 m, seven within 300–500 m and 39 (74%) within 525–1,334 m. Compared with overall station distribution (62% below 500 m, 38% above; Fig. 2) this suggests wide elevational use but relative scarcity in the lowlands. All records were above 460 m except in Hala-Bala WS (the only Sundaic site in which it was camera-trapped), where it occurred down to 118 m (Appendix 2), suggesting the possibility of different habitat use between Sundaic and non-Sundaic Thailand. The species may occur at least mostly in hills and mountains in Lao PDR; the lowest record traced by Duckworth (1997) was at about 520 m, similar to the 460 m in adjacent non-Sundaic Thailand (there has been very little survey after 1997 in lowland Lao PDR using methods likely to detect this species; JWD). This might also be so in Borneo (Wilting *et al*. 2010a,), although there are at least some low-elevation records there (Belden *et al*. 2014). However, it is common in lowlands in some other places (e.g. Sumatra: Holden 2006). Of the 53 camera-trap stations recording it, 49 were in evergreen forests (including 14 in gallery evergreen) and four, all in Huai Kha Khaeng WS, were in deciduous forest. Gallery evergreen forest occurs in Thung Yai Naresuan WS – West along watercourses with thin (5–50 m wide) riparian strips amid extensive grassy deciduous forest (Steinmetz & Simcharoen 2006). Some of the records classified as 'deciduous' might have been from such evergreen strips. Evergreen forest provided most of Conforti's (1996) records in Huai Kha Khaeng WS. Pelage differs greatly in colour and pattern between Sundaic and non-Sundaic animals (Pocock 1934). Both forms were photographed in the southernmost survey area, Hala-Bala WS, where 90% of the animals were of the Indochinese form. Currently, the species has no evident conservation needs in Thailand.

Binturong *Arctictis binturong*

*Recent records* – Of the eleven survey areas confirmed to hold Binturong, it was camera-trapped in only six (29%). It was sighted in only a few places: Hala-Bala WS in 2002 (M. Pliosungnoen *in litt*. 2013), Thung Yai Naresuan WS – West in 2008 and 2012 (WC & T. Dawrueng, respectively) and in Khao Ang Rue Nai WS in 2010 (R. Phoonjampa per NB 2012). A hunted head was confiscated and confirmed to be from Tai Rom Yen NP (FKH). Binturongs were caught in chicken-baited live-traps in Phu Khieo WS (31 times; at least six individuals; in 1998–2002; Grassman *et al*. 2005a, LIG) and Thung Yai Naresuan WS – West (four times; two individuals; 2010–2011; WC). One was seen during daylight high in an emergent tree near the Khao Sok NP headquarters in 1996 (AJL).

*Earlier records* – There were earlier camera-trap records from Huai Kha Khaeng WS (Conforti 1996) and there are many past sightings in Khao Yai NP, extending into 1996 (e.g. Nettelbeck 1997). Singles were seen in Khao Phanom Bencha NP in 1987 (J. W. K. Parr *in litt*. 2011), Kaeng Krachan NP in 1994, Huai Kha Khaeng WS (1985) and Phu Khieo WS in 1984 (NB).

*Discussion* – Effective camera-trap surveying of Binturong is hindered by its arboreal nature. Binturong is partly diurnal, large and neither especially quiet nor stealthy, so should be found readily when present. The startlingly few sight records compared with Nettelbeck's (1997) in central Khao Yai NP perhaps indicate a cause for concern. In nearby countries, it is now very rare in Lao PDR (e.g. Duckworth *et al*. 1999, Coudrat *et al*. 2014) and Vietnam (Willcox *et al*. 2014: Table SOM 3) and perhaps extinct in China (Lau *et al*. 2010). The threats to Binturong, at least in non-Sundaic Southeast Asia, are assumed to relate largely to hunting. Because Thailand has a far bigger area under at least fairly effective protection from illegal hunting than does Lao PDR, Cambodia, Vietnam or Myanmar, it might well retain more Binturongs. Its national conservation status warrants clearer assessment.

Small-toothed Palm Civet *Arctogalidia trivirgata*

*Recent records* – No camera-trap records of Small-toothed Palm Civet were traced. One was live-trapped (at ground level) in Phu Khieo WS in 2002 (Grassman *et al.* 2005b, Eaton *et al.* 2010). It was spotlit in Khao Yai NP (2006; M. Pliosungnoen *in litt.* 2009), Thung Yai Naresuan WS – West (2007–2008; WC) and Hala-Bala WS (2010, J. Hall *in litt*. 2010). In Khao Yai NP, it was also photographed in 2013 (T. Ong-in and K. Saralanba *in litt*. 2013). One was photographed in Thale Ban NP in 2013 (K. Jiaranaisakul *in litt*. 2013).

*Earlier records* – One was live-trapped (on the floor) in Khlong Saeng WS in 1993 (AJL). It was spotlit in Khao Yai NP (1995–1996, Duckworth & Nettelbeck 2008) and Huai Kha Khaeng WS (1994 or 1995, Conforti 1996; also six earlier records by Rabinowitz & Walker 1991).

*Discussion* – Most records came from evergreen forest but the one in Thung Yai Naresuan WS – West was resting in a tree in grassland (with scattered deciduous forest trees) near limestone outcrops with evergreen trees (WC). The absence of camera-trap records for this highly arboreal genus and predominance of spotlighting records fits observations throughout its range (e.g. Duckworth & Nettelbeck 2008, Willcox *et al*. 2012, Wahyudi & Stuebing 2013, Chutipong *et al.* 2014, Kakati & Srikant 2014). Spotlighting has been too patchy in Thailand to allow firm conclusions on this species's national status, but nothing suggests it is not widespread and common. The ge-

nus contains three distinct groups of taxa, currently (e.g. Corbet & Hill 1992) considered conspecific: on Java, in the rest of the Sundaic subregion, and in the non-Sundaic range (van Bemmel 1952, Eaton *et al*. 2010). The latter two both occur in Thailand; the photographed animals in Hala-Bala WS and Thale Ban NP were of a Sundaic form, but the form at Khlong Saeng WS (the only other survey area with records south enough that it might support a Sundaic form) was Indochinese. It is implausible that the Indochinese form in Thailand has any conservation needs; recent information on the Sundaic form is insufficient to tell.

Banded Civet *Hemigalus derbyanus*

*Recent records* – Camera-trap records of Banded Civet came from 17 camera-trap stations in five survey areas (24%). In Khlong Saeng WS, one was camera-trapped near a water hole and mineral lick in interior evergreen forest at 200 m asl. Twelve camera-trap photographs of Banded Civet were taken in an earlier survey in Khlong Saeng WS (Kanchanasaka 2001a). Camera-trap stations recording the species in Hala-Bala WS and Khao Sok NP were in moist evergreen forest at 162–579 m asl, those at Khlong Saeng WS and Kuiburi NP at 196 m and 695 m. One was camera-trapped in evergreen forest of Kaeng Krachan NP in 2004 at 255 m (Kekule 2004, L. B. Kekule *in litt*. 2008).

*Earlier records* – There seem to be few other Thai records: Lekagul & McNeely (1977: 592) wrote that "a specimen was recently obtained … near Thung Song, Nakhon Si Thammarat [a little south of Khao Sok NP], the first accurate locality record for Thailand". Nabhitabhata & Chan-ard (2005) listed Thung Yai district [near Thung Song district], Nakhon Si Thammarat province, without original details.

*Discussion* – Some recent camera-trap surveys elsewhere in Banded Civet's known range have found it only rarely or not at all (e.g. Holden 2006, Than Zaw *et al*. 2008, Hedges *et al*. 2013) but others, particularly in Borneo, have found it readily (e.g. Wilting *et al*. 2010a). Holden (2006) suspected that the species might avoid forest roads and trails and evidence consistent with this was presented by Wilting *et al*. (2010a). The paucity of Thai camera-trap records might at least in past reflect common use of roads and trails for camera-trap stations.

Of 17 Thai camera-trap stations with records (see Appendix 4), 14 were below 360 m. This does not necessarily indicate a lowland distribution in Thailand: in Khlong Saeng WS and Khao Sok NP all camera-trapping was below 360 m, whilst in Hala-Bala WS the highest camera-trap was at only 722 m. Four survey areas (Khao Sam Roi Yot NP, Thale Noi NHA, Tai Rom Yen NP and Bang Lang NP) within the species's range (Kaeng Krachan NP and southwards) did not record the species. The species's habitat (evergreen forest) was not surveyed in the first two areas; in the latter two it was, and there is now (Appendix 4) a record from Tai Rom Yen NP. Thus, there is no strong suggestion of a patchy distribution in its Thai range.

Banded Civet is restricted to the Sundaic subregion. The northernmost older Thai record was at about 9°14′N, 98°40′E, similar to that in Myanmar (10°09′N; Than Zaw *et al*. 2008). The Kaeng Krachan NP record was much further north, at about 12°53′N. This is still well south of Lekagul & McNeely's (1977) implication that the species occurs north to Kra and mapping of it north to 15°N. Compared with the other Sundaic small carnivores, this northern limit is further south than that of Banded Linsang (15°53′N), similar to that known for Otter Civet (c. 13°N; sight record) and north of the limits of Malay Weasel (10°N), Short-tailed Mongoose and Malay Civet (both south of 5°37′N). Extensive conversion of lowland forest in southern peninsula Thailand to crop plantations (e.g. Stibig *et al.* 2014) has perhaps fragmented the species's distribution and reduced numbers in Thailand. Its nationally endangered listing (Nabhitabhata & Chan-ard 2005) may well be appropriate.

Otter Civet *Cynogale bennettii*

*Recent record* – The only recent record traced was a duo seen and described well at Kaeng Krachan NP on 12 March 1998 (S. Sheridan-Johnson in Anon. 1998). Anon. (1998) appealed for further Thai Otter Civet records from the bird-watching community; none was forthcoming.

*Earlier records* & *discussion* – In Pru Toh Daeng [now Chaloem Prakiat WS] one morning during 1992–1993, one was clearly seen as it crossed a road near the edge of swamp forest at Ban Pa Wai (Kanchanasaka 1995, B. Kanchanasaka *in litt*. 2013). A second-hand sight-record per J. Nabhitabhata from a staff member of Phu Kradung NP was caveated by Schreiber *et al*. (1989) as in need of confirmation. This locality, at *c*.16°53′N, 101°53′E, lies well northeast of known localities of not just Otter Civet, but of any Sundaic mammal (or bird) in Thailand. Pending further information, the report should be considered an error. A global review of the species (Veron *et al*. 2006a) traced no Thai records other than the above. Nabhitabhata & Chan-ard (2005) listed no Thai localities other than Pru Toh Daeng. Thonglongya (1974) saw a mounted skin among the small collection at the Royal Forest Department, Bangkok, perhaps the basis for Lekagul & McNeely's (1977) including the species in the Thai fauna. An animal at Dusit zoo, Bangkok, in the mid-1980s was reportedly caught in the country (Schreiber *et al*. 1989). The paucity of Thai records suggests that the species might be extremely rare in the country. Elsewhere, however, it can be locally common, e.g. in northern Sabah, Malaysian Borneo and in southeastern Sumatra (Wilting *et al*. 2010a).

Small Asian Mongoose *Herpestes javanicus*

*Recent records* – Small Asian Mongoose was camera-trapped in seven survey areas (33%) (see Appendix 4). Of the 19 camera-trap stations detecting it, 15 were in degraded secondary growth (dry evergreen), with one each in dry dipterocarp interfaced with evergreen, degraded mixed deciduous, secondary growth (abandoned plantation) and a dry and heavily grazed area with replanted mangrove trees. One was seen at the KMUTT Ratchaburi campus, Ratchaburi province, in 2007 in highly degraded dry dipterocarp forest (WC). In Khao Yai NP, singles were photographed by the waterfall at Camp Gong Kaew (the abandoned golf course and open grassland) (C. Waradee *in litt*. 2014) and observed in 2008 on an open managed lawn near the Training Center (DN); Austin & Tewes's (1999) five records were from open grassland, despite their survey concentrating on forest. In five years of field work in Kuiburi NP (2007–2011), RSt had about four direct sightings of this

mongoose and one camera-trap record, all below 200 m asl in secondary evergreen forest, scrub growth or pineapple fields outside (sometimes several kilometers) the park. Although not camera-trapped in Phu Khieo WS, the species was live-trapped nine times around the headquarters in open forest–grassland mosaic and village habitat during 1998–2002. It was reported for Phu Jong Nayoi NP during December 1998 – January 1999 (Ling *et al*. 1999), but no details are given.

*Earlier records* – In Huai Kha Khaeng WS and Thung Yai Naresuan WS, an earlier camera-trap survey found the species at only one station, in tall grass adjacent to a seasonal pool of water (Conforti 1996). Parr (2003) wrote that it occurs in Bangkok suburbs based on his sightings at sites such as lowland marsh around the Asian Institute of Technology (AIT) and Khlong 5, Pathum Thani province (J. W. K. Parr verbally 2014); however, RSt never observed the species during substantial time at AIT.

*Discussion* – The paucity of records during contributing camera-trap surveys (Appendix 3) probably reflects most surveys' focus on forest, typically evergreen: most records came from heavily anthropogenic areas, as in Lao PDR, (Duckworth *et al*. 2010), Myanmar (Than Zaw *et al*. 2008), the Cardamom mountains, Cambodia (Holden & Neang 2009) and in lowland eastern Cambodia (R. J. Timmins *in litt*. 2014). It seems surprising that camera-trapping at Thale Noi NHA and Maenam Pachi WS, with only fragmented and degraded remnants of natural vegetation (Cutter & Cutter 2009), did not find the species, perhaps reflecting low survey effort (Table 2); it was camera-trapped at Khao Sam Roi Yot NP in a dry, heavily grazed reforested mangrove area. While the species is seen during peripheral activities in some localities (e.g. Kuiburi NP, above), this is not universal. Duckworth *et al*. (2010) suggested that this species's main (semi-)natural habitat in non-Sundaic SE Asia is open deciduous forest. Some Thai records come from such habitat, but some sizeable tracts of dry dipterocarp forest seem not to hold the species, at least not at all commonly. For example, neither RSt nor WC has ever seen it in or around Thung Yai Naresuan WS – West, despite much time in open mixed deciduous and dry dipterocarp forests. In Cambodia, R. J. Timmins (*in litt*. 2014) considered that, proportional to effort, field sightings are rare in extensive tracts of dry dipterocarp forest compared with those in agricultural and highly degraded secondary habitats (usually derived from semi-evergreen, mixed deciduous or riparian forest). Few Thai surveys cover edge or degraded habitats, hindering firm deductions about the species's distribution in the country. Several trapped animals at 870 m in Phu Khieo WS (Grassman *et al*. 2005b, LIG) and two sightings at 730–750 m in Khao Yai NP came from above the maximum elevation recorded in adjacent Lao PDR by Duckworth *et al*. (2010; 530 m).

For decades it was unclear whether Small Asian Mongoose comprises one species or two, Javan Mongoose *H. javanicus* (*sensu stricto*) and Small Indian Mongoose *H. auropunctatus* (Wells 1989 and references therein). Lekagul & McNeely (1977) considered that both inhabited Thailand. Two subsequent analyses (Taylor & Matheson 1999, Veron *et al*. 2006b) distinguished two species, but apparently used few Thai specimens, so their lack of *auropunctatus* records from the country does not mean it does not occur. Separation of the two forms from camera-trap photographs or field sightings would be difficult and has not been attempted here.

Crab-eating Mongoose *Herpestes urva*

*Recent records* – Crab-eating Mongoose was camera-trapped in 13 survey areas (62%). One was seen at Doi Lang NP (North) in 2012 (A. J. Pierce *in litt*. 2014).

*Earlier records* – None adds materially to the camera-trap records from the many survey areas.

*Discussion* – Survey areas lacking records were mostly those with few small carnivores of any species recorded, meaning that this mongoose cannot be assumed to be rare in or absent from them. Of 105 camera-trap stations with records, 40% (42 stations) were below 500 m asl, in protected areas such as Khao Ang Rue Nai WS, Huai Kha Khaeng WS, Kaeng Krachan NP, Kuiburi NP and Khlong Saeng WS. There are no obvious conservation issues for the species in Thailand, which is also widespread and common in neighbouring Myanmar, Lao PDR and Cambodia (Duckworth 1997, Than Zaw *et al*. 2008, Holden & Neang 2009, Johnson *et al*. 2009, Schank *et al*. 2009, Coudrat *et al*. 2014, Gray *et al*. 2014a, 2014b). Southern peninsula Thailand is near the southern limit of its world range: it does not reach the southern tip of the Thai–Malay peninsula (Hedges *et al*. 2013).

*Notes on species reported from Thailand but without authoritative records*

Least Weasel *Mustela nivalis*

Supparatvikorn (2000) reported a road-kill Least Weasel from Doi Phahompok NP. The species was thereby included in the Thai Red List (Nabhitabhata & Chan-ard 2005). The specimen is in fact a Yellow-bellied Weasel (Supparatvikorn *et al*. 2012). The closest Least Weasel record to Thailand is from far northern Vietnam: one specimen – of a taxonomically distinct form – from an elevation well above Thailand's highest mountain (Abramov 2006). Least Weasel seems unlikely to occur in Thailand.

Small-toothed Ferret Badger *Melogale moschata*

Storz & Wozencraft (1999) mapped much of North and Northeast Thailand within the range of Small-toothed Ferret Badger and stated that it inhabits Thailand. However, they gave no records and, both earlier and later, Wozencraft (1993, 2005) omitted Thailand from the species's world range. Its range and habitat use in Myanmar and Lao PDR (Than Zaw *et al*. 2008, Robichaud 2010) suggest it might well inhabit Thailand (Lekagul & McNeely 1977: 533). On current knowledge it can be distinguished visually from Large-toothed Ferret Badger only by skull and dentition (Schank *et al*. 2009); even this can be problematic (Stefen & Feiler 2004). The scant attention paid to species-level identification of many ferret badger records in Thailand (as more widely in the region) means that Small-toothed Ferret Badger could well be overlooked in Thailand.

Short-tailed Mongoose *Herpestes brachyurus*

Wells (1989) drew attention to American Museum of Natural History mongoose specimen M-31597, labelled from Thailand. Some (e.g. Gilchrist *et al*. 2009) accepted this animal to confirm Short-tailed Mongoose occurrence in Thailand. The skin, collected by L. C. Bulkley in 1909, is indeed a Short-tailed Mongoose, but its origin is ambiguous. It has no collector's tag; the earliest AMNH label merely states "Siam" [= Thailand] as

the locality; a later AMNH tag gives "Thailand, probably Trang" [in the far south]; and the handwritten accessions catalogue originally recorded it as from "near Bangkok, Siam" (some 700 km from Trang), changed to "Thailand: Trang" at some later stage (P. Sweet *in litt*. 2010, A. Poekempner *in litt*. 2011). No explanation is given for these changes, perhaps made when the skin was re-identified from an earlier listing as *H. javanicus*. Trang, close to Malaysia, is plausibly within this species's range; Bangkok is not. Various other Bulkley specimens have anomalous localities, most notably a Chinese Pangolin *Manis pentadactyla* from southern Thailand, an origin that, if the animal is correctly identified, is highly unlikely. AMNH appears to hold no written information about Bulkley's movements (A. Poekempner *in litt*. 2011). Thus, while plausibly Short-tailed Mongoose does (or did) occur in southernmost Thailand, the Bulkley specimen does not on its own demonstrate this; neither Wells (1989) nor Van Rompaey (2000) accepted it to do so.

*Notes on species occurring in adjacent countries which may yet be found in Thailand*

The recent discovery of Yellow-bellied Weasel in Thailand, with its fairly wide in-country range (Supparatvikorn *et al*. 2012), hints that other species might occur as yet unknown. As well as Small-toothed Ferret Badger and Short-tailed Mongoose, chief among these could be Malay Civet *Viverra tangalunga*. This could be overlooked as Large Indian or Large-spotted Civets. It is common in west Malaysia (e.g. Medway 1978). The recent first Thai record, in the far south, another of the distinctive Siamang *Symphalangus syndactylus* (Treesucon & Tantithadapitak 1997) underlines the possibility for new discoveries there. *Viverra* civets and mongooses in the southern peninsula and ferret badgers anywhere (perhaps particularly the northern highlands) should be checked carefully. To find any other so-far recognised species of small carnivore new for Thailand would be a major surprise.

## Conservation status of small carnivores in Thailand

This collation of records allows Thai small carnivores to be set, with varying confidence, into several groups reflecting their conservation status (Table 4).

Six species seem secure in the country (Table 4): they remain widespread, at least locally common and no national-level conservation issues are obvious. Thailand may have special regional importance for the two globally Near Threatened species in this category, Hog Badger and Large Indian Civet. This reflects the larger area under at least somewhat effective conservation management than in most nearby countries, the same reason Thailand has a healthier Tiger population than Myanmar, China, Lao PDR, Vietnam or Cambodia (Simcharoen *et al*. 2007, Walston *et al*. 2010).

Seven more species are probably secure at present (Table 4). Although rather few records of each were found, in the context of survey effort and inferring from other countries, they seem unlikely to have any major threat in the country. Four of these seven have range boundaries in Thailand (Yellow-bellied and Stripe-backed Weasels their southern boundaries, Malay Weasel and Banded Linsang their northern). Malay Weasel in particular has only a small range and its placement in this category is less confident than for the others.

Three species are apparently threatened nationally (Table 4). Their few recent Thai records indicate genuine national rarity, although each species may be numerous at one or two localities. The outlook for these species in Thailand is grim without specific conservation intervention. All are recognised as globally threatened. Large-spotted Civet was formerly widespread, but habitat conversion in its elevational range has been extremely heavy and it is likely to be susceptible to snaring. The relatively many survey areas with records masks the fact that suitable habitat (land below approximately 400 m or, if in gentle terrain, up to about 600 m) is scarce in Thai protected areas. Even much land below 400 m might not be occupied. Moreover, as stressed by Jenks *et al*. (2010), low-elevation land is often at the edge of the protected area in question, degraded (while not rendering it unsuitable for this species, such areas tend to be low priority in protected area management) and easily accessible to hunters. Khao Yai NP is a good example of a protected area supporting the species but apparently in only a very small proportion of its area. The other two species, Hairy-nosed Otter and Otter Civet, are tied to localised special habitats themselves under threat: low-lying wetlands. These three species are the immediate small carnivore conservation priorities in Thailand.

Eight species are of uncertain national conservation status (Table 4). Each has few recent records, so is either rare and plausibly threatened, or overlooked. In non-Sundaic Southeast Asia as a whole, the three otters and Binturong are in steep decline and highly threatened: this may well be so in Thailand. But perhaps, as with Large Indian Civet and Hog Badger, Thailand might hold regionally important populations of these species; the scarcity of records might simply reflect generally low survey effort for otters and a generally lower efficiency of non-baited camera-trapping for Binturong than for *Viverra* civets and Hog Badger. Few surveys after the mid 1990s focused on otters: surveys in the South, including Hala-Bala WS, for Hairy-nosed Otter (B. Kanchanasaka *in litt*.

**Table 4.** Present (2014) national conservation status of small carnivores in Thailand.

| National conservation status | Species |
|---|---|
| Apparently secure (six) | Yellow-throated Marten, Hog Badger, Large Indian Civet, Common Palm Civet, Masked Palm Civet, Crab-eating Mongoose |
| Inferred secure (seven) | Yellow-bellied Weasel, Malay Weasel, Stripe-backed Weasel, Banded Linsang, Small Indian Civet, Small-toothed Palm Civet, Small Asian Mongoose |
| Apparently threatened (three) | Hairy-nosed Otter, Large-spotted Civet, Otter Civet |
| Unclear (eight) | Siberian Weasel, Large-toothed Ferret Badger, Eurasian Otter, Smooth-coated Otter, Asian Small-clawed Otter, Spotted Linsang, Binturong, Banded Civet |

2014); a survey on otter habitat use in Huai Kha Khaeng WS (Faengbubpha 2014); and an ongoing occupancy survey in the Inner Gulf (A. Khamjing *in litt*. 2014). Survey effort in Banded Civet's limited (southern) Thai range was mostly low. Based on their conservation status elsewhere, it would be surprising if any of the remaining three species, Siberian Weasel, Large-toothed Ferret Badger and Spotted Linsang, were at risk in Thailand. However, there remain surprisingly few Thai Spotted Linsang records, the presence of Siberian Weasel seems to be an ecological anomaly, and assessing the conservation status of Large-toothed Ferret Badger is hindered by the paucity of firm identifications to species. These eight species are the clear small carnivore priorities for conservation-oriented surveys in Thailand, with the otters, Binturong and Banded Civet arguably in more urgent need than the others because they are all considered globally threatened (or, globally Near Threatened in the case of Eurasian Otter).

## Conservation of small carnivores in Thailand

*Hunting as a threat to small carnivores*

Throughout most of Thailand hunting probably has been and remains widespread. Yet it is under-recorded, so the extent to which it is a conservation problem for small carnivores is unclear. Some protected areas are evolving effective protection of high-trade-value species such as Tiger (Simcharoen *et al*. 2007, Steinmetz *et al*. 2009, 2010), but most are still heavily poached (Magnus 2001, Tungittiplakorn & Dearden 2002, Lynam *et al*. 2005, 2006, Brodie *et al.* 2009). Hunting occurs for trade outside the local community and for household/domestic consumption. In-country consumption includes small carnivores (Magnus 2001, Tungittiplakorn & Dearden 2002, Steinmetz *et al.* 2006, A. Pattanavibool verbally 2013) and exerts some influence on at least local abundance of some species. For example, locals assessed, based on their encounters, that palm civets (collectively) and Large Indian Civet had declined around villages in Thung Yai Naresuan WS, through hunting for household consumption (Steinmetz *et al.* 2006). These declines were perceived to be localised to the forest edges of villages and fields, i.e. areas totalling a minor fraction of the sanctuary. The same villagers perceived populations of Yellow-throated Marten, otters and Hog Badger to be stable (Steinmetz *et al*. 2006). In Kuiburi NP, small carnivores were mentioned as hunted or eaten by just 1.4% of 735 villagers from 12 buffer zone villages, suggesting consumption is rare; 'e-hen' (collectively meaning civets) was the only species group mentioned. As comparison, 51% claimed to consume wild pigs *Sus* (RSt). Magnus's (2001) formal interviews with 28 hunters and 96 consumers suggested that civets and mongooses were variably hunted and consumed, with hunting and consumption considered as significant source of protein and income generation. Tungittiplakorn & Dearden (2002) examined hunting and wildlife in northern highland villages. They found a consistent extirpation sequence, with civets, linsangs and badgers in the lowest (sixth; still present in most areas) tier; among small carnivores, only Binturong was in a higher tier (third). They commented on the great difficulties in deciding which small carnivores were under discussion, so whilst all except Binturong were in one tier, of the most resilient animals, this does not exclude that particular species within this aggregate will be more declined. The position of Hog Badger in this tier is surprising but in this area consumption had only recently started and only by the young. Similarly 'civets' (plausibly including Yellow-throated Marten and mongooses, species likely to occur but not specifically mentioned) were said not usually to be eaten, to be killed mainly as pests, then discarded or given to labourers of other ethnic groups.

Hunting is also undertaken by mobile bands of high-value wood (e.g. the aloewood *Aquliaria crassna*, the rosewood *Dalbergia cochinchinensis*) poachers. In many, probably most, protected areas (documented in Khao Yai NP, Thap Lan NP, Pang Sida NP and Phu Khieo WS, they hunt for their own consumption during their frequent long visits into the interior forests (Grassman *et al.* 2005a, KEJ, DN).

*Priority interventions*

The conservation of the three evidently threatened species in Thailand requires a combination of habitat protection and suppression of hunting and perhaps trade. Large-spotted Civet requires attention to the parts of the protected areas in which it occurs (on gentle terrain and largely under 300–400 m). Hairy-nosed Otter and Otter Civet depend on low-lying forested, perhaps mostly coastal plain, wetlands. Pru Toh Daeng is the most important known area for these species. Any other populations perhaps have a weaker outlook: the habitat analysis of Wilting *et al*. (2010b) for the broadly syntopic Flat-headed Cat *Prionailurus planiceps* selected Pru Toh Daeng as the only Thai locality with positive long-term prospects. There is as yet no evidence that trade is a priority to address for these three species; it is, or will become, plausibly so for the otter, but this is perhaps less likely for the civets.

*Priority conservation surveys*

Surveys are most important to understand distribution and threats of globally threatened or Near Threatened species of unclear national status, then for species apparently threatened nationally and known from few sites. These total 11 species: Eurasian Otter, Smooth-coated Otter, Hairy-nosed Otter, Asian Small-clawed Otter, Large-spotted Civet, Binturong, Banded Civet and Otter Civet in the first group, Siberian Weasel, Large-toothed Ferret Badger and Spotted Linsang in the second.

Almost half these 11 species in need of further survey are tied to wetlands (four otters and Otter Civet). A national small-carnivore survey of wetland areas retaining extensive semi-natural habitat is probably the highest survey priority. Fishing Cat and Flat-headed Cat also severely threatened inhabitants of wetlands (Cutter & Cutter 2009, Wilting *et al*. 2010b, Tantipisanuh *et al.* 2014b), so would sensibly be included in such a survey. All these species pose identification challenges. Excepting molecular analysis, only camera-trapping would be likely to give results allowing reliable species identification if any but a handful of suitably experienced people conducted the surveys. Camera-traps must be located specifically with these species in mind: general camera-trapping typically finds these species only rarely, even where they are known to occur (e.g. Wilting *et al*. 2010b, for Flat-headed Cat). As well as the coastal plain wetlands, interior hill riparian areas might support at least some of the otters, potentially in significant populations if protected effectively.

Large-spotted Civet is known from many localities so

seeking further populations might seem of low priority. However, few localities with recent records are likely to hold viable populations. Therefore, an examination, based on topography and forest cover across Thailand, to see if any large (several hundred square kilometers) tracts of forested level lowlands exist that remain unsurveyed, so might hold a so-far unknown large population, is important.

The Sundaic Banded Civet has only a small Thai distribution. It should be readily camera-trapped, but following the findings of Wilting *et al*. (2010a), surveys in its potential range might best set many camera-traps away from trails or roads. This is contrary to locations typically selected for surveys of species such as Tiger.

The surprising paucity of Binturong direct sightings urges clarification of its Thai status, particularly its threats. It should prioritise understanding why sighting rates are typically low (in contrast to those of Nettelbeck 1997) over simply finding more localities holding the species. Conventional (unbaited) camera-trapping may not be the most effective survey method. Where competent direct observation surveyors are available, an alternative method may be to seek the species in fruiting trees (by day or night), but this is very labour intensive (see Nettelbeck 1997). As a visually distinctive species, collation of sightings from local people (e.g. protected area staff and villagers) and from other forest-goers (e.g. birdwatchers and primatologists) might be effective, although risks of misidentification must always be borne in mind. Camera-trap encounter rates could perhaps be increased by setting them in canopy gaps (where Binturongs would be forced to the ground, but this is untested) and baiting (judging by success with baited live-traps; see species account).

Spotted Linsang can also be difficult to find predictably when present, although it has been camera-trapped widely in at least China, Vietnam and Lao PDR (Lau *et al*. 2010, Willcox *et al*. 2014: Table SOM 3, Gray *et al*. 2014b, JWD). The species is confused a lot more than might be assumed, with various bold-patterned small carnivores (e.g. Than Zaw *et al*. 2008). No one seems yet to have experimented with camera-trapping specifically in understorey tangles within its Thai range; this might give higher encounter rates, but remains to be tested. The species is also fairly difficult to find by spotlighting (JWD). Compared with Binturong and the weasels, which are partly and apparently almost entirely diurnal, respectively, appeals to birdwatchers are likely to yield many fewer records of the almost fully nocturnal Spotted Linsang.

Siberian Weasel is probably the toughest species to propose survey for because its habitat use in Thailand and adjacent Lao PDR apparently differs from that in its main Palaearctic and Himalayan range. Thai (and Lao) records are not high-montane areas as in Myanmar, but seemingly from ordinary mid-elevation areas not obviously different from the many other areas of such habitat with no records of the species. This hinders selection of survey areas. The best approach is to compile historical records with as much detail as possible on origin, for cues of location, elevation and habitat to search. There are several specimens at TISTR (J. E. Murray *in litt*. 2009), which warrant a critical taxonomic comparison with material from the species's main range, given that this population may be disjunct. Other Southeast Asian weasels are not readily camera-trappable (Duckworth *et al*. 2006, Abramov *et al*. 2008, Supparatvikorn *et al*. 2012), so this one might well also be problematic. The best chance of future records might come from seeking remains of killed animals in villages, checking road-killed small carnivores, and appealing to birdwatchers for records. Live-trapping, hair-snaring and perhaps baited camera-traps might be the most effective intensive search methods.

*The 'secure' species*

The inferred healthy national conservation status of 13 species (over half those known from the country) reflects Thailand's extensive protected area system within which multiple areas curtail habitat loss and hunting pressure sufficiently even for populations of some large ungulates in heavy trade demand to rebound (Simcharoen *et al*. 2007, Steinmetz *et al*. 2009, 2010). If this falters, while some small carnivores are unlikely to have any national-level conservation needs in Thailand under any plausible short- to mid-term scenario (e.g. Yellow-throated Marten and Small Asian Mongoose), other now-common species might (e.g. Hog Badger and Large Indian Civet). As long as people are tempted to break national wildlife law and as long as people desire to convert further natural habitat into agriculture and industry, latent threats remain.

*The value of camera-trapping for Thai small carnivore survey*

This collation of records shows that camera-trapping finds some small carnivore species well, but, as currently undertaken, is inefficient for others. No records by any method during the survey period were traced for one species (Siberian Weasel) and for eight species that were found (Yellow-bellied, Stripe-backed and Malay Weasels; Eurasian, Hairy-nosed and Asian Small-clawed Otters; Small-toothed Palm Civet and Otter Civet), the contributing surveys provided no camera-trap records. Thus nine of Thailand's 24 species (38%) were not detected by the primary survey method, even though seven of these nine (the exceptions being Siberian Weasel and Hairy-nosed Otter) were demonstrably present in at least one camera-trap survey area during or (Eurasian Otter) shortly before the review period. That over a third of the country's small carnivore species were not detected by, in total, a massive camera-trap effort (about 80,000 camera-trap nights) underlines how incomplete camera-trapping, as conventionally employed, is in documenting, still less monitoring, small carnivore communities in Thailand.

Of the 21 survey areas, no small carnivores were camera-trapped in one (Thale Noi NHA), while three more (Khao Sam Roi Yot NP, Maenam Pachi WS and Bang Lang NP) camera-trapped only one species each. In Maenam Pachi WS overall camera-trap effort was low; in Thale Noi NHA all camera-traps were set at non-forest wetland edges; and in Khao Sam Roi Yot NP nearly all camera-traps were in rice fields and reforested mangroves. These factors, not necessarily a poor carnivore community, perhaps explain these areas' few records. In Bang Lang NP, by contrast, survey style, effort and spatial coverage was comparable to other areas (e.g. Khao Sok NP [KSK1 in Appendix 1] and Tai Rom Yen NP) where more species were detected. Most other survey areas recorded at least five species of small carnivore, although at Dong Yai WS and Tai Rom Yen NP only three and four species were camera-trapped, respectively.

The contributing camera-trap surveys were not conduct-

**Table 5.** Applicability of conventional camera-trapping as a survey method to detect Thai small carnivores.

| Applicability | Species |
|---|---|
| Species readily camera-trapped where present | Yellow-throated Marten, Hog Badger, Large Indian Civet, Large-spotted Civet, Common Palm Civet, Crab-eating Mongoose |
| Species frequently camera-trapped where present, perhaps fairly often overlooked by typical surveys | Ferret badger[1], Small Indian Civet[1], Masked Palm Civet, Banded Civet, Small Asian Mongoose[1] |
| Species rarely camera-trapped but targeted camera-traps siting[2] might boost encounter rates | Eurasian Otter, Hairy-nosed Otter, Smooth-coated Otter, Asian Small-clawed Otter, Banded Linsang, Spotted Linsang, Binturong, Otter Civet |
| Species camera-trapped only exceptionally | Yellow-bellied Weasel, Siberian Weasel, Malay Weasel, Stripe-backed Weasel, Small-toothed Palm Civet |

[1]These species, unlike the others, seem to be overlooked by the low survey effort outside closed forest and, particularly, in heavily degraded areas. Categorisation as such of ferret badger is provisional.
[2]Such as water's edge for otters.

ed in parallel with intensive use of other survey methods, so it is unclear which species were present but not camera-trapped in each survey area. There is a good correspondence of each species's general prominence in the camera-trap record for these Thai surveys with those in Myanmar (Than Zaw *et al*. 2008). Some Myanmar camera-trap survey areas also recorded hunted animals. Invariably, this revealed small carnivore species not camera-trapped, even when camera-trapping was intensive. Adding insight from elsewhere in northern South-east Asia (authors' pers. obs.), small carnivore species can be segregated by effectiveness of conventional camera-trapping (Table 5).

Six species are so widely found that they are probably predictably camera-trapped where present, provided a reasonable survey is undertaken (at least 1,000 camera-trap-nights from many stations; cameras operational throughout the 24-hr cycle, at an appropriate height above ground, setters with basic skills in station selection and so on). These comprise larger-bodied species, including four ground-dwellers (Hog Badger; Large Indian and Large-spotted Civets; Crab-eating Mongoose) and two that spend significant time off the ground (semi-arboreal) (Yellow-throated Marten and Common Palm Civet).

Four or five species seem somewhat less predictably recorded so require higher or more diverse effort: one is perhaps more arboreal (Masked Palm Civet); one perhaps somewhat avoids trails, beside which many camera-traps are set (Banded Civet); and 2–3 because they occur mostly in open and/or degraded areas not typically the focus of camera-trapping in a landscape (Small Indian Civet, Small Asian Mongoose and perhaps Large-toothed Ferret Badger). When these latter habitats in occupied areas are camera-trapped, at least the mongoose and civet are likely to be found.

Eight species are presently recorded ineffectively with camera-traps, for various reasons. Camera-trap positioning is usually inappropriate for otters (and, presumably, Otter Civet) but several otter-specific studies (e.g. Kruuk *et al*. 1993, Nguyen *et al*. 2004) show that when these animals are targeted, camera-trapping is effective. Binturong is too arboreal for ordinary camera-trapping to be more than hit-or-miss. The amenability of linsangs to conventional camera-trapping is less readily categorised. They are rarely numerous in camera-trap results, but turn up in small numbers widely. Occasionally they can be among the most commonly camera-trapped small carnivores (e.g. Hedges *et al*. 2013).

Finally, typical camera-trapping only exceptionally detects two genera. The arboreal Small-toothed Palm Civet is a special case of where specific positioning (in this case, in the canopy) can boost encounter rates (see Wahyudi & Stuebing 2013). South-east Asian weasels might be so rarely camera-trapped because they forage mostly in dense ground vegetation (Ross *et al.* 2013), but this remains to be confirmed. They are the smallest carnivores in Thailand, perhaps small enough for few passes to trigger camera-traps as typically set (see Glen *et al*. 2013). In most surveys in South-east Asian forest, the encounter rates of small ground-dwelling birds, rats and other rodents are very low considering their abundance relative to larger mammals more commonly camera-trapped (R. J. Timmins *in litt*. 2014).

Thus, camera-trapping, as conventionally undertaken in South-east Asia, cannot alone effectively document an area's small carnivore community. Presumably, 'deeper' surveys (i.e. longer; more stations; greater area surveyed etc.) will find more species. But placing camera-traps in a greater range of situations is likely to be even more effective at this, if micro-habitat use in part explains consistently low numbers of records of some genera. The effects of camera-trap placement on detection of Southeast Asian small carnivores have only recently been seriously investigated (Chutipong *et al.* 2014) and much remains to be learnt. Similarly, attractants (baits and lures) bring animals into recording range from typically non-camera-trapped micro-habitats such as dense understorey and above-ground areas (Schlexer 2008).

Camera-trapping might even need to be coupled with additional methods for full small carnivore community documentation. Mindful that small carnivore records are likely to continue to be 'by-catch' of other survey foci, additional methods must require few additional resources (equipment, time, specialist experience, etc.). In particular, the sort of varied exact spots of setting, use of baits and other variations in camera-trap use that would be needed are likely to be unacceptable to many camera-trap surveys using specific, precise methods for research purposes. Probably, the single change most practicable for almost everybody to record presently little-known species is for camera-trappers simultaneously to seek and photograph (wherever possible) hunted animals, road-kills,

and any other forms of record amenable to photography and where the origin of the animal is not in doubt. This may be problematic where hunting is illegal and this prohibition is enforced (so hunters will dislike outsiders photographing their kills), but in many areas at least some hunting is accepted.

More generally, potential survey methods for little-recorded species need testing in areas where they are known to be present. This will allow future surveys in unknown areas to be more effective, and better interpretation of the results of searches not finding the species.

There are 426 government-declared protected areas in Thailand: 123 national parks, 58 wildlife sanctuaries and 60 non-hunting areas (Tantipisanuh *et al.* 2014a). The contributing surveys came from only 21 survey areas (ten wildlife sanctuaries, eight national parks, one non-hunting area and two areas not government-declared protected areas). In four of these, only 0–1 small carnivore species were camera-trapped and doubtless many more species are present. But even in the areas with most species camera-trapped, it is safe to assume that other species were present but not found by this method. Of the 407 protected areas with no contributing surveys, a few have had some level of camera-trapping but most have had none, nor have they had any other credible small carnivore surveys.

## Conclusions

The small carnivores of Thailand vary from widespread and common to rare and localised. Species-specific knowledge of conservation status is very patchy. No small carnivore seems to have become extinct in the country in historical times. High levels of conversion of natural habitats, hunting and wildlife trade mean that this may change, without active intervention. Wetland species are particularly at risk. Some species are healthier in status in Thailand than in neighbouring countries. The probably reflects Thailand's more effective and better funded protected area system and its physical distance from China and Vietnam, the major importers of wildlife. However, there is still considerable scope for enhancing protected area effectiveness in Thailand (e.g. Lynam *et al*. 2006). New systems for adaptive park management are being piloted (Stokes 2010, 2013), as are alternative approaches such as community-based wildlife recovery initiatives (Steinmetz *et al*. 2006) and poaching reduction through outreach to promote behaviour change (Steinmetz *et al*. 2014). The latter approaches could be more cost-effective than traditional law enforcement for small carnivores because they lack high market value (at least in Thailand); high-value species are much more likely to require dedicated law enforcement.

Any survey recording small carnivores in Thailand, particularly in the North or Central Plains, and any research, even of the common species, would add to the knowledge base from which to conserve Thai small carnivores. Available resources for small carnivore conservation in Thailand should be directed towards the priority species and habitats wherever possible.

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**Appendix 1. The numbers and percentages[1] of camera-trap stations that recorded small carnivores[2] based on 21 survey areas[3] of Thailand between 1996 and 2013.**

| Survey area | # camera-trap stations & % species detected | Yellow-throated Marten | Hog Badger | Ferret badger | Smooth-coated Otter | *Unidentified otter* | Banded Linsang | Spotted Linsang | Large Indian Civet | Large-spotted Civet | Small Indian Civet | Common Palm Civet | Binturong | Masked Palm Civet | *Unidentified palm civet* | Banded Civet | Small Asian Mongoose | Crab-eating Mongoose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PK1** | **15** | **1** | | | | | | | **7** | | | **2** | | | | | | **1** |
| | % | *7* | | | | | | | *47* | | | *13* | | | | | | *7* |
| **PK2** | **44** | **1** | **2** | | | | | | **8** | | | **1** | **3** | | | | | |
| | % | *2* | *5* | | | | | | *18* | | | *2* | *7* | | | | | |
| **KY1** | **143** | **11** | **22** | **1** | | | | | **61** | | **5** | **24** | **3** | **1** | | | | **14** |
| | % | *8* | *15* | *1* | | | | | *43* | | *3* | *17* | *2* | *1* | | | | *10* |
| **KY2** | **216** | | **3** | | | | | | **22** | **2** | | **3** | **2** | | | | | **3** |
| | % | | *1* | | | | | | *10* | *1* | | *1* | *1* | | | | | *1* |
| **SKR** | **117** | | **2** | | | | | | **3** | **1** | **1** | **29** | | | | | **2** | |
| | % | | *2* | | | | | | *3* | *1* | *1* | *25* | | | | | *2* | |
| **TL1** | **6** | **1** | **1** | | | | | | **4** | | | | | | | | | |
| | % | *17* | *17* | | | | | | *67* | | | | | | | | | |
| **TL2** | **23** | | **8** | | | | | **1** | **21** | **1** | **1** | **12** | **3** | | | | **1** | |
| | % | | *35* | | | | | *4* | *91* | *4* | *4* | *52* | *13* | | | | *4* | |
| **HSM** | **96** | | **1** | **1** | | | | | **1** | **2** | | **1** | | | | | | |
| | % | | *1* | *1* | | | | | *1* | *2* | | *1* | | | | | | |
| **DY** | **21** | | | | | | | | **2** | | | **1** | | | | | | **1** |
| | % | | | | | | | | *10* | | | *5* | | | | | | *5* |
| **TP1** | **22** | | **2** | | | | | | **9** | **2** | **1** | **2** | | | | | | **1** |
| | % | | *9* | | | | | | *41* | *9* | *5* | *9* | | | | | | *5* |
| **TP2** | **83** | **4** | | **4** | | | | **1** | **2** | | **4** | **13** | | | | | **8** | |
| | % | *5* | | *5* | | | | *1* | *2* | | *5* | *16* | | | | | *10* | |
| **KARN1** | **275** | **9** | **24** | | **6** | | | | **18** | **39** | **15** | **20** | | | | | **5** | **13** |
| | % | *3* | *9* | | *2* | | | | *7* | *14* | *5* | *7* | | | | | *2* | *5* |
| **KARN2** | **21** | **1** | **1** | | | | | | | **2** | **1** | **1** | | | | | | |
| | % | *5* | *5* | | | | | | | *10* | *5* | *5* | | | | | | |
| **TYW** | **196** | **22** | **2** | **1** | **1** | ***2*** | **14** | | **96** | | **2** | **23** | **5** | **33** | | | | **34** |
| | % | *11* | *1* | *1* | *1* | *1* | *7* | | *49* | | *1* | *12* | *3* | *17* | | | | *17* |
| **HKK1** | **183** | **2** | **2** | | | | | | **75** | **1** | | **9** | | **7** | | | | **12** |
| | % | *1* | *1* | | | | | | *41* | *1* | | *5* | | *4* | | | | *7* |
| **HKK2** | **113** | **9** | **13** | **2** | **1** | | | | **32** | **1** | **2** | **21** | | **1** | | | | **5** |
| | % | *8* | *12* | *2* | *1* | | | | *28* | *1* | *2* | *19* | | *1* | | | | *4* |
| **SLP** | **51** | **1** | **6** | | | | | | **5** | **4** | | **3** | | | | | | **1** |
| | % | *2* | *12* | | | | | | *10* | *8* | | *6* | | | | | | *2* |
| **MP** | **4** | | | | | | | | | | | **2** | | | | | | |
| | % | | | | | | | | | | | *50* | | | | | | |

| Survey area | # camera-trap stations & % species detected | Yellow-throated Marten | Hog Badger | Ferret badger | Smooth-coated Otter | *Unidentified otter* | Banded Linsang | Spotted Linsang | Large Indian Civet | Large-spotted Civet | Small Indian Civet | Common Palm Civet | Binturong | Masked Palm Civet | *Unidentified palm civet* | Banded Civet | Small Asian Mongoose | Crab-eating Mongoose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **KK1** | **22** | | | | **1** | | **2** | | **15** | | | **5** | | | | | | |
| | % | | | | *5* | | *9* | | *68* | | | *23* | | | | | | |
| **KK2** | **72** | **5** | **19** | | | | | | **37** | | | **18** | | | | | | **10** |
| | % | *7* | *26* | | | | | | *51* | | | *25* | | | | | | *14* |
| **KB** | **77** | **3** | **3** | | | | **1** | | **1** | **3** | **1** | **9** | **1** | | | **1** | **1** | **7** |
| | % | *4* | *4* | | | | *1* | | *1* | *4* | *1* | *12* | *1* | | | *1* | *1* | *9* |
| **SRY** | **4** | | | | | | | | | | | | | | | | **1** | |
| | % | | | | | | | | | | | | | | | | *25* | |
| **KS1** | **1** | | | | | | | | | | | | | | | | | |
| | % | | | | | | | | | | | | | | | | | |
| **KS2** | **6** | | | | **2** | | **1** | | | | | | | | | **1** | | **2** |
| | % | | | | *33* | | *17* | | | | | | | | | *17* | | *33* |
| **KSK1** | **10** | **2** | | | | | **1** | | | | | | | | | **2** | | |
| | % | *20* | | | | | *10* | | | | | | | | | *20* | | |
| **KSK2** | **1** | | | | | | **1** | | | | | | | | | | | |
| | % | | | | | | *100* | | | | | | | | | | | |
| **TRY** | **33** | | **1** | | | | | | **1** | | | **1** | | **1** | | | | |
| | % | | *3* | | | | | | *3* | | | *3* | | *3* | | | | |
| **TN** | **1** | | | | | | | | | | | | | | | | | |
| | % | | | | | | | | | | | | | | | | | |
| **BL** | **24** | | | | | | | | | | | | | | ***1*** | | | |
| | % | | | | | | | | | | | | | | *4* | | | |
| **HLBL1** | **36** | **1** | | | | | | | | | | | | | | | | |
| | % | *3* | | | | | | | | | | | | | | | | |
| **HLBL2** | **19** | **8** | | | | | **2** | | | | | **1** | **5** | **8** | | **8** | | **1** |
| | % | *42* | | | | | *11* | | | | | *5* | *26* | *42* | | *42* | | *5* |
| **HLBL3** | **16** | **2** | | | | | | | | | | **1** | **1** | **2** | | **4** | | |
| | % | *13* | | | | | | | | | | *6* | *6* | *13* | | *25* | | |

[1]Of all camera-trap stations deployed during the survey in question.
[2]Scientific names in Table 1. Species not recorded by the contributing camera-trap surveys are omitted from this table.
[3]Contributing surveys are profiled in Table 2.
For PK1 Lynam *et al.* (2001) listed Hog Badger and Binturong, which seem not to have been photographed then. Subsequent survey (PK2) recorded them both in the area. Kitamura *et al.* (2010) listed Small Asian Mongoose for Hala-Bala WS (HLBL2), an error for Crab-eating Mongoose.

**Appendix 2. Elevational distribution[1] of surveys and of camera-trap records for each species[2] of small carnivore, based on stations species were detected in 21 survey areas[3] of Thailand between 1996 and 2013.**

| Region | Survey area | Yellow-throated Marten | Hog Badger | Ferret badger | Smooth-coated Otter | *Unidentified otter* | Banded Linsang | Spotted Linsang | Large Indian Civet | Large-spotted Civet | Small Indian Civet | Common Palm Civet | Binturong | Masked Palm Civet | *Unidentified palm civet* | Banded Civet | Small Asian Mongoose | Crab-eating Mongoose | Elevation range of camera-traps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NE | PK1 | 807 | | | | | | | 800–892 | | | 805–892 | | | | | | 807 | 713–892 |
| | PK2 | 875 | 820–887 | | | | | | 730–918 | | | 820 | (631–) 839–866 | | | | | | 631–944 |
| | KY1 | 750–1,091 | (164–) 646–1,016 | 97 | | | | | 75–1,197 | | (94–) 773–843 | 75–94, 507–843 | 793–1,016 | 1,079 | | | | 669–1,197 | 75–1,197 |
| | KY2 | | 255, 467 | | | | | | 124–421, 745–1,255 | 467–471 | | (187–) 421–519 | 421–519 | | | | | 421–456 (–915) | 32–1,306 |
| | SKR | | 446–634 | | | | | | 420–536 | 380 | 285 | 285–691 | | | | | 411–420 | | 285–691 |
| | TL1 | 536 | 696 | | | | | | 605–766 | | | | | | | | | | 532–766 |
| | TL2 | | 487–843 | | | | | 614 | 368–846 | 496 | 496 | 368–843 | 530–726 | | | | 464 | | 368–846 |
| | HSM | | 733 | 180 | | | | | 31 | 42; 269 | | 31 | | | | | | | 31–347; 641–927 |
| | DY | | | | | | | | 571–617 | | | 534 | | | | | | 534 | 338–617 |
| | TP1 | | 414–451 | | | | | | 131–462 | 131–283 | 131 | 227–306 | | | | | | 134 | 131–508 |
| | TP2 | (136–) 356–501 | | 143–332 | | | | 544 | 143, 482 | | 130–302 | 143–490 | | | | | 143–505 | | 113–544 |
| SE | KARN1 | 99–130 | 99–130 | | 106–115 | | | | 106–174 | 99–130 | 99–130 | 99–130 | | | | | 99–123 | 106–130 | 93–174 |
| | KARN2 | 158 | 182 | | | | | | | 116–135 | 135 | 141 | | | | | | | 107–224 |
| W | TYW | 762–1,119 | 919–949 | 934 | 738 | *924–934* | 728–1,119 | | 728–1,119 | | 902–933 | 738–1,119 | 738–1,025 | 738–1,119 | | | | 728–1,119 | 728–1,142 |
| | HKK1 | 483; 1,272 | 495–526 | | | | | | 248–743; 1,152–1,272 | 274 | | 247–371; 636; 1,230–1,334 | | 462–495; 1,225–1,334 | | | | 436–516; 987–1,272 | 228–780; 987–1,334 |
| | HKK2 | 228–646 | 272–784 | 469–483 | 290 | | | | 197–743 | 194 | 191–238 | 191–514(–743) | | 525 | | | | 282–638 | 191–784 |
| | SLP | 435 | 109–387 | | | | | | 47–387 | 47–156(–453) | | 47–156 (–387) | | | | | | 274 | 31–453 |
| | MP | | | | | | | | | | | 479–565 | | | | | | | 298–565 |
| | KK1 | | | | 259 | | 568–640 | | 262–739 | | | 328–383 | | | | (255)* | | | 262–840 |
| | KK2 | 331–565 | 296–565 | | | | | | 296–565 | | | 296–597 | | | | | | 331–536 | 296–597 |
| | KB | 160–369 | 334–415 (–695) | | | | 322 | | 117 | 160–249 | 158 | 158–429 (–695) | 253 | | | 695 | 160 | 172–410 | 117–695 |
| | SRY | | | | | | | | | | | | | | | | 2 | | 2–3 |
| S | KS1 | | | | | | | | | | | | | | | | | | 180 |
| | KS2 | | | | 120 | | 137 | | | | | | | | | 196 | | 137–164 | 120–196 |

| Region | Survey area | Yellow-throated Marten | Hog Badger | Ferret badger | Smooth-coated Otter | *Unidentified otter* | Banded Linsang | Spotted Linsang | Large Indian Civet | Large-spotted Civet | Small Indian Civet | Common Palm Civet | Binturong | Masked Palm Civet | *Unidentified palm civet* | Banded Civet | Small Asian Mongoose | Crab-eating Mongoose | Elevation range of camera-traps |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | KSK1 | 152–270 | | | | | 354 | | | | | | | | | 201–354 | | | 71–354 |
| | KSK2 | | | | | | 222 | | | | | | | | | | | | 222 |
| | TRY | | 302 | | | | | | 163 | | | 488 | | | | | | | 90–488 |
| | TN | | | | | | | | | | | | | | | | | | c. 1 |
| | BL | | | | | | | | | | | | | | | | | | 164–778 |
| | HLBL1 | 350 | | | | | | | | | | | | | *164* | | | | 54–570 |
| | HLBL2 | 162–350; 637–722 | | | | | 162–350 | | | | | 404 | 162–350 (–637) | 162–404 | | 162–579 | | 579 | 162–722 |
| | HLBL3 | 253–348 | | | | | | | | | | 195 | 348 | 118–195 | | 164–348 | | | 96–711 |

[1]Specifically for each survey area, in case it varies across the country. The recorded elevation of camera-trap records is given as a range, with outliers in parentheses. These elevation records do not include Appendix 4 records.

[2]Scientific names in Table 1. Species not recorded by the contributing camera-trap surveys are omitted from this table.

[3]Contributing surveys are profiled in Table 2.

*The record of Banded Civet from Kekule (2004)

**Appendix 3. Individual records of selected species.**

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| **Yellow-bellied Weasel** | | | | | | |
| Doi Phu Kha NP | C. Atchariyayart | 19°12′N, 101°05′E | c. 1,300 | Hill evergreen mixed with some pine | Dp | 2013 |
| Ang Ga trail, Doi Inthanon NP | B. Pisanworawit | 18°33′N, 98°28′E | c. 2,200 | Evergreen | Dp | 2013 |
| **Malay Weasel** | | | | | | |
| Kachong waterfall, Khao Bantad WS | NB | 7°32′N, 99°48′E | 242 | Evergreen forest near waterfall (twice) | D | 1992 |
| Tum Nung waterfall | W. Tantanawat | 9°00′N, 98°28′E | c. 66 | Crossing a small stream in evergreen forest | Dp | 2011 |
| **Stripe-backed Weasel** | | | | | | |
| Phu Khieo WS | A. Manawong | 16°23′N, 101°34′E | c. 860 | Drinking from artificial pond by HQ; evergreen | Dp | 2014 |
| Phu Khieo WS | C. Waradee | 16°27′N, 101°28′E | c. 900 | Deciduous / evergreen forest transition | Dp | 2014 |
| Ban Khao Tok Nam, Kuiburi, Prachuab-kirikhan province | Kuiburi NP staff, RSt & N. Seuaturien | 12°06′N, 99°44′E | c. 105 | Village | Gp | 2009 |
| Huai Kha Khaeng WS | Anon. | 15°43′N, 99°11′E | c. 619 | Dry evergreen near Huai Nam Tuen Ranger Station | Dp | 2009 |
| **Unidentified weasel** | | | | | | |
| Doi Ang Khang, Chiang Mai province | P. Katsura | 19°54′35.8″N, 99°02′45.2″E | 1,450 | Small pocket of disturbed hill evergreen forest near Royal Project site; drinking at a small pool | Dp | 2012 |
| **Unidentified ferret badger** | | | | | | |
| Gaeng Pitsamai, Mekong River, Ubon Ratchathani province | P. Junmee | 15°24′N, 105°33′ | c. 100 | Near dry dipterocarp forest | Rp | 2014 |
| Huai Kha Khaeng WS | MCB | 15°28′47″N, 99°16′29″E | 483 | Mixed deciduous forest | C | 2010 |
| Huai Kha Khaeng WS | MCB | 15°28′00″N, 99°16′16″E | 469 | Mixed deciduous forest | C | 2010 |
| Huai Samong | DNP | 14°06′08″N, 102°03′48″E | 180 | Mixed deciduous forest | C | 2013 |
| Khao Yai NP | AJL | 14°10′49″N, 101°48′32″E | 97 | Mixed deciduous forest | C | 2002 |
| Ta Phraya NP | MCB | 14°07′49″N, 102°35′46″E | 143 | Dry evergreen forest | C | 2009 |
| Ta Phraya NP | MCB | 14°04′33″N, 102°34′09″E | 275 | Dry evergreen forest | C | 2009 |
| Ta Phraya NP | MCB | 14°08′26″N, 102°39′06″E | 332 | Dry evergreen forest | C | 2012 |
| Ta Phraya NP | MCB | 14°06′35″N, 102°34′55″E | 149 | Dry evergreen forest | C | 2012 |
| Thung Yai Naresuan WS – West | WC | 15°20′41″N, 98°47′25″E | 934 | Gallery evergreen amidst extensive grassland | C | 2007 |
| Phu Khieo WS | LIG | n/a | c. 700–900 | Mixed deciduous (thrice), hill evergreen forest (twice) | L | 1998–2002 |
| Mahidol University – Kanchanaburi campus | S. Prasopsin (per NB) | 14°07′N, 99°09′E | 175 | Mixed deciduous | Dp | 2012 |
| Huai Samong | DNP (M. Safoowong) | 14°03′28″N, 102°02′00″E | 145 | Secondary mixed deciduous with Imperata cylindrica | Lp | 2014 |
| **Eurasian Otter** | | | | | | |
| Mae Wong NP | B. Kanchanasaka | n/a | n/a | n/a | n/a | n/a |
| Doi Ang Khang, Chaing Mai province | B. Kanchanasaka | n/a | n/a | n/a | n/a | n/a |
| Chiang Saen, Chiang Rai province | B. Kanchanasaka | n/a | n/a | n/a | Skin | n/a |
| **Hairy-nosed Otter** | | | | | | |
| Pru Toh Daeng, Narathiwat province | See text | n/a | n/a | Peat-swamp forest | D | See text |
| Khao Bantad WS | See text | n/a | n/a | Found in a fish trap | R | See text |
| Pru Toh Daeng | J. Hall | n/a | n/a | Peat-swamp forest | D | 2010 |
| **Smooth-coated Otter** | | | | | | |
| Krabi province | J. W. K. Parr | n/a | c. 1 | Sandbar in mangrove, north of Krabi town (2 km) | D | 1988 |

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| Khlong Saeng WS | NB | n/a | c. 100–130 | Along Khlong Saeng, Khlong Ya, Khlong Kuan; lowland evergreen forest | D | 1994, 1996, 1997 |
| Huai Kha Khaeng WS | NB | n/a | 197 | Along Huai Tap Salao; mixed deciduous forest | D | 2006, 2008, 2009 |
| Huai Kha Khaeng WS | N. Sukumal | n/a | 239 | Stream; group of more than c.10 | Dp | 2013 |
| Khao Yai NP | K. Saralanba | n/a | c. 750 | Stream; group of more than c.10 | Dp | 2013 |
| Sri Na Karin Dam, Kanchanaburi province | W. Onganunkun | n/a | c. 180 | A group | Dp | 2013 |
| Khok Kham subdistrict, Samutsakhon province | K. Tonsakulrungruang | n/a | c. 10 | Three individuals ran in front of car. | Dp | 2013 |
| Khok Kham subdistrict, Samutsakhon province | K. Saralanba | n/a | c. 5 | Street | Dp | 2013 |
| Inner Gulf, Bangkhuntien, Bangkok | A. Kamjing | n/a | n/a | Village | Gp | 2013–2014 |
| Huai Kha Khaeng WS | MCB | n/a | 290 | Mixed deciduous | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | n/a | 115 | Evergreen forest | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | n/a | 115 | Evergreen forest | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | n/a | 115 | Evergreen forest | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | n/a | 106 | Secondary growth forest | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | n/a | 106 | Secondary growth forest | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | n/a | 106 | Secondary growth forest | C | 2009 |
| Khlong Saeng WS | PBC | n/a | 120 | Evergreen forest | C | 2003 |
| Khlong Saeng WS | PBC | n/a | 120 | Evergreen forest | C | 2003 |
| Thung Yai Naresuan WS – West | WC | n/a | 738 | Evergreen forest | C | 2012 |
| Kaeng Krachan NP | AJL | n/a | 230 | Evergreen forest along river | C | 2001 |
| Khao Sok NP | Kanchansaka et al. 2003 | n/a | n/a | n/a | C* | 2001–2002 |
| Khlong Saeng WS | Kanchansaka et al. 2001a | n/a | n/a | n/a | C* | n/a |
| Thab Salao stream, Huai Kha Khaeng WS | Faengbubpha 2014 | n/a | n/a | Mixed deciduous | C* | 2011–2012 |
| **Asian Small-clawed Otter** | | | | | | |
| Hala-Bala WS | N. Sukumal | n/a | 319 | Stream in moist lowland evergreen | Dp | 2013 |
| Thale Noi NHA | S. Opitakon | n/a | c. 10 | Near lake; road-kill bodies of adult female and cubs | Rp | 2012 |
| Krabi province | J. W. K. Parr | n/a | c. 1 | Mangroves near town (several times) | D | 1988 |
| Khao Sok NP | Kanchansaka et al. 2003 | n/a | n/a | n/a | C* | 2001–2002 |
| Khlong Saeng WS | Kanchansaka et al. 2003 | n/a | n/a | n/a | C* | 2001–2002 |
| Thab Salao stream, Huai Kha Khaeng WS | Faengbubpha 2014 | n/a | n/a | Mixed deciduous | C* | 2011–2012 |
| Inner Gulf, Bangkhuntien, Bangkok | WC | n/a | 0–5 | Coastal area | Verbal remarks | 2009–2010 |
| **Unidentified otters** | | | | | | |
| Thung Yai Naresuan WS – West | WC | n/a | n/a | Gallery evergreen amidst extensive grassland | C | 2007–2008 |
| Kaeng Krachan NP | AJL | n/a | n/a | Petchburi river | C | 2003 |
| Samut Prakarn province | P. Pathumratanatharn | n/a | n/a | Urban area | G | 2005 |
| Trang province | NB | n/a | n/a | Trang river bank | D | 1991 |
| **Banded Linsang** | | | | | | |
| Hornbill Camp, Huai Kha Khaeng WS | RSu | 15°28′N, 99°19′E | 926 | Stream (less than 5 m wide) in evergreen forest | D | n/a |
| Mae Wong NP | U. Dachyosdee | 15°53′N, 99°08′E | c. 520 | Secondary growth (evergreen) close to stream | Dp | 2012 |

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| Suan Phung district, Ratchaburi province | W. Taksintum | 13°34′N, 99°18′E | c. 370 | Secondary growth (evergreen) | Dp | 2013 |
| Near Khao Bantad WS, Satun province | I. Sra-ar per P. D. Round | 7°07′N, 100°00′E | 98 | Evergreen forest on limestone | Rp | 2011 |
| Kaeng Krachan NP | Kekule 2004 | c.12°48′N, 99°26′E | 370 | Evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′22″N, 101°49′57″E | 162 | Evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′24″N, 101°48′41″E | 350 | Evergreen | C | 2004 |
| Kuiburi NP | RSt | 12°04′06″N, 99°33′38″E | 322 | Evergreen | C | 2007 |
| Kaeng Krachan NP | AJL | 12°51′14″N, 99°22′48″E | 640 | Evergreen | C | 2001 |
| Kaeng Krachan NP | AJL | 12°51′25″N, 99°23′08″E | 568 | Evergreen | C | 2001 |
| Khlong Saeng WS | PBC | 9°15′56″N, 98°36′15″E | 137 | Evergreen | C | 2003 |
| Khao Sok NP | AJL | 8°54′09″N, 98°30′47″E | 354 | Evergreen | C | 1996 |
| Khao Sok NP | PBC | 8°55′51″N, 98°42′33″E | 222 | Evergreen | C | 2004 |
| Thung Yai Naresuan WS | Steinmetz & Simcharoen 2006 | 15°20′N, 98°47′E | 700 | Riparian semi-evergreen forest | D | 2006 |
| Thung Yai Naresuan WS – West | WC | 15°18′26″N, 98°46′00″E | 982 | Evergreen | C | 2012 |
| Thung Yai Naresuan WS – West | WC | 15°19′13″N, 98°46′51″E | 861 | Evergreen | C | 2012 |
| Thung Yai Naresuan WS – West | WC | 15°19′19″N, 98°46′48″E | 888 | Evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°20′29″N, 98°46′49″E | 894 | Evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°20′42″N, 98°47′29″E | 934 | Gallery evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°20′49″N, 98°46′55″E | 919 | Evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°20′55″N, 98°46′22″E | 911 | Evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°21′16″N, 98°46′28″E | 925 | Evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°22′26″N, 98°43′30″E | 786 | Gallery evergreen | C | 2007 |
| Thung Yai Naresuan WS – West | WC | 15°05′53″N, 98°52′27″E | 1,059 | Evergreen | C | 2012 |
| Thung Yai Naresuan WS – West | WC | 15°05′54″N, 98°52′27″E | 1,119 | Evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°05′54″N, 98°53′12″E | 1,025 | Secondary growth (evergreen) | C | 2007 |
| Thung Yai Naresuan WS – West | WC | 15°08′23″N, 98°54′19″E | 728 | Secondary growth (evergreen) | C | 2012 |
| Thung Yai Naresuan WS – West | WC | 15°08′03″N, 98°54′35″E | 785 | Secondary growth (evergreen) | C | 2012 |
| Salakpra WS | RSu & KS | 14°24′23″N, 99°15′29″E | 170 | Degraded dry evergreen | C | 2014 |
| Khlong Saeng WS | Kanchanasaka 2001a | n/a | n/a | n/a | C* | 1997–2000 |
| Huai Kha Khaeng WS | Steinmetz & Simcharoen 2006 | 15°27′N, 99°19′E | 950 | Hill evergreen forest | D | 1998 |
| Huai Kha Khaeng WS | Steinmetz & Simcharoen 2006 | 15°29′N, 99°20′E | 800 | Mixed deciduous forest | C* | 2005 |
| Huai Kha Khaeng WS | Wongchoo 2014 | n/a | n/a | n/a | C* | 2005–2009 |
| Thung Yai Naresuan WS – East | Vinitpornsawan 2013 | n/a | n/a | n/a | C* | 2010–2012 |
| **Spotted Linsang** | | | | | | |
| Thap Lan NP | DN | 14°14′13″N, 101°57′49″E | 614 | Degraded evergreen | C | 2013 |
| Ta Phraya NP | MCB | 14°07′24″N, 102°30′30″E | 544 | Degraded evergreen | C | 2012 |
| Thap Lan NP | Redford et al. 2011 | 14°16′18″N, 102°16′01″E | 561 | Evergreen forest | C* | 2008 |
| Pang Sida NP | Redford et al. 2011 | 14°07′21″N, 102°15′19″E | 564 | Evergreen forest | C* | 2011 |

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| **Large-spotted Civet** | | | | | | |
| Thung Yai Naresuan WS – West | N. Seuaturien | 15°20′N, 98°45′E | c. 700 | Mixed deciduous and dry dipterocarp forest | D | 2006 |
| Ban Huai Seua, Thong Pha Phum district, Kanchanaburi province | WC | 14°53′N, 98°49′E | 570 | Degraded mixed deciduous forests mixed with small area of reforestation (teak) | D | 2006 |
| Huai Kha Kaeng WS | MCB | 15°35′30″N, 99°20′19″E | 194 | Deciduous | C | 2010 |
| Huai Kha Kaeng WS | RSu | 15°31′23″N, 99°17′25″E | 274 | Deciduous | C | 1999 |
| Huai Samong | DNP | 14°05′20″N, 102°05′16″E | 269 | Deciduous | C | 2013 |
| Huai Samong | DNP | 14°04′46″N, 102°03′46″E | 42 | Agriculture area | C | 2013 |
| Khao Ang Rue Nai WS | KEJ | 13°29′12″N, 101°52′18″E | 111 | Evergreen | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°25′09″N, 101°53′26″E | 106 | Secondary growth (evergreen) | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′36″N, 101°52′53″E | 122 | Evergreen | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°25′06″N, 101°52′44″E | 112 | Secondary growth (evergreen) | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°24′04″N, 101°52′36″E | 99 | Secondary growth (evergreen) | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°24′34″N, 101°52′35″E | 110 | Secondary growth (evergreen) | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°24′35″N, 101°53′11″E | 123 | Evergreen | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°25′12″N, 101°53′13″E | 106 | Secondary growth (evergreen) | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′09″N, 101°53′26″E | 106 | Secondary growth (evergreen) | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′09″N, 101°53′26″E | 106 | Secondary growth (evergreen) | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′39″N, 101°52′52″E | 122 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′09″N, 101°53′26″E | 106 | Secondary growth (evergreen) | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°25′39″N, 101°52′52″E | 122 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′11″N, 101°53′49″E | 120 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′37″N, 101°53′33″E | 115 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′11″N, 101°53′49″E | 120 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′39″N, 101°52′52″E | 122 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′37″N, 101°53′33″E | 115 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′11″N, 101°53′49″E | 120 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°23′31″N, 101°54′14″E | 130 | Deciduous | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′39″N, 101°52′52″E | 122 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°28′56″N, 101°51′34″E | 116 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′37″N, 101°53′33″E | 115 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′11″N, 101°53′49″E | 120 | Evergreen | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°23′31″N, 101°54′14″E | 130 | Deciduous | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′39″N, 101°52′52″E | 122 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°24′36″N, 101°53′08″E | 123 | Secondary growth (evergreen) | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°23′31″N, 101°54′14″E | 130 | Deciduous | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°24′11″N, 101°53′49″E | 120 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°25′39″N, 101°50′12″E | 106 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°24′21″N, 101°53′38″E | 120 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°25′48″N, 101°53′06″E | 118 | Secondary growth (evergreen) | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°24′49″N, 101°53′22″E | 123 | Evergreen | C | 2010 |

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| Khao Ang Rue Nai WS | KEJ | 13°24′21″N, 101°53′38″E | 120 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°23′41″N, 101°54′03″E | 130 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°25′48″N, 101°53′06″E | 118 | Secondary growth (evergreen) | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°23′41″N, 101°54′03″E | 130 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°24′21″N, 101°53′38″E | 120 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | KEJ | 13°24′49″N, 101°53′22″E | 123 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | MCB | 13°29′05″N, 101°49′18″E | 116 | Evergreen | C | 2010 |
| Khao Ang Rue Nai WS | MCB | 13°23′02″N, 101°56′26″E | 135 | Evergreen | C | 2010 |
| Khao Yai NP | KEJ | 14°21′03″N, 101°43′35″E | 471 | Deciduous (degraded) | C | 2006 |
| Khao Yai NP | KEJ | 14°20′49″N, 101°43′09″E | 467 | Deciduous (degraded) | C | 2006 |
| Kuiburi NP | RSt & N. Seuaturien | 12°10′06″N, 99°38′12″E | 196 | Secondary growth (abandoned plantation) | C | 2010 |
| Kuiburi NP | RSt & N. Seuaturien | 12°11′14″N, 99°39′22″E | 160 | Secondary growth (abandoned plantation) | C | 2010 |
| Kuiburi NP | RSt & N. Seuaturien | 12°09′59″N, 99°37′01″E | 249 | Secondary growth (evergreen) | C | 2010 |
| Sakaerat BR | SS | 14°31′08″N, 101°55′35″E | 380 | Evergreen | C | 2010 |
| Salakpra WS | KS | 14°20′43″N, 99°16′46″E | 156 | Deciduous | C | 2012 |
| Salakpra WS | KS | 14°21′30″N, 99°17′14″E | 47 | Evergreen | C | 2013 |
| Salakpra WS | KS | 14°20′58″N, 99°17′33″E | 453 | Deciduous | C | 2013 |
| Salakpra WS | KS | 14°22′48″N, 99°16′02″E | 102 | Deciduous | C | 2013 |
| Ta Phraya NP | AJL | 14°10′37″N, 102°44′25″E | 283 | Evergreen | C | 1998 |
| Ta Phraya NP | AJL | 14°07′07″N, 102°36′47″E | 131 | Secondary growth | C | 1998 |
| Thap Lan NP | DN | 14°20′50″N, 102°06′54″E | 496 | Secondary growth | C | 2013 |
| Khao Yai NP | DN | 14°27′36″N, 101°21′17″E | 779 | Evergreen | C | 2010 |
| Huai Kha Kaeng WS | Wongchoo 2014 | n/a | below 400 | Mixed deciduous and dry dipterocarp | C* | 2005–2009 |
| **Small Indian Civet (incidental records only)** | | | | | | |
| Thung Yai Naresuan WS – West | WC | 15°07′N, 98°54′E | c. 830 | Grassy mixed deciduous | D | 2007 |
| Edge of Khao Yai NP | WC | 14°22′N, 101°46′E | c. 500 | Grassy edge of agriculture | D | 2007 |
| Thung Yai Naresuan WS – West | WC | n/a | c. 700–900 | Gallery evergreen amid dry dipeterocarp and mixed deciduos forests with extensive grass (two); secondary evergreen by frequently burned grassy mixed deciduous (one) | L | 2010–2011 |
| Phu Khieo WS | LIG | n/a | c. 700–900 | Mixed deciduous forest (10 captures) | L | 1998–2002 |
| Kaeng Krachan NP | LIG | n/a | c. 500–800 | Small grass field amid evergreen forest near Ban Krang camping area | L | 1996 |
| Khao Yai NP | JWD | 14°26′N, 101°21′E | c. 730 | Degraded areas around Khao Yai's HQ (four times) | D | 1995 |
| Khao Yai NP | Austin & Tewes 1999 | See reference | See reference | Open & edge habitat, semi-evergreen or mixed deciduous | D, C* | See reference |
| **Binturong** | | | | | | |
| Khao Phanom Bencha NP | J. W. K. Parr | c.8°14′N, 98°55′E | c. 160 | In tree c 20 m high in primary evergreen forest | D | 1987 |
| Hala-Bala WS | M. Pliosungnoen | c.5°45′N, 101°50′E | 137 | Ficus tree in evergreen forest | D | 2002 |
| Kaeng Krachan NP | NB | 12°48′N, 99°30′E | 333 | In tree near salt lick (Pong Prom) in evergreen forest | D | 1994 |
| Huai Kha Kaeng WS | NB | 15°28′N, 99°19′E | 695 | Evergreen forest along trail to Khao Khieo (from Khao Nang Rum) | D | 1985 |
| Phu Khieo WS | NB | c.16°27′N, 100°37′E | 784 | Mother & cub; evergreen (in primate study plot) | D | 1984 |

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| Thung Yai Naresuan WS – West | WC | 15°21′N, 98°47′E | c. 900 | Gallery evergreen | D | 2008 |
| Thung Yai Naresuan WS – West | WC | 15°07′N, 98°53′E | c. 790 | On Ficus tree in mixed deciduous mixed with secondary evergreen | D | 2008 |
| Thung Yai Naresuan WS – West | T. Dawrueng | 15°07′N, 98°53′E | c. 790 | Sleeping in tree in secondary evergreen | Dp | 2012 |
| Thung Yai Naresuan WS – West | WC | n/a | c. 700–900 | Edge of evergreen and mixed deciduous (one); small patch of riparian (gallery) evergreen amidst vast area of dry dipterocarp forest (one) | L | 2010–2011 |
| Khao Sok NP | AJL | c.8°55′N, 98°31′E | c. 70 | At headquarters, lowland evergreen | D | 1996 |
| Phu Khieo WS | LIG | n/a | c. 700–900 | Hill evergreen forest (31 captures) | L | 1998–2002 |
| Khao Ang Rue Nai WS | R. Phoonjampa (per NB) | 13°16′N, 101°45′E | 133 | Secondary lowland evergreen forest logged 25 years previously | Dp | 2010 |
| Thung Yai Naresuan WS – West | T. Dawreung | 15°07′21″N, 98°53′27″E | 790 | Secondary evergreen | Dp | 2012 |
| Tai Rom Yen NP | FKH | 8°58′N, 99°32′E | n/a | Confiscated animal (head); from evergreen partly limestone | Rp | 2013 |
| Hala-Bala WS | DNP (S. Thong-aree) | 5°48′14″N, 101°48′51″E | 348 | Moist Evergreen Forest | C | 2005 |
| Hala-Bala WS | SK | 5°47′50″N, 101°47′01″E | 637 | Moist Evergreen Forest | C | 2006 |
| Hala-Bala WS | SK | 5°48′22″N, 101°49′57″E | 162 | Moist Evergreen Forest | C | 2004 |
| Hala-Bala WS | SK | 5°48′24″N, 101°48′41″E | 350 | Moist Evergreen Forest | C | 2004 |
| Hala-Bala WS | SK | 5°48′40″N, 101°48′26″E | 347 | Moist Evergreen Forest | C | 2004 |
| Hala-Bala WS | SK | 5°48′06″N, 101°49′21″E | 273 | Moist Evergreen Forest | C | 2004 |
| Kuiburi NP | RSt & N. Seuaturien | 12°04′40″N, 99°35′24″E | 253 | Dry evergreen | C | 2010 |
| Khao Yai NP | KEJ | 14°13′17″N, 101°40′54″E | 421 | Dry evergreen | C | 2004 |
| Khao Yai NP | KEJ | 14°15′27″N, 101°40′34″E | 519 | Dry evergreen | C | 2004 |
| Khao Yai NP | AJL | 14°20′10″N, 101°28′50″E | 1,016 | Dry evergreen | C | 2001 |
| Khao Yai NP | AJL | 14°26′27″N, 101°18′29″E | 915 | Dry evergreen | C | 2000 |
| Khao Yai NP | AJL | 14°26′49″N, 101°19′48″E | 793 | Dry evergreen | C | 2001 |
| Phu Khieo WS | LIG | 16°25′36″N, 101°35′16″E | 866 | Dry stream bed/Evergreen | C | 2001 |
| Phu Khieo WS | LIG | 16°26′43″N, 101°38′39″E | 631 | Dry stream bed/Evergreen | C | 2001 |
| Phu Khieo WS | LIG | 16°28′40″N, 101°35′57″E | 839 | Hill evergreen trail | C | 2001 |
| Thap Lan NP | DN | 14°12′10″N, 102°04′55″E | 530 | Dry evergreen | C | 2013 |
| Thap Lan NP | DN | 14°16′26″N, 102°04′49″E | 726 | Dry evergreen | C | 2013 |
| Thap Lan NP | DN | 14°20′44″N, 101°58′08″E | 714 | Dry evergreen | C | 2013 |
| Thung Yai Naresuan WS – West | WC | 15°19′41″N, 98°47′16″E | 902 | Gallery evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°20′44″N, 98°46′52″E | 919 | Dry evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°21′34″N, 98°46′25″E | 921 | Dry evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°05′55″N, 98°53′12″E | 1,025 | Dry evergreen | C | 2010 |
| Thung Yai Naresuan WS – West | WC | 15°08′40″N, 98°52′01″E | 738 | Dry evergreen | C | 2012 |
| **Small-toothed Palm Civet** | | | | | | |
| Hala-Bala WS | J. Hall | n/a | n/a | Evergreen | D | 2010 |
| Khao Yai NP | M. Pliosungnoen | c.14°26′N, 101°22′E | c. 795 | Mo Singto; evergreen forest | D | 2006 |
| Thung Yai Naresuan WS – West | WC & N. Seuaturien | 15°07′N, 98°54′E | c. 800 | Edge of dry evergreen, road to Nam Choan; resting in tree c. 10 m above ground | D | 2007–2008 |
| Thung Yai Naresuan WS – West | WC & RSt | 15°07′N, 98°54′E | c. 780 | Open mixed deciduous close to ranger station | D | 2007–2008 |
| Thung Yai Naresuan WS – West | WC | 15°07′N, 98°54′E | c. 780 | Open mixed deciduous close to ranger station | D | 2007–2008 |
| Thung Yai Naresuan WS – West | WC | 15°07′N, 98°54′E | c. 780 | Open mixed deciduous close to ranger station | D | 2007–2008 |

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| Thung Yai Naresuan WS – West | WC & A. J. Pierce | 15°20′N, 98°47′E | c. 860 | Dry evergreen | D | 2007–2008 |
| Thung Yai Naresuan WS – West | WC | 15°20′N, 98°47′E | c. 880 | Dry evergreen | D | 2007–2008 |
| Thung Yai Naresuan WS – West | WC | 15°20′N, 98°47′E | c. 880 | Dry evergreen | D | 2007–2008 |
| Thung Yai Naresuan WS – West | WC | 15°20′N, 98°46′E | c. 880 | Mixed deciduous forest close to evergreen of limestone outcrop | D | 2007–2008 |
| Thung Yai Naresuan WS – West | WC | 15°20′N, 98°47′E | 861 | Gallery evergreen | D | 2007–2008 |
| Khlong Saeng WS | AJL | 8°59′N, 98°46′E | 95 | Logged & degraded evergreen forest on island in Rajaphrabha Dam | L | 1993 |
| Phu Khieo WS | LIG | n/a | c. 700–900 | Hill evergreen forest | L | 2002 |
| Thale Ban NP | K. Jiaranaisakul | 6°42′N, 100°10′E | c. 150 | Close to NP's accommodation | Dp | 2013 |
| Khao Yai NP | T. Ong-in | 14°24′N, 101°22′E | c. 760 | At least four individauls fed on the fig tree | Dp | 2013 |
| Khao Yai NP | K. Saralanba | 14°24′N, 101°22′E | c. 770 | Three adults and two offspring on a Ficus tree | Dp | 2013 |
| **Banded Civet** | | | | | | |
| Hala-Bala WS | SK | 5°48′22″N, 101°49′57″E | 162 | Moist evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′04″N, 101°49′06″E | 273 | Moist evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′02″N, 101°49′15″E | 273 | Moist evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′06″N, 101°49′21″E | 273 | Moist evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′40″N, 101°48′26″E | 347 | Moist evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′23″N, 101°48′44″E | 350 | Moist evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′33″N, 101°48′31″E | 404 | Moist evergreen | C | 2004 |
| Hala-Bala WS | SK | 5°48′05″N, 101°46′52″E | 579 | Moist evergreen | C | 2006 |
| Hala-Bala WS | DNP (S. Thong-aree) | 5°48′07″N, 101°50′08″E | 164 | Moist evergreen | C | 2005 |
| Hala-Bala WS | DNP (S. Thong-aree) | 5°47′54″N, 101°49′17″E | 195 | Moist evergreen | C | 2005 |
| Hala-Bala WS | DNP (S. Thong-aree) | 5°48′24″N, 101°48′42″E | 348 | Moist evergreen | C | 2005 |
| Hala-Bala WS | DNP (S. Thong-aree) | 5°48′13″N, 101°48′54″E | 348 | Moist evergreen | C | 2005 |
| Khao Sok NP | AJL | 9°00′11″N, 98°35′50″E | 201 | Moist evergreen | C | 1996 |
| Khao Sok NP | AJL | 8°54′09″N, 98°30′47″E | 354 | Moist evergreen | C | 1996 |
| Khlong Saeng WS | PBC | 9°13′37″N, 98°40′06″E | 196 | Moist evergreen | C | 2003 |
| Kuiburi NP | RSt & N. Seuaturien | 12°00′07″N, 99°35′11″E | 695 | Dry evergreen | C | 2010 |
| Kaeng Krachan NP | L. B. Kekule | 12°53′07″N, 99°17′26″E | 255 | Dry evergreen | C | 2004 |
| Kuiburi NP | N. Seuaturien | 12°04′29″N, 99°34′08″E | 247 | Dry evergreen | C | 2014 |
| Kuiburi NP | S. Tanasarnpaiboon | 12°00′45″N, 99°35′56″E | 560 | Dry evergreen | C | 2014 |
| Hala-Bala WS | T. Dawreung | 5°55′41″N, 101°35′32″E | 417 | Moist evergreen | C | 2014 |
| **Otter Civet** | | | | | | |
| Kaeng Krachan NP | Anon. 1998 | c.12°48′N, 99°26′E | c. 390 | Lowland evergreen, along stream at KM 18 | D | 1998 |
| Near Ban Pa Wai, Chaloem Prakiat WS | Kanchanasaka 1995, B. Kanchansaka in litt. 2013 | n/a | n/a | Swamp forest | D | 1992–1993 |
| **Small Asian Mongoose** | | | | | | |
| KMUTT Ratchaburi campus, Ratchaburi province | WC | 13°32′N, 99°49′E | c. 74 | Highly degraded dry dipterocarp | D | 2007 |
| Kuiburi NP | RSt | n/a | below 200 | Secondary evergreen, scrub, pineapple fields (four times) | D | 2007–2011 |
| Khao Yai NP | DN | 14°25′N, 101°22′E | 752 | Near Training Center; open managed lawn near secondary moist evergreen patch | D | 2008 |

| Locality | Observer/surveyor | Lat/Long | Elevation (m) | Habitats and other notes | Record type | Year recorded |
|---|---|---|---|---|---|---|
| Phu Khieo WS | LIG | 16°23′22″N, 101°34′33″E | 870 | Around headquarters in open forest/grasslands and village habitat (six captures) | L | 1998–2002 |
| Phu Khieo WS | LIG | 16°23′08″N, 101°34′10″E | 870 | Around headquarters in open forest/grasslands and village habitat (three captures) | L | 1998–2002 |
| Khao Yai NP | C. Waradee | 14°26′N, 101°22′E | 730 | Abandoned golf course and small open grassland | Dp | 2014 |
| Khao Ang Rue Nai WS | KEJ | 13°24′35″N, 101°53′11″E | 123 | Secondary growth (evergreen) | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°24′04″N, 101°52′36″E | 99 | Secondary growth (evergreen) | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°25′12″N, 101°53′13″E | 106 | Secondary growth (evergreen) | C | 2009 |
| Khao Ang Rue Nai WS | KEJ | 13°25′39″N, 101°52′55″E | 122 | Secondary growth (evergreen) | C | 2008 |
| Khao Ang Rue Nai WS | KEJ | 13°25′06″N, 101°52′44″E | 112 | Secondary growth (evergreen) | C | 2008 |
| Kuiburi NP | RSt & N. Seuaturien | 12°11′14″N, 99°39′22″E | 160 | Abandoned plantation | C | 2010 |
| Sakaerat BR | SS | 14°30′28″N, 101°55′45″E | 420 | Secondary growth (evergreen; near helipad) | C | 2011 |
| Sakaerat BR | SS | 14°31′11″N, 101°54′40″E | 411 | Dry dipterocarp forest | C | 2011 |
| Thap Lan NP | DN | 14°20′54″N, 102°04′55″E | 464 | Secondary growth (evergreen) | C | 2013 |
| Ta Phraya NP | MCB | 14°11′14″N, 102°47′58″E | 273 | Secondary growth (evergreen) | C | 2009 |
| Ta Phraya NP | MCB | 14°11′15″N, 102°50′12″E | 282 | Secondary growth (evergreen) | C | 2009 |
| Ta Phraya NP | MCB | 14°12′52″N, 102°49′35″E | 289 | Secondary growth (evergreen) | C | 2009 |
| Ta Phraya NP | MCB | 14°06′30″N, 102°31′28″E | 505 | Secondary growth (evergreen) | C | 2009 |
| Ta Phraya NP | MCB | 14°07′49″N, 102°33′35″E | 481 | Secondary growth (evergreen) | C | 2009 |
| Ta Phraya NP | MCB | 14°07′49″N, 102°35′46″E | 143 | Cleared, open, secondary growth | C | 2009 |
| Ta Phraya NP | MCB | 14°08′25″N, 102°38′35″E | 375 | Secondary growth (evergreen) | C | 2012 |
| Ta Phraya NP | MCB | 14°08′33″N, 102°44′31″E | 356 | Secondary growth (evergreen) | C | 2009 |
| Khao Sam Roi Yot NP | PBC | 12°07′34″N, 99°57′50″E | 2 | Dry, heavily grazed replanted mangroves | C | n/a |
| Salakpra WS | RSu | 14°20′N, 99°16′E | 181 | Degraded mixed deciduous | C | 2014 |
| Suan Hin Pha Ngam, Nong Hin, Loei province | RSu | 17°03′3″N, 101°44′37″E | 670 | Limestone forest amid agriculture | Dp | 2014 |
| Huai Kha Khaeng WS/Thung Yai Naresuan WS – West | Conforti 1996 | n/a | n/a | Tall grass adjacent to a seasonal pool | C* | 1996 |
| Around AIT and Khlong 5, Pathum Thani province | J. W. K. Parr | n/a | below 50 m | Lowland marshes | D | early 2000s |
| Khao Dinso, Pathiu, Chumphon province | A. J. Pierce | 10°38′N, 99°17′E | c. 360 | Secondary scrub woodland with 2–3 m, very open, canopy | D | 2014 |
| Khao Yai NP | Austin & Tewes 1999 | See reference | See reference | See reference | See reference | See reference |

Detailed comprehensively in Appendix 3 are the individual records for most species excepting six common species widely and frequently camera-trapped: Yellow-throated Marten, Hog Badger, Large Indian Civet, Common Palm Civet, Masked Palm Civet and Crab-eating Mongoose. For Small Indian Civet only the incidental records are given. Among surveyors/observers, abbreviations are used for authors of this paper. Coordinates recorded with a handheld GPS unit are given to the nearest second, those derived from maps (e.g. Google Earth) to the nearest minute. Coordinates of otter records are omitted for security reasons. Elevations come from a variety of sources and are all approximate. Habitat types were described based on available information from the observers, sometimes with reference to Google Earth and discussion with other surveyors familiar with the areas. Records are categorised as camera-trap photographs from contributing surveys (C); camera-trap photographs from other sources, including late-received (Appendix 4) records (C*); direct sightings (D); live-trapping (L), captive animals (G); dead animals or their remains (R). Records for methods other than C are not comprehensively listed for cells with C records. Non-camera-trap records validated by examination of photographs are suffixed ‘p’. Camera-trapping records from other surveys (C*) were not validated during the review. Except where stated, records were of single animals.

## Appendix 4. Additional recent records

While finalising this article, more records surfaced, some from the review period but missed during compilation, some from after. These records are not included in Appendices 1–2 or in the species accounts, but are detailed here, and, mostly, in Table 3 and/or in Appendix 3 (as appropriate).

Unidentified weasel *Mustela*
An unidentified weasel was photographed by an enthusiastic birder in a small pocket of disturbed hill evergreen forest (at 1,450 m asl) at Doi Ang Khang, Chiang Mai province. It was photographed while approaching a small water pool but features allowing the species to be identified are not visible.

Unidentified ferret badger *Melogale*
A dog-bitten dead ferret badger was found inside Mahidol University, Kanchanaburi (Saiyok) campus in 2012 at 175 m asl, in degraded mixed deciduous forest (S. Prasopsin verbally 2014). The skull is reportedly deposited at the Natural History Museum. A male ferret badger (weight about 850 g) was live-trapped by DNP in August 2014 at Huai Samong proposed dam area, in a reforestation area where *Imperata* grass dominates at 145 m asl (M. Safoowong *in litt*. 2014). These two recent records add evidence of the Thai occurrence of this genus in poor and degraded and edge areas – habitats on which most of the surveys collated here did not focus.

Smooth-coated Otter *Lutrogale perspicillata*
A camera-trap in Kaeng Krachan NP set on a sandbar adjacent to a deep pool (2–3 m) with minimal current along the Petchburi river photographed a group (4–6 individuals) of Smooth-coated Otter several times during January to March 2001 (AJL). The river is amid evergreen forest at 230 m asl.

Banded Linsang *Prionodon linsang*
A Banded Linsang was camera-trapped in June 2014 in degraded dry evergreen forest at 170 m asl at Salakpra WS (RSu & KS). This new locality for this species is within the known range (northern limit Mae Wong NP).

Large-spotted Civet *Viverra megaspila*
A Large-spotted Civet was camera-trapped in Khao Yai NP in secondary evergreen forest at 779 m asl (DN) (Fig. 4). The area is amid very gentle terrain with much open habitat created by settlement and agriculture some 40 years ago. This is the highest recorded elevation from Thailand, slightly exceeding that of a sight record from Thung Yai Naresuan WS – West. This general area within the park has been heavily and repeatedly camera-trapped over the last decade; it seems impossible that the species is common there. It is unclear whether these rare strikingly high-elevation records are of dispersing animals or of scattered residents where terrain and habitat is locally suitable.

Banded Civet *Hemigalus derbyanus*
Additional records, all from camera-trapping in 2014, came from two survey areas in the known range, Kuiburi NP and Hala-Bala WS. At Kuiburi NP, two records were in dry evergreen forest at 247 m and 560 m asl (N. Seuaturien and S. Tanasarnpaiboon *in litt*. 2014, respectively). In addition, the latter

**Fig. 4.** A Large-spotted Civet *Viverra megaspila* camera-trapped in Khao Yai National Park, Thailand, in secondary evergreen forest at the unusually high elevation of 779 m asl. Note the suspended bait (flesh). (Photo: Dusit Ngoprasert).

record (a video camera-trap) was a female with two cubs. A record from Hala-Bala WS was from moist evergreen forest at 417 m asl (T. Dawreung verbally 2014). On 18 November 2014, an adult and young were camera-trapped in evergreen forest in Tai Rom Yen NP (8°49′11″N, 99°28′49″E; 767 m).

Small Asian Mongoose *Herpestes javanicus*
One was camera-trapped in Salakpra WS in 2014, in degraded mixed deciduous forest at 181 m asl (RSu). This record adds another survey area to the eight where species was confirmed (Table 3). On 21 June 2014, RSu photographed an animal at 06hr38 at Suan Hin Pha Ngam Park, Nong Hin district, Loei province, at 670 m asl. The area is covered by forest associated with limestone surrounded by agricultural field (Fig. 5). In October 2014, one animal was seen on Khao Dinso, Pathiu district, Chumphon province, in regenerating scrub woodland with very open canopy height at c. 2–3 m, at c. 360 m asl (A. J. Pierce verbally 2014).

**Fig. 5.** A Small Asian Mongoose *Herpestes javanicus* photographed on 21 June 2014 at Suan Hin Pha Ngam Park, Nong Hin district, Loei province, Thailand, at 670 m asl. The area is covered by forest associated with limestone surrounded by agricultural fields (Photo: Ronglarp Sukmasuang).

# Contents



An aberrant colour form of Stripe-necked Mongoose *Herpestes vitticollis* (see *SCC* 50: 77–78), with her normal coloured young one, Valparai, Tamil Nadu, India (Photo by Ganesh Raghunathan, December 2014).

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