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Brown-tailed Vontsira *Salanoia concolor* in Madagascar (Photo: A. F. A. Hawkins)

The diversity and status of the civets (Viverridae) of Singapore

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Abstract

A review of the civet records from Singapore confirms the existence of four species (Small-toothed Palm Civet *Arctogalidia trivirgata*, Common Palm Civet *Paradoxurus hermaphroditus*, Malay Civet *Viverra tangalunga* and Large Indian Civet *V. zibetha*) out of the nine hitherto recorded; it is not totally clear that the two *Viverra* species are native. The status of Masked Palm Civet *Paguma larvata* is indeterminate, while the natural occurrence of Binturong *Arctictis binturong*, Otter Civet *Cynogale bennettii*, Small Indian Civet *Viverricula indica* and Large Spotted Civet *Viverra megaspila* seems doubtful.

Keywords: biodiversity, historical ambiguity, recent field records, Viverridae

Introduction

The family Viverridae (civets) consists of small- to medium-sized carnivores that are widely distributed in the warmer parts of the Old World. Ten species of civets are known from the Malay Peninsula (Francis 2008), the strip of land at the south-eastern corner of the Asian continent which is also part of the Sunda Shelf, and is largely occupied by Peninsular Malaysia and southern Thailand. At the southern tip of the Malay Peninsula is Singapore (1°20'N, 103°50'E), a small country where nine species of civets have been reported, although specific records of most are not readily available.

Singapore is separated from the Asian mainland by the Straits of Johor, a channel of seawater that is, at its narrowest point, only 600 m wide. The main island of Singapore and sixty smaller islands make up an area of 710 km^2 (NParks 2010). Bukit Timah Hill, its highest point, is 164 m above sea level. The climate is equatorial and has a mean annual rainfall of 2,375 mm, never falling below a mean of 100 mm in the driest months (Corlett 1992). The area was largely covered in diverse lowland tropical rainforest until the arrival of Sir Stamford Raffles in 1819 (Corlett 1992, Turner 1993), followed by the development of Singapore into a trading post, and now a metropolitan city. Currently, only 2.8 km^2 of primary forest remain (Corlett 1997), in the Bukit Timah Nature Reserve and the Central Catchment Nature Reserve. These rainforest nature reserves are protected natural areas, and along with Sungei Buloh Wetland Reserve and Labrador Nature Reserve make up 33.26 km^2 (about 4.7%) of Singapore's total land area (NParks 2010).

The Viverridae of Singapore has been reported by Cantor (1846), Ridley (1895), Chasen (1924), Harrison (1974), Medway (1983), Yang *et al.* (1990), Teo & Rajathurai (1997), Baker & Lim (2008), Lim *et al*. (2008) and Lim & Ou Yang (2012). This article is a review of their diversity and local status in the country.

Species list

The following records are from published literature (including specimen records), preserved specimens largely in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research at the National University of Singapore, and observations and photographs submitted to the records database of the Vertebrate Study Group of The Nature Society (Singapore). Malay words are used in locality names with Malay–English translations as follows: Bukit – Hill; Jalan – Road; Kampung – Village; Pulau – Island; Sungei – River or Stream. Taxonomy and nomenclature follow Jennings & Veron (2009). Sightings were of single animals except where stated. Individual records are given in the Appendix and locations are marked on Fig. 1.

Binturong *Arctictis binturong* (Raffles)

Subspecies: *Arctictis binturong binturong* (Raffles)

Arctictis binturong – Harrison 1974: 229 (Singapore: not recorded for many years), Baker & Lim 2008: 167 (Singapore: extinct).

Arctitis [*sic*] *binturong binturong* – Yang *et al*. 1990: 14, 21 (Singapore: indeterminate status).

Harrison (1974) suggested that the type specimen of Binturong, described by Raffles, may have been from Singapore, and claimed that the species had not been recorded there for many years. However, in the original description, Raffles (1821: 253) stated that the animal (as *Viverra? binturong*) was "found at Malacca", which is not in Singapore, and at that time might even have referred to an origin from other parts of the Malay Peninsula: Malacca was a major trade centre of the region at that time (Kennedy 1993) and it is therefore possible that the specimen came from a market. If it had been from Singapore, Raffles would have written thus, as he did for *Simia maura?* (= *Presbytis femoralis*), *Tupaia ferruginea* (= *Tupaia glis*) and *Sciurus affinis* (= *Ratufa affinis*). The reasoning behind Harrison's claim is unknown, and there is apparently no historical record of Binturong in Singapore. However, escapees, such as that listed in the Appendix, have been recorded (Yang *et al*. 1990).

Small-toothed Palm Civet *Arctogalidia trivirgata* (Gray)

Subspecies: *Arctogalidia trivirgata trivirgata* (Gray) (see Corbet & Hill 1992: 212)

Paguma trivirgata – Cantor 1846: 201 (Singapore).

Arctogalidia trivirgata – Chasen 1924: 83, Harrison 1974: 230 (seemed to occur in Singapore), Corbet & Hill 1992: 212, Baker & Lim 2008: 152 & 163 (Singapore: rare and restricted to a few areas), Lim *et al*. 2008: 200 (Singapore: 'critically endangered', confined to Bukit Timah and Central Catchment Nature Reserves).

Arctogalidia trivirgata sumatrana – Medway 1983: 94, Yang *et al*. 1990: 14 & 21 (Singapore: indeterminate status).

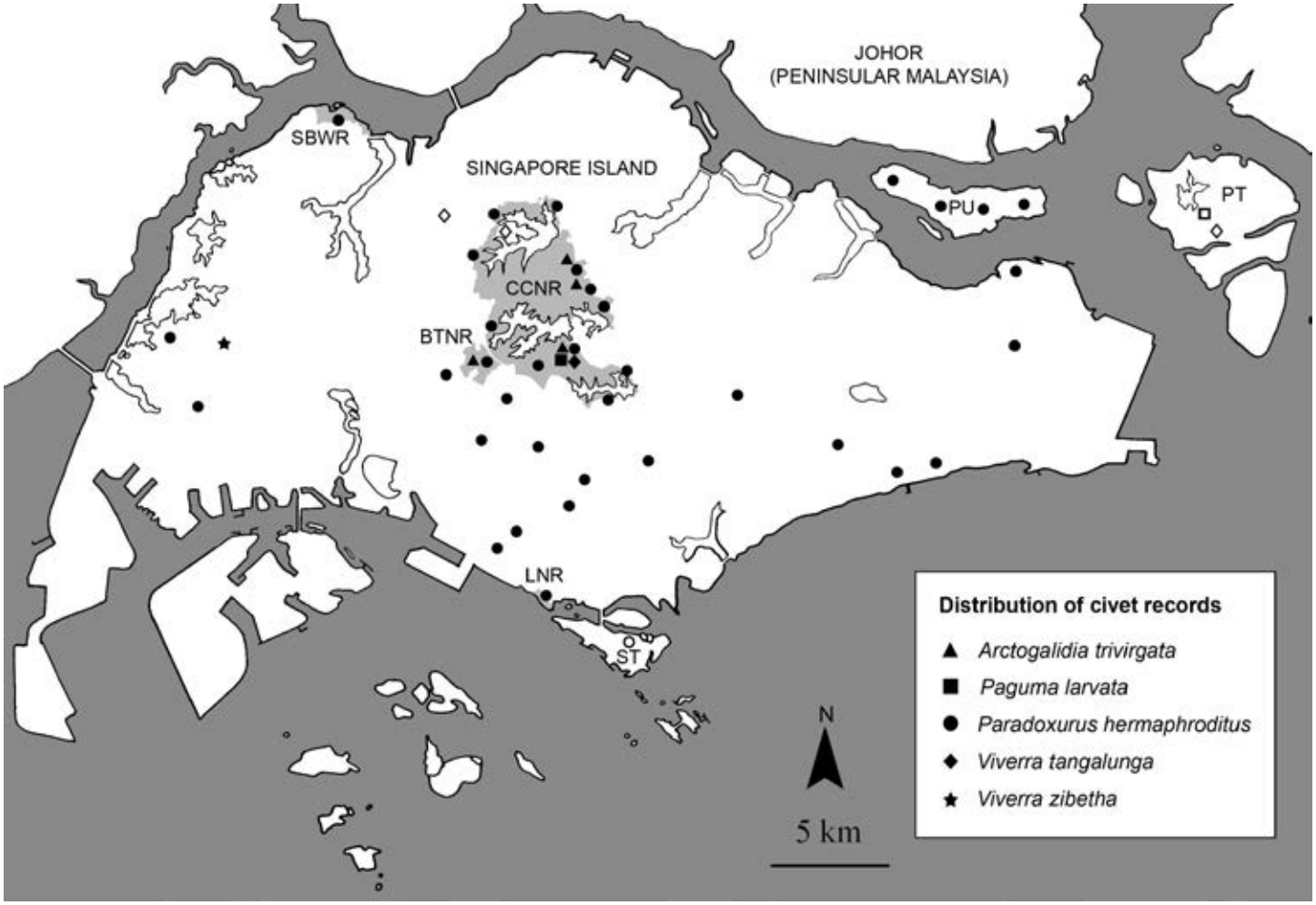

Fig. 1. Singapore, with known locations of civet records. Solid shapes represent confirmed, hollow shapes unconfirmed, records. Offshore islands: PU = Pulau Ubin, PT = Pulau Tekong, ST = Sentosa; Nature Reserves: BTNR = Bukit Timah Nature Reserve, CCNR = Central Catchment Nature Reserve, LNR = Labrador Nature Reserve, SBWR = Sungei Buloh Wetland Reserve.

Fig. 2. The arboreal Small-toothed Palm Civet *Arctogalidia trivirgata* has only been recorded in Singapore by night-transect spotlighting (photo: Celine Low).

Museum specimens

- Singapore – female acquired from C. O. Hagerdon on 15 March 1922 (ZRC 4.1293; Chasen 1924: 83).
- Singapore – male presented by C. O. Hagerdon on 23 November 1922 (ZRC 4.1294; Chasen 1924: 83).

Chasen (1924) cited two specimens in the collection of the Raffles Museum and mentioned another three local individuals that were brought to the museum within two years. The fate of the latter is not clear. This species appears to be highly vocal and is known to make a loud chirping call. It appears to be confined in Singapore to the Bukit Timah and Central Catchment Nature Reserves, where it has been widespread but rarely observed in the past two decades: the records in the Appendix are the total from at least 300 hours of spotlighting surveys (Fig. 2). In Singapore, this species is regarded as critically endangered by Lim *et al*. (2008).

Masked Palm Civet *Paguma larvata* (Smith)

Subspecies: *Paguma larvata annectens* (Robinson & Kloss; also see Corbet & Hill 1992: 210)

Paguma leucomystax – Cantor 1846: 200 (Singapore), Chasen 1924: 82–83 (Singapore: occurrence seemed suspicious).

Paguma larvata – Harrison 1974: 228 (Singapore: apparently used to occur at the turn of the 20th century), Baker & Lim 2008: 163 (Singapore: rare and restricted to a few areas?),

Lim *et al*. 2008: 200 (Singapore: 'critically endangered'), Patou *et al*. 2009: 220 (specimen from Singapore Zoo).

Paguma larvata jourdainii – Medway 1983: 93 (presence of endemic [*sic*] population in Singapore not confirmed), Yang *et al*. 1990: 14 & 21 (Singapore: occurrence doubtful), Teo & Rajathurai 1997: 370 (MacRitchie and Pulau Tekong).

Chasen (1924) cited (as *P. leucomystax*), with suspicion, a specimen in the Raffles Museum labelled as having been taken in Singapore in 1895. However, this specimen could not be located at the present and may have been lost. Patou *et al*. (2009: 220) cited a 'Singapore' specimen from the Singapore Zoo; this was most probably a captive-born animal imported from the Taipei Zoo (Razak Jaffar, Wildlife Reserves Singapore, *in litt.* 2012). The 1990 record from Pulau Tekong cannot be confirmed and there is no way to ascertain if the 1994 sighting is of a former captive animal. As there is neither recent proof of its wild occurrence in Singapore, nor indisputable historical record there, the national status of Masked Palm Civet should be considered indeterminate.

Common Palm Civet *Paradoxurus hermaphroditus* (Pallas)

Subspecies: uncertain pending a thorough taxonomic revision. Patou *et al*. (2010) proposed that the species as conventionally constituted may be paraphyletic, indicating that it perhaps should be split into at least three distinct species. The Singapore population falls into the group that occurs in the lowlands (under 200 m) of Indochina, the Malay Peninsula, Sumatra and Java.

Pardoxurus [sic] *musanga* – Cantor 1846: 201 (Singapore).

Viverra malaccensis – Ridley 1895: 92 (Singapore; misidentification).

Paradoxurus hermaphroditus – Chasen 1924: 82, Chuang 1973: 3, Harrison & Tham 1973: 252, Harrison 1974: 227, Corlett & Lucas 1995: 98 (Bukit Timah Nature Reserve), Chua 2000: 109 & 134 (Pulau Ubin), Anonymous 2003: 25 & 92 (Sungei Buloh Wetland Reserve), Baker & Lim 2008: 152 & 163 (Singapore: widespread and uncommon), Chua 2010: 137 (Sungei Buloh Wetland Reserve).

Paradoxurus hermaphroditus musanga – Medway 1983: 93, Yang *et al*. 1990: 14 & 21 (Singapore: common), Teo & Rajathurai 1997: 369 (Bukit Timah and Central Catchment Nature Reserves).

Museum specimens

- Thomson Road, reservoir – specimen presented by A. A. Day on 26 July 1921 (ZRC 4.1415).
- Singapore Island – male acquired by 'Purdy' on 3 March 1927 (ZRC 4.1392).
- Singapore – specimen obtained by 'Kadir' on 4 January 1944 (ZRC 4.1393).
- Ulu Pandan, off Holland Road – female road-kill collected by H. T. W. Tan on 6 February 2008 (ZRC 4.8182; also see Appendix).

According to Harrison & Tham (1973: 252), *Paradoxurus hermaphroditus* was "caught in the jungles of Singapore and neighbouring countries and . . . used for human consumption by those who believe that its meat possesses invigorating properties". However, this practice does not appear to be prevalent in recent years, at least in Singapore. Common Palm Civet frequently lives in and around human habitation, particularly in rural and suburban areas where there are fruit trees for it to feed in, and roof spaces into which it can retire by day (Harrison 1974, Baker & Lim 2008, Xu 2010).

This close association with people has given rise to human–civet conflict in some residential areas. From being a subject of gastronomic interest, this animal has, in recent years, been viewed as a nuisance by some. Not many people are tolerant of thumping sounds (of civets running) on the ceiling, the dislodging of roof tiles, or of having their fruit trees raided (by civets). As a result, many of these animals were trapped by residents (Xu 2010).

Some civets caught at suburban Siglap in 2009 and early 2010 were translocated to the Bukit Timah and Central Catchment Nature Reserves (T. M. Leong verbally 2012), Labrador Nature Reserve and other wooded but non-protected areas. This had apparently led to a rise in the sightings of this species in the nature reserves over those two years. The concentration of sightings at Pulau Ubin in 1999 and 2000 was, however, due to an intensive wildlife survey conducted by the National Parks Board (NParks) on the island during that period. Despite being by far the most commonly observed civet in Singapore, it is regarded as uncommon at the national level (Baker & Lim 2008).

Otter Civet *Cynogale bennettii* Gray

Subspecies: none recognised.

Cynogale bennetti [*sic*] – Harrison 1974: 231 (Singapore specimen at the Natural History Museum in London).

Cynogale bennettii – Yang *et al*. 1990: 15 & 21 (Singapore: occurrence doubtful), Baker & Lim 2008: 170 (Singapore: occurrence doubtful).

Apart from an old specimen without precise collection data at the Natural History Museum in London, there is no other record of this rare civet in Singapore. Meiri (2005) included the specimen in his publication as "highly likely" (p. 21) to have been obtained in Singapore, because it did not seem odd according to the species's distribution (S. Meiri *in litt.* 2012), despite having at the same time noted (for another specimen labelled from Singapore, of Indian Grey Mongoose

Fig. 3. Camera-trap image of a Malay Civet *Viverra tangalunga* attracted to chicken carcass in the Central Catchment Nature Reserve (photo courtesy of Norman Lim and Ou Yang Xiuling).

Herpestes edwardsii) that "Singapore is and has been . . . a major trade center, and thus records of supposedly Singaporean specimens should be taken with a grain of salt". Furthermore, from specimen lists and field records (Veron *et al*. 2006), Otter Civet appears to occur naturally in low numbers and other than the lone Singaporean specimen in question, has not been recorded from other small islands. The evidence suggests its occurrence in Singapore is doubtful.

Large-spotted Civet *Viverra megaspila* Blyth

Subspecies: none recognised.

Viverra megaspila – Chasen 1924: 82 (refers to Singapore material identified as *V. tangalunga* by Cantor 1846), Corbet & Hill 1992: 206, Baker & Lim 2008: 170 (Singapore: doubtful occurrence).

Viverra megaspila megaspila – Medway 1983: 90 (Singapore record considered tentative), Yang *et al*. 1990: 14 & 21 (Singapore: doubtful occurrence).

There is no actual record of *V. megaspila* in Singapore. Chasen (1924) was of the opinion that Cantor's (1846) record of *V. tangalunga* from Singapore could be *V. megaspila* (because the two species were formerly confused). However, because Chasen did not even see Cantor's material, there is no support for his referral of Cantor's record to *V. megaspila*. Conversely, Lim & Ou Yang (2012) reported a specimen from Singapore labelled as *V. megaspila* deposited at the Muséum National d'Histoire Naturelle in Paris, France, under catalogue number MNHN CG 1970-369, which was later determined to be *V. tangalunga.* In the Malay Peninsula, *V. megaspila* is uncommon and there are apparently no records of it south of Perak (Jennings & Veron 2011).

Malay Civet *Viverra tangalunga* Gray

Subspecies: *Viverra tangalunga tangalunga* Gray

Viverra tangalunga – Cantor 1846: 197 (Singapore), Corbet & Hill 1992: 206, Baker & Lim 2008: 170 (Singapore: indeterminate status), Jennings & Veron 2011: 319, Lim & Ou Yang 2012: 79 (camera-trapped at MacRitchie forest).

Viverra tanhalunga [*sic*] – Chuang 1973: 3.

Viverra tangalunga tangalunga – Medway 1983: 90, Yang *et al*. 1990: 13 & 21 (Singapore: indeterminate status), Teo & Rajathurai 1997: 370 (Central Catchment Nature Reserve, ?Pulau Tekong).

No report of *V. tangalunga* from Singapore before January 2012 cited diagnostic characters or was photographed. All these should therefore be treated as unconfirmed, possibly being misidentified *V. zibetha*. As these two species superficially resemble each other, they can easily be confused with each other in the field. Teo & Rajathurai (1997) were of the opinion that the then recent record from Pulau Tekong may have been of *V. zibetha*.

The record from the Central Catchment Nature Reserve in the early 1990s (Teo & Rajathurai 1997) seems suspicious. It was reported by a staff of the Singapore Zoo, and the timing coincided with the donation to the zoo of a *V. zibetha* trapped near Jalan Bahar (see below) in May 1990.

The paucity of confirmed records of this rather large and conspicuous civet, which shows a degree of tolerance to disturbed habitats (Colón 2002, Jennings *et al*. 2006) places some doubt on its natural occurrence in Singapore. However, a camera-trap survey of the Bukit Timah and Central Catchment Nature Reserves from September 2011 to January 2012 yielded one confirmed record of *V. tangalunga* (Lim & Ou Yang 2012; Fig. 3). Perhaps the individual was a former captive, but if it is indeed part of a native population, the species in Singapore should be regarded as rare, possibly critically endangered. Lim & Ou Yang (2012) also reported a specimen of *V. tangalunga* from Singapore, catalogued by the Muséum National d'Histoire Naturelle, Paris, in 1969 as MNHN CG 1970-369. The label lacks precise information on the collection location and date, and the collector. As with all civet specimens from Singapore, caution is needed over its origin (see discussion).

Large Indian Civet *Viverra zibetha* Linnaeus

Subspecies: *Viverra zibetha sigillata* Robinson & Kloss

Viverra zibetha – Cantor 1846: 197 (Singapore), Chasen 1924: 81–82 (five specimens taken between 1908 and 1922), Chuang 1973: 3, Harrison 1974: 225 (seemed to be the commonest civet in Singapore), Corbet & Hill 1992: 205, Baker & Lim 2008: 170 (Singapore: indeterminate status), Lim *et al*. 2008: 201 (Singapore: 'critically endangered'), Jennings & Veron 2011: 318.

Viverra zibetha pruinosa – Medway 1983: 90, Yang *et al*. 1990: 13 & 21 (Singapore: indeterminate status).

Museum specimens

- Singapore – female acquired on 30 November 1917 (ZRC 4.1470; Chasen 1924: 81).
- Changi 10th mile – female obtained on 5 November 1924 (ZRC 4.1471).
- Bukit Timah – female obtained on 23 February 1925 (ZRC 4.1472).
- Bukit Timah – two skins acquired in 1934 (ZRC 4.1473, 1474).
- Bukit Timah – male acquired on 7 February 1935 (ZRC 4.1475).
- Singapore – male obtained on 19 February 1941 (ZRC 4.1463).

Chasen (1924: 82) reported that *V. zibetha* was "commonly imported" into Singapore "and no doubt escape[s] from captivity at times". He cited three Singapore specimens at the Raffles Museum taken in 1908, 1917 and 1922, respectively. He also mentioned two other individuals that were locally obtained in 1921 and 1922. Of these, only that from 1917 (ZRC 4.1470) remains in the collection today. Five specimens taken during 1924–1941 were subsequently added. These specimens could have given Harrison (1974) the impression that *V. zibetha* was the commonest civet in Singapore. Indeed, there were then far fewer specimens of *Paradoxurus hermaphroditus* and *Arctogalidia trivirgata* in the collection of the Raffles Museum. In view of Chasen's note that this is a commonly traded species, whether or not it is indigenous needs to be determined.

According to Harrison (1974: 225), *V. zibetha* is partly associated with human activities, and "may have spread down to the Malay Peninsula with human cultivation". Indeed, the sole recent confirmed Singapore record, verified from a published photograph, was of an animal trapped in a farming area in 1990. Its wild or captive origin cannot be determined. This species is restricted to continental Southeast Asia, north to

southern China and west to northern India; Singapore would be the southern limit of its range (Corbet & Hill 1992), whereas *V. tangalunga*, confined to insular Southeast Asia except for occurrence on the Malay Peninsula (Corbet & Hill 1992), appears better adapted to the dense, humid rainforest habitat prevalent in the region.

Apart from the one individual trapped at Jalan Bahar, there were also unconfirmed sightings of *V. zibetha* from Central Catchment Nature Reserve, Pulau Tekong, Lornie Road and Old Holland Road (Lim *et al*. 2008). Because there are no confirmed records apart from the one trapped in 1990, its national status is considered indeterminate (Baker & Lim 2008) or critically endangered (Lim *et al*. 2008).

Small Indian Civet *Viverricula indica*
(E. Geoffroy Saint-Hilaire)

Subspecies: *Viverricula indica klossi* Pocock

Viverricula malaccensis – Cantor 1846: 199 (Singapore), Ridley 1895: 92 (Singapore: but name incorrectly applied to information relating to Common Palm Civet *Paradoxurus hermaphroditus*).

Viverricula indica – Chuang 1973: 3, Harrison 1974: 226, Corbet & Hill 1992: 206, Baker & Lim 2008: 170 (Singapore: indeterminate status).

Viverricula indica indica – Yang *et al*. 1990: 14 & 21 (Singapore: doubtful occurrence).

We are aware of no Singapore specimen of *V. indica* in a museum, nor any recorded sighting in Singapore. Considering that *V. indica* is, when present, relatively easily camera-trapped and spotlit (e.g. Su Su 2005, Kumara & Singh 2007, Holden & Neang 2009), it is unlikely to remain unnoticed in Singapore if extant. Furthermore, this species occurs, perhaps predominantly, in areas of heavy habitat degradation and human activity (e.g. Lekagul & McNeely 1988, Su Su 2005). Thus, it would be unlikely to have escaped observation or collection had it been present in Singapore. Therefore, its occurrence here is highly doubtful. Although Chuang (1973) cited it as one of the common civets in Singapore, it is likely that, as with Ridley (1895), he had misidentified *Paradoxurus hermaphroditus*.

Discussion

Nine of the ten species of civets accepted for Peninsular Malaysia by Francis (2008) have been reported from Singapore, the exception being Banded Civet *Hemigalus derbyanus*. There are confirmed records of wild-living animals of four species: *Arctogalidia trivirgata, Paradoxurus hermaphroditus, Viverra tangalunga* and *V. zibetha*. Two (*A. trivirgata* and *V. tangalunga*) are confined to the Bukit Timah and Central Catchment Nature Reserves; the third (*P. hermaphroditus*), which adapts to disturbed habitats and human habitation, faces conflict from some humans who do not welcome it in their homes. *Viverra zibetha* has not been seen locally for at least 18 years. A confirmed *Paguma larvata* sighting from the Central Catchment Nature Reserve may have involved an escaped captive. Although this cannot be proven, subsequent surveys have not found the species, and the only other recent report, from Pulau Tekong, is unconfirmed. Moreover, truly wild origin of the two *Viverra* species is not totally certain (see species accounts).

The occurrence of the remaining four species is doubtful. There is no proof that *Arctictis binturong* ever occurred naturally, but it inhabits islands in the Riau Archipelago, such as Bintan and Kundur (Corbett & Hill 1992), which are near Singapore. Hence, there may be a possibility that the species was present in Singapore, but extirpated before proper mammal records or collections began. Records of *Cynogale bennettii* and *Viverricula indica* may have been based on specimens acquired through trade. Singapore was a bustling trading centre and imported specimens may have been purchased in the market, yet labelled as implying a Singapore origin. *Viverra megaspila* was included because it was assumed, apparently without strong foundation, to be the correct identity of an early record of *V. tangalunga*. The inclusion of the species with doubtful Singapore occurrence in previous literature as locally extinct (Yang *et al*. 1990, Baker & Lim 2008) may have resulted in inaccuracies in estimates of extinction rates in Singapore by authors such as Brook *et al*. (2003). This does not reduce the severity of the extinction threats that civets in Singapore face today.

With the exception of *P. hermaphroditus*, which adapts readily to human habitation, the survival of most Singaporean species of civets depends, to varying degrees, on the availability of forest. Although the total green cover in Singapore is 47%, most of it is not rainforest (Turner 1993). The scarcity of extensive tall forest may have led to the possible extinction of forest-dependent species and contributed to the apparent rarity of *Arctogalidia trivirgata* and *V. tangalunga,* which may have lower densities in disturbed forest habitats (Heydon & Bulloh 1996, Lekagul & McNeely 1988, Colón 2002).

Trade in civets could have been lucrative in the past, given their culinary use (Cantor 1846, Chasen 1924, Harrison & Tham 1973). Their kittens were probably in demand as pets. Civets were also a feature in the perfume industry, which uses civet musk. Being a major trading centre, many species of animals caught from surrounding areas passed through Singapore. Some may have escaped from captivity (Chasen 1924) while others may have been purchased locally and then labelled as having been obtained in the country. Old museum specimens bearing such labels and without detailed collection data should be treated with a large dose of suspicion (see *Cynogale bennettii*, above).

Until the past two decades, there was no concerted effort to survey wild mammals in Singapore. Most of the recent records of wild mammals, including civets, are from surveys in the Bukit Timah and Central Catchment Nature Reserves (Teo & Rajathurai 1997, Leong & Gan 2012), roadkills, and academic research (Chua 2009, Xu 2010, Fung 2011). More recently, camera-traps have been used, in the Bukit Timah and Central Catchment Nature Reserves, Western Catchment, Pulau Ubin and Pulau Tekong (see Lim & Ou Yang 2012), resulting in the first confirmed record of *V. tangalunga* in Singapore.

Still, little is known about civet ecology in Singapore. Other than the presence and distribution of species presented here, and the diet of *P. hermaphroditus* (Xu 2010, Fung 2011), information is scant. Many civets are at least partly arboreal, but conventional use of camera-traps only records civets on or near the ground, thereby missing largely arboreal species such as *Arctogalidia trivirgata* (Walston & Duckworth 2003, Hunter & Barrett 2011). Hence, other techniques such as spotlighting

and baited cage-traps may be necessary to understand all species' local status.

This update of the status of civets in Singapore highlights the importance of careful examination and critical evaluation of museum specimen labels and original literature: doubtful records sometimes become embedded in 'common knowledge' as valid. Apart from confusing the understanding of the status and distribution of individual species, such confusions may have erroneously inflated the extinction rate of mammals in Singapore. Further research in the ecology and behaviour of civets in Singapore is vital in understanding the autecology and conservation of nationally threatened species.

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Appendix. Civet records from Singapore

Location	Date	Time	Habit when observed	Observer/Reference
Arctictis binturong				
Bukit Panjang: Cheng Hua Garden	May 2004	N.A.	Fine adult, believed to be a zoo escapee, was caught and returned to the Singapore Zoo	*The Straits Times* 8 May 2004: 6
Arctogalidia trivirgata				
Bukit Timah Nature Reserve	Between Jun 1993 and Jul 1997	Night	Two unconfirmed records of probably the same individual. "calling incessantly [from trees], sounding like Slender Squirrel *Sundasciurus tenuis*, but much louder and exaggerated"	Teo & Rajathurai 1997
Central Catchment Nature Reserve: Nee Soon sector	1997	Night	Two observed	S. H. Yeo in Teo & Rajathurai 1997
Sime Forest: Petaling Trail	12 Sep 2003	Night	In tree	R. Tan & N. Lim, photo
Upper Peirce Reservoir Park: access road from Old Upper Thomson Road	29 Oct 2004	Night	In tree	A. Yeo. Photo in Baker & Lim 2008
Nee Soon Swamp-forest: pipeline trail at bend of pipe	11 Nov 2010	Night (23h30)	N.A.	S. H. Yeo

(Continued)

Location	Date	Time	Habit when observed	Observer/Reference
Nee Soon Swamp-forest: pipeline trail at former pumphouse	21 Dec 2010	Night (21h15)	In tree near a stream	N. Baker & company, photo
Nee Soon Swamp-forest: pipeline trail, where pipe goes underground near pond	3 Apr 2011	Night (22h35)	In tree, made a 'chiirrp-chiirrp' call	C. Low & company, photo (Fig. 2)
Nee Soon Swamp-forest: pipeline trail	10 Apr 2011	Night (21h16)	In fruiting trees near a drain	M. Chua
Paguma larvata				
Pulau Tekong	1990	N.A.	N.A.	Teo & Rajathurai 1997, Lim *et al.* 2008
Central Catchment Nature Reserve: MacRitchie sector, Sime Road, Kalang Circus	13 Aug 1994	Night (22h15)	N.A.	Teo & Rajathurai 1997, Subaraj, Lim & Teo 2000, Lim *et al.* 2008
Paradoxurus hermaphroditus				
Tanglin: Singapore Botanic Gardens	1924	Dusk	Sometimes observed crossing grass lawns from tree to tree	Chasen 1924
Pasir Panjang: Zehnder Road	Sep 1985; 12 Apr 1987; 30 May 1987; Feb 1988	N.A.	Three juveniles accompanied by two adults; three young with two adults; two dashed through trees and then onto ground, growling and chasing each other; one confronted a cat in the house	Hall 1989
Upper Jurong: Pasir Laba Road	30 May 1986	N.A.	Trapped in the bathroom of an army barrack	Anon. 1988b, Lim 1996
Bukit Timah: Swiss Club Road	19 Oct 1986	Night (04h00)	N.A.	Anon.1988b
Pulau Ubin	20 Mar 1988	N.A.	In captivity; apparently taken on the island	Anon.1988a
Alexandra Park	29 Oct 1989	Night (02h00)	On a fence	Yeo 1989
Pulau Ubin: Sungei Maman mangroves	21 Feb 1992	N.A.	Possible individual	F. Hamid in Yeo & Lim 1992 as "civet cat"
Pulau Ubin	Between Apr and Nov 1993	N.A.	Uncommon resident based on surveys	Subaraj 2000
Pulau Ubin: Kampung Melayu	8 Apr 1993	N.A.	At edge of secondary forest	R. Subaraj in Anon. 1993
Central Catchment Nature Reserve	Between Jun 1993 and Jul 1997; 8 Jan 1995; 11 Mar 1995	N.A.; 09h30; morning & night	Five records within remnant agricultural habitat along fringes of forest, one in Lower Peirce sector, one in Mandai sector, and three in Upper Seletar sector; Upper Seletar sector: Mandai Range; Upper Seletar sector: Mandai Range forest – one juvenile in morning, one adult in night	Teo & Rajathurai 1997, Lim *et al.* 2000
Bedok: Lucky Heights, off Upper East Coast Road	Oct 1994, 21 May 1995 and 29 May 1995	N.A.	Three individuals trapped in roof space of one house	*The Straits Times* 2 Jun 1995, photos; Lim *et al.* 2000
Sentosa Island: Mount Serapong	Unknown, probably 1995	Night	Two records of at base of Mount Serapong, species identification unconfirmed	Subaraj 1995
Pulau Ubin: valley between Surau and Bukit Belukar	23 Jan 1999	N.A.	Seen from observation hide	B. Wee & company
Pulau Ubin: off Jalan Jelutong opposite Pekan Quarry	20 Mar 1999	Night (20h45)	Seen in bamboo clump	Members of VSG
Pulau Ubin: near junction of Jalan Batu Ubin and Jalan Noordin	20 Mar 1999	Night (21h35)	One adult with two cubs seen in papaya tree	Members of VSG
Pulau Ubin: off Jalan Noordin near National Police Cadet Corps campsite	23 May 1999	Night (01h00)	In coconut palm	Members of VSG
Pulau Ubin: Jelutong Bridge	19 Aug 2000	Night (21h30)	N.A.	R. Teo & company
Pulau Ubin: near Murai Hut	19 Aug 2000	Night (23h15)	Feeding on figs of *Ficus aurantiacea* in a rubber tree	R. Teo & company
Pulau Ubin: Jalan Endut Senin, near base of Puaka Hill	28 Oct 2000	Night (23h00)	N.A.	R. Teo & company

Location	Date	Time	Habit when observed	Observer/Reference
Tanglin: Cluny Road, Singapore Botanic Gardens, road near underground car-park of National Parks Board headquarters building	4 Feb 2001	Night (19h50)	Spotted at roadside from car	M. Strange & B. C. Ng
Upper Changi: Tanah Merah Besar Lane	23 Dec 2001	Night	N.A.	D. Yeo
Portsdown Road area: Jalan Hang Jebat	Dec 2002	Night	In mango tree	N. Baker
Bukit Timah Nature Reserve: Cave Path	2 Oct 2003	N.A.	In tree	N. Lim & H. H. Tan
Sungei Buloh Wetland Reserve: behind Visitor Centre	12 Apr 2003	Night (21h45)	In clump of fishtail palm *Caryota mitis* at the end of mangrove boardwalk	R. Subaraj & company
Upper East Coast Road: Kew Drive	1 Jul 2004	Night (23h00)	In suburban garden on a Yellow Cane Palm *Dypsis lutescens*	V. D'Rozario
Bukit Batok Nature Park	15 Oct 2004	Night	Two on the ground and then climbing up trees	K. W. Chan & N. Lim
Bukit Timah Nature Reserve	26 Jul 2004	Night	N.A.	A. Yeo, photo
Changi Point: Changi Beach Club	13 Apr 2005	Evening	Walking along the top of a tennis court fence	D. Yeo
Upper East Coast Road: Kew Drive	27 May 2005; 20 Jun 2005; 14 Aug 2005; 28 Aug 2005; 3 Sep 2005; 16 Dec 2005	07h00; 08h00; night; 20h00; 20h00; 20h40	Juvenile on roof of house; very wet baby climbed down Yellow Cane Palm; juvenile on mango tree; two juveniles in juniper tree *Juniperus*; juvenile observed eating leaf buds of a tree with large leaves; a female with three kittens on mango tree	V. D'Rozario
Upper Jurong: forest patch next to Singapore Discovery Centre	24 Feb 2006	Evening	High up in tree	R. Teo & company
Pan Island Expressway: on the road shoulder heading toward BKE between lamp-posts 1226 and 1228	7 Jun 2006	Morning (08h30)	Large (2.75 kg) and almost intact carcass. Pelage was yellowish brown and the carcass had a strong pandan smell	Aminurashid bin Eksan
Mandai Road: just before junction of Mandai Lake Road at lamp-post 143	2 Sep 2006	Morning	Badly crushed road-kill	N. Abdullah
MacRitchie forest: MacRitchie Nature Trail, along boardwalk	7 Mar 2007	Night	Female	N. Lim & K.W. Chan, photo
Bukit Timah Road: near Newton Flyover	22 Mar 2007	Morning (08h30)	Road-kill	'Cynthia' (public record contribution)
Holland Road: next to forested patch opposite Maris Stella Kindergarten	19 May 2007	Evening (17h50)	Fresh road-kill	K. C. Chuang, photo
Bukit Timah: Rebecca Road	11 Jul 2007	Night (20h20)	One adult with five young observed climbing down a banyan tree in residential area	T. Schroter
Pulau Ubin: main jetty, near information kiosk	28 Oct 2007	Dusk	N.A.	R. Tan & company
Chestnut Forest	8 Nov 2007	Evening	One, perhaps two, seen resting high up in trees	N. Baker
Jalan Kembangan	28 Nov 2007	N.A.	Caught in a garden, in a cat trap	R. Ng
Upper East Coast Road: Kew Drive	20 Jan 2008	Night (20h15)	Two medium-sized individuals observed in a suburban garden	V. D'Rozario
Ulu Pandan: Holland Road, at about 20 m from junction of Tan Boon Chong Avenue, towards Holland Village	6 Feb 2008	Early morning	Female road-kill	H. T. W. Tan & S. S. N. Tan. Specimen (ZRC 4.8182) deposited at Raffles Museum [see text]
Tanglin: Nassim Road: on grass verge opposite the Philippine Embassy	16 Apr 2008	N.A.	Adult female road-kill	D. Boxall
Siglap: Frankel Avenue	Sep 2008	N.A.	"One group" reported residing "on top" of a house	W. Chan
Bedok: Taman Bedok	3 Sep 2008	Dawn (06h30)	Sighted in the backyard of a house	H. C. Chin
Sungei Buloh Wetland Reserve: behind the visitor centre	5 Sep 2008	Evening	N.A.	C. Goh & company, photo
Sungei Buloh Wetland Reserve: behind the visitor centre	3 Oct 2008	Evening	At least one sighted in a clump of bamboo	S. H. Chan & company

(Continued)

Location	Date	Time	Habit when observed	Observer/Reference
Pulau Ubin: compound of Outward Bound School	17 Dec 2008	Night (21h00)	Adult and one young	M. Chua & company
Pulau Ubin	12 Feb 2009	Night (01h30)	N.A.	R. Teo, photo
Pulau Ubin	17 Feb 2009	Night	N.A.	M. Chua & V. D'Rozario
Mandai Road: 300 m towards Upper Thomson Road after junction with access road to Mandai Columbarium	23 Mar 2009	Morning (08h00)	Road-kill	R. Lim
Bukit Timah Nature Reserve: main road to summit before Keruing Hut	26 Mar 2009	Night (21h00)	On right side of road, then bounded off down slope to the side	T. M. Leong & company
Nee Soon Swamp-forest: pipeline trail	7 May 2009	Night (19h30 & 20h30)	First one in forest off pipeline and second one before pipeline trail	M. Chua & company
Tanglin area: Ridley Park	17 May 2009	Night (21h00)	In suburban garden	F. Thomas
Bukit Timah Nature Reserve: Lasia Valley, Senapang Road	15 Aug 2009	Night	In tree	S. H. Yeo & V. D'Rozario, photo
Portsdown Road: near gate of Tanglin School	25 Aug 2009	N.A.	Dead example on roadside	J. Bromley
Bartley: Bidadari	28 Aug 2009	Night	One in tree in wooded former cemetery	M. Chua
Bukit Timah Nature Reserve: Catchment Path	26 Sep 2009	Night	In tree	K. W. Chan, photo
Bukit Timah Nature Reserve: Jungle Fall Path, about 30 m from main road	7 Nov 2009	Night	In tree	S. H. Yeo & B. C. Ng
Changi Point: Changi Village, tree area behind Apartment Block 5 and next to Apartment Block 21	10 Oct 2009	Night (01h30)	One on grass lawn observed climbing up a tree to join another	W. Remahl
Bukit Timah Nature Reserve	6 Mar 2010	Night	One in tree in strip of vegetation along the Bukit Timah Expressway opposite Catchment Pond; another at Jungle Fall Path	K. W. Chan & M. Chua, photos
Labrador Park	29 Mar 2010	Night (21h00)	On ground along a path in the forest patch, apparently feeding on emerging cicadas	T. M. Leong & Amin
Bukit Batok Nature Park	11 Jun 2010	Night (19h45)	One adult with three young	S. H. Yeo
Tanglin: Cluny Road, in front of Eusoff College	29 Sep 2010	Night (22h35)	Observed crossing road	D. Yeo
Upper East Coast Road: Kew Drive	15 Jan 2011	Night (22h20)	In a suburban garden	V. D'Rozario, photo
Bedok: Eastwood Drive	7 Jun 2011	Day	On a wooden beam under the attap roof (thatched with nipah palm) of a suburban house verandah, appeared unafraid of humans, and was on the beam all afternoon, disappearing in the early evening	K. French, photo
Western Catchment: Murai	8 May 2012	Night	One in tree near Murai Reservoir	M. Chua & company
Viverra tangalunga				
Mandai Track 16	Before 1969	N.A.	Reported to be common in this rural area, but species identification uncertain	Anon.1988b
Central Catchment Nature Reserve: Upper Seletar sector	Early 1990s	N.A.	Unconfirmed record. May be *V. zibetha*	Vasantha in Teo & Rajathurai 1997
Pulau Tekong	Feb 1991	N.A.	Observed regularly foraging near Camp, but species identification uncertain. May be *V. zibetha*	K. W. Li in Yeo 1991
Central Catchment Nature Reserve: MacRitchie Reservoir forest	4–10 Jan 2012	Night (during 23h52 – 05h56)	Camera-trapped consuming carrion bait. From the images, it appeared that only one individual was photographed	Lim & Ou Yang 2012 (Fig. 3)
Viverra zibetha				
Jalan Bahar	May 1990	N.A.	Trapped by a farmer	*Sin Min Daily News* 14 May 1990, Anon. 1990

The locations of these records, except that of the escaped Binturong, are marked on Fig. 1.

Recent records of Brown-tailed Vontsira *Salanoia concolor* (Eupleridae) in Masoala National Park, Madagascar

Frank HAWKINS

Abstract

The presence of Brown-tailed Vontsira *Salanoia concolor* in Masoala National Park, Madagascar, is confirmed from sightings and trapping evidence. It seems rare and has been recorded only in areas remote from human habitation. On present evidence it is only found, across its range, in lowland forest (below 600–700 m).

Keywords: altitudinal use, distribution range, endemic, lowland forest, Malagasy carnivores

Fahitana vao aingana ny Salano *Salanoia concolor* (Eupleridae) ao amin'ny valan-javaboary ny Masoala, Madagascar

Famintinana

Ny fahitana imaso sy ny fandrika nampetraka dia manamafy ny fisian'ny Salano *Salanoia concolor* ao amin'ny valan-javaboary ny Masoala. Vitsy ity karazam-biby ity ary tsy hita raha tsy amin'ny toerana lavitrin'ny faritra misy mipetraka. Atramin'ny izao dia ala lemaka (ambany noho ny 600–700 metatra) no nahitana azy.

Introduction

Over the last 20 years Brown-tailed Vontsira *Salanoia concolor* (Eupleridae), a small mongoose-like carnivore endemic to eastern Madagascar, has been found in several lowland rainforest areas in northeastern Madagascar: Makira forest (Farris *et al*. 2012, Goodman 2012), Betampona (Britt 1999, Britt & Virkaitis 2003), Mananara Nord (Schreiber *et al*. 1989) and Zahamena (N. Rakotoson *in litt*. 1995). Older records are known from the area between Betampona, Mananara, Zahamena and Masoala (Grandidier & Petit 1932, Albignac 1973). Animals reported around Lake Alaotra (e.g. Garbutt 2007) have turned out to be a hitherto undescribed species, Durrell's Vontsira *S. durrelli* Durbin *et al*., 2010. *Salanoia concolor* is currently considered Vulnerable B1ab(ii,iii) on *The IUCN Red List of Threatened Species* (IUCN 2012), and has so far only been recorded from lowland forests (at the sites noted above) at less than 750 m elevation.

The presence of *S. concolor* on the Masoala peninsula of northeastern Madagascar has long been reported (Albignac 1973, Nicoll & Langrand 1989, Schreiber *et al*. 1989) but no details of its presence in, or specific records from, Masoala seem to have been published. Its presence in Masoala is very important from a conservation point of view, because there are few other large areas of lowland forest remaining in Madagascar, this being one habitat type that has suffered very badly over the last 50 years (Harper *et al*. 2007). The ecology and conservation importance of Masoala are described in Kremen *et al*. (2001) and Kremen (2003).

There are no recent records of *S. concolor* from elsewhere, despite greatly increased survey effort in eastern Madagascar. Most of this survey effort has been focused on mid- and high-elevation forests (above 800 m), perhaps accounting for the lack of *S. concolor*. However, recent surveys in forests below 800 m in Marojejy National Park, Anjanaharibe-Sud Special Reserve and the corridor between them have not produced any observations of *Salanoia* (Safford & Duckworth 1990, Goodman 1998, 2000, Goodman & Wilmé 2003).

This note confirms the species's presence at Masoala and give some indication of its status there. I sought information from people that had spent significant time in Masoala, or that I knew had seen *S. concolor* there. There may be many other people who have seen *S. concolor* in Masoala or elsewhere, and their sightings warrant publication.

Records in chronological order

R. J. Safford (*in litt*. August 2012) has spent many months working in Madagascar on birds and mammals and has experience with most Malagasy carnivores. He visited Andranobe field station (15°41'S, 49°57'E, about 8 km south of the village of Ambanizana on the west coast of the Masoala Peninsula) for 10 days in April 1992. Around midday on 24 April, while in primary forest about 500 m above sea level, two *S. concolor* "trotted past me. . . ., exactly as *Galidia* [Ring-tailed Vontsira *Galidia elegans*] had been doing almost daily, and not behaving any differently". The diagnostic dark brown coloration and unmarked tail were seen clearly.

Lily-Arison Réné de Roland (*in litt*. September 2012) worked an average of six months per year between September 1992 and December 2003 in Masoala, conducting research on raptors while based at Andranobe field station but visiting the whole of the peninsula during this period. He saw *S. concolor* twice only: in February 1993 around 500 m from the Andranobe Field Station; and in July 1995 around 25 km from the field station, in the east of the peninsula.

During May 1996, Vonjy Andrianjakarivelo (*in litt*. September 2012) of the Wildlife Conservation Society conducted a small mammal survey around Andranobe field station using Sherman and National/Havahart traps. Only the latter traps were capable of catching *Salanoia*, and were baited with dried fish. Three sites around Andranobe were sampled with 20 National/Havahart traps for eight days at each site, giving a

total of 480 trap-days. Only one *S. concolor* was trapped during this exercise. Two other sites, Ambohitsitondroina (15°34'S, 50°00'E) and Bedinta (15°40'S, 49°59'E), both around 5 km from Andranobe, were sampled in a similar way (20 traps at each of three sub-sites for eight days). No *Salanoia* was captured at these sites, although three other carnivore species, including the diurnal *G. elegans*, were trapped across the three sites sampled. The capture of *G. elegans* suggests that the trapping methods were appropriate for *S. concolor*. Details of other captures will be published separately.

In October 1999, Robert Dowsett and Françoise Dowsett-Lemaire visited the eastern side of Masoala, Antsahamananara (15°18'38"S, 50°14'04"E), for four days, visiting forest at an altitude ranging from 50 to 500 m. During this time, their guide reported that he had seen *S. concolor* twice (although they themselves did not); he apparently reliably distinguished this species from the much commoner *G. elegans*. They also spent four days at Sarahandrano (15°17'32"S, 50°17'11"E) without noting *Salanoia* (F. Dowsett-Lemaire *in litt.* August 2012).

BirdQuest Limited are a U.K.-based bird tour company that since 1999 have arranged tours to Masoala (usually staying at the Arol Lodge, on the western side of the peninsula, 5 km south of Andranobe and close to the forest edge). Over ten tours, totalling about 35–40 days in the field, they have never recorded *S. concolor*, despite recording *G. elegans* many times. P. Morris (*in litt*. August 2012), the leader on many of these tours and with 15 years' experience of birds and mammals in Madagascar, considers it unlikely that *Salanoia* would have been overlooked by the tour groups.

At 08h50 on 3 January 2007, about 2 km north-northeast of the Masoala Forest Lodge hotel near Andranobe, at an altitude of about 100 m a.s.l., the author, accompanied by H. Jacoby, J. Durbin and B. Bidani saw two *S. concolor* moving up a shallow valley at about 30 m range (Fig. 1). The animals showed little sign of fear or even awareness of us, and foraged by moving fairly rapidly over the leaf litter with heads down. On one occasion they scampered around, appearing to play with each other. One stood on its hind legs to investigate a trunk, with its paws against the tree. When the author approached closer to take photographs, it stood on its hind legs and peered at him for a few seconds (see picture on front cover) before disappearing over a shallow ridge into a deep valley.

This was the only sighting of *Salanoia* during three days spent in the vicinity of the hotel. A *G. elegans* was seen about half an hour after the *Salanoia* sighting, on the edge of primary forest, near a clump of *Aframomum* (Zingiberaceae). Compared with *G. elegans*, these *S. concolor* seemed more slightly built with a longer, thinner snout and a slightly shorter tail that lacked the dark rings characteristic of *G. elegans*.

Fig. 1. Brown-tailed Vontsira *Salanoia concolor* near Andranobe, Masoala, Madagascar, 3 January 2007 (Photo: A. F. A. Hawkins).

Conclusions

These observations demonstrate the existence of *S. concolor* in at least two parts of Masoala National Park. Andranobe is the only area where there have been repeated sightings; even there they are irregular, and this is amongst the closest to intact and least disturbed areas of the park. It seems to be absent or much scarcer in some of the more disturbed areas. Its diurnal behaviour and lack of fear of people (at least in two of the observations presented here) would surely mean that if the species were more common, encounters would be more frequent.

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Note added in press. Armand Marozafy, an ecotourist guide for Arol Lodge, has seen single *Salanoia concolor* about once per year for the last fourteen years; once, two together (per Olivier Fournajoux *in litt*. October 2012).

Notes on Cozumel Raccoon *Procyon pygmaeus* and Tres Marías Raccoon *P. insularis*

Vladimir DINETS

Abstract

Photographs and observations of raccoons *Procyon* from Cozumel Island and the adjacent mainland suggest that some previously reported differences between Cozumel Raccoon *P. pygmaeus* and Northern Raccoon *P. lotor* are not diagnostic, and that Cozumel Raccoon and Tres Marías Raccoon *P. insularis* should be treated equally as either full species or as subspecies of Northern Raccoon.

Keywords: island, Northern Raccoon, *Procyon lotor*, Procyonidae

Anotaciones sobre el Mapache de Cozumel *Procyon pygmaeus* y el Mapache de Tres Marías *P. insularis*

Resumen

Fotos y observaciones de mapaches *Procyon* de la Isla de Cozumel y de tierra firme adyacente sugieren que algunas de las diferencias reportadas previamente entre el Mapache de Cozumel *P. pygmaeus* y el Mapache *P. lotor* no son suficientemente diagnósticas. Adicionalmente, que el Mapache de Cozumel y el Mapache de Tres Marías *P. insularis* deben ser tratados de forma idéntica, ya sea como la misma especie o como subespecie del Mapache.

Palabras clave: isla, Mapache, *Procyon lotor*, Procyonidae

The genus *Procyon* includes two well-defined parapatric species of raccoons: Northern Raccoon *P. lotor* and Crab-eating Raccoon *P. cancrivorus*. In addition, there are five island taxa with very small ranges, all of which are closely related to Northern Raccoon, but which were usually treated as full species up to the 1970s (Nowak 1999). Later it was realised that three West Indian taxa, namely 'Bahamas Raccoon *P. maynardi*', 'Barbados Raccoon *P. gloveralleni*' and 'Guadeloupe Raccoon *P. minor*', represent very recent human introductions of Northern Raccoon (Morgan & Woods 1986, Helgen *et al*. 2008). But the other two island taxa, Tres Marías Raccoon *P. insularis* and Cozumel Raccoon *P. pygmaeus*, remain subject to controversy. Are they well-defined subspecies or full species?

Tres Marías Raccoon differs from Northern Raccoon in its broad, strikingly robust skull, narrow molars and carnassials, and more uniform pelage coloration (Helgen & Wilson 2005). It possibly has broader front feet (the only recorded footprints were 73 mm wide when 75 mm long, while Northern Raccoon footprints of the same length are usually about 68 mm wide) and longer stride length (35–45 cm, as opposed to 20–40 cm in Northern Raccoon). It seems comparatively large-headed under field observation conditions (Dinets 2004).

Cozumel Raccoon has reduced dentition (Merriam 1901), averages 17.5% smaller in linear measurements than does Northern Raccoon from the adjacent mainland, the Yucatan Peninsula (*P. l. shufeldti*, according to Helgen & Wilson 2005; McFadden & Meiri in press), and is said to possess, characteristically, a black throat and golden tail (Merriam 1901). Fossil Cozumel Raccoons are known only from the Holocene (McFadden *et al*. 2008). MtDNA data suggest that Cozumel Raccoon and Northern Raccoons from Yucatan form a clade separate from Northern Raccoons from the U.S.A. (McFadden 2004); that some mainland populations of Northern Raccoon show levels of population genetic variation similar to the difference between raccoons from Cozumel and mainland Mexico (McFadden & Meiri in press); and that the divergence of Cozumel Raccoon could have happened as recently as 3,050 years before present (ybp; McFadden *et al*. 2008). It is possible that Cozumel Raccoon is a result of an ancient human introduction: the earliest evidence of human presence on the Caribbean coast of Mesoamerica dates back to approximately 11,200 ybp (Hester *et al.* 1981). To my knowledge, no molecular data have been examined for Tres Marías Raccoon.

Recently, I had an opportunity to observe and photograph Cozumel Raccoons (Figs 1, 2) and Northern Raccoons from the adjacent mainland (Figs 3, 4) at close range (2–15 m). Two Cozumel Raccoons were observed near Cozumel sewage treatment plant (20°32'20"N, 86°53'34"W) on 7 July 2012; one disappeared after 15 min but the other remained in view for a further 25 min. Northern Raccoons (a group of eight) were observed for about two hours at Cenote Manati (20°16'59"N, 87°23'29"W) near Tulum, Quintana Roo, on 6 July 2012 (Fig. 5).

As Fig. 3 clearly shows, mainland raccoons can possess the black throat mark and golden tail coloration that are supposed to be distinguishing features of Cozumel Raccoon (Merriam 1901). Despite being smaller than their mainland relatives, Cozumel Raccoons were very similar to them in gait (a peculiar plantigrade gallop-like gait with left and right paws leaving prints side by side). Their footprints were indistinguishable from those of mainland raccoons in overall shape, although predictably smaller in print size (front footprint 55–60 mm wide, 60–65 mm long) and stride length (22–28 cm).

Helgen & Wilson (2005) considered Cozumel Raccoon to be a full species and Tres Marías Raccoon to be a well-defined subspecies, because the latter has "much less striking" (p. 230) morphological differences from mainland raccoons. However,

Fig. 1. Close-up Cozumel Raccoon *Procyon pygmaeus*, northwestern Cozumel Island, Mexico.

Fig. 2. Cozumel Raccoon *Procyon pygmaeus*, northwestern Cozumel Island, Mexico.

Fig. 3. Northern Raccoon *Procyon lotor*, Cenote Manati, Quintana Roo, Mexico. Note the black throat mark and the golden-yellow tail (see picture on back cover).

Fig. 4. Northern Raccoon *Procyon lotor*, Cenote Manati, Quintana Roo, Mexico.

Fig. 5. Locations of raccoon *Procyon* observations mentioned in text.

the authors actually found Tres Marías Raccoon to have a more distinctive skull than Cozumel Raccoon, and the only really 'striking' morphological feature of Cozumel Raccoon that they mention is its small size. Unlike many earlier authors, they did not find any differences in pelage coloration between Cozumel and mainland raccoons—a result corroborated by the images presented here.

Of course, photographs of single individuals and brief visual observations are of limited use in the age of molecular systematics. However, being possibly the only zoologist to have observed both Tres Marías and Cozumel Raccoons in the wild, I find them both equally similar to Northern Raccoon. Until molecular data on Tres Marías Raccoon become available, it is probably more logical to consider them both either full species or subspecies, depending on one's preferred criteria and species concept.

Both taxa are rare in their small geographic ranges. Tres Marías Raccoon is already extinct on one of the two islands it inhabited historically, and numbers less than 250 mature individuals on the other (Zeveloff 2003). Although *The IUCN Red List of Threatened Species* lists Cozumel Raccoon as Critical-

ly Endangered (Cuarón *et al.* 2008), it does not consider Tres Marías Raccoon a separate species, so this latter falls within the Least Concern category of Northern Raccoon (Timm *et al.* 2008). The 'Conservation Species Concept' accepts elevating subspecies to species purely for alleged conservation benefit, but this is usually not scientifically justifiable (Gamauf *et al.* 2005). However, by analogy with Cozumel Raccoon, I recommend considering Tres Marías Raccoon a full species until molecular data become available.

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Small carnivores, big database – inferring possible small carnivore distribution and population trends in Israel from over 30 years of recorded sightings

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Abstract

The Israel Nature and Parks Authority (INPA) has been recording wildlife observations over many years in an open-access database. Given the time scale and number of observations, these can provide insight into trends in spatial distribution and some populations and communities of local species. This study discusses the possible implications of patterns in small carnivore sightings in Israel from 1980 to 2010. The records suggest that some changes affected all species similarly, whilst others had different, sometimes opposite, effects on different species. Records for all five species have been decreasing in the southern deserts of Israel, although in other regions the relative number of sightings of Egyptian Mongoose *Herpestes ichneumon* has been increasing over time, while those for Ratel *Mellivora capensis*, Stone Marten *Martes foina* and Marbled Polecat *Vormela peregusna* have been decreasing. The relative number of sightings of Eurasian Badger *Meles meles* has fluctuated over time, but shows no obvious trend. Spatial data also suggest that the distributions of the two already regionally threatened species, Ratel and Marbled Polecat, are decreasing and that the species need, possibly immediately, conservation attention. Distributions of the other species seem stable, perhaps suggesting that their situation, for now, is secure. Additional data exist in other sources in Israel; their comparison with the present dataset and the use of more analytical tools could test the suggestions of this study.

Keywords: *Herpestes ichneumon*, Israel Nature and Parks Authority (INPA), *Martes foina*, *Meles meles*, *Mellivora capensis*, *Vormela peregusna*

טורפים קטנים, מאגר מידע גדול – ניתוח מגמות אפשריות בתפוצת ואוכלוסיית הטורפים הקטנים בישראל מתוך למעלה מ-30 שנים של תצפיות מתועדות

תקציר

רשות הטבע והגנים בישראל מתעדת תצפיות בבעלי חיים וצמחים במשך שנים רבות במאגר מידע הזמין לציבור. בהתחשב במשך הזמן ומספר התצפיות, יכולים הנתונים במאגר זה לספק תובנות לגבי מגמות בתפוצה ובמספר מדדי אוכלוסייה וחברה של מינים מקומיים. מחקר זה דן במשמעויות אפשריות של מגמות בתצפיות בטורפים קטנים בישראל משנת 1980 ועד 2010. הנתונים מציעים שכמה שינויים השפיעו על כל המינים באורח דומה בזמן שלאחרים הייתה השפעה שונה, לעיתים הפוכה, על מינים שונים. מספר התצפיות בכל המינים נמצא במגמת ירידה במדבריות הדרום בזמן שבאזורים אחרים מספר התצפיות היחסי בנמייה *Herpestes ichneumon* עלה לאורך הזמן בעוד שאלו בגירית הדבש *Mellivora capensis*, בדלק *Martes foina* ובסמור *Vormela peregusna* ירדו. מספר התצפיות היחסי בגירית המצויה *Meles meles* השתנה לאורך הזמן אך לא הראה כל מגמה ברורה. הנתונים המרחביים מציעים כי תחום התפוצה ו/או גודל האוכלוסייה של שני המינים המקומיים שכבר נמצאים בסכנת הכחדה, גירית הדבש והסמור, מצטמצמים ושמינים אלו זקוקים למאמצי שימור, ייתכן שבאופן מיידי. תפוצת שאר המינים נראית יציבה, דבר שעשוי להצביע על כך שלפחות בזמן זה הם עדיין אינם תחת איום. נתונים נוספים נמצאים במאגרים נוספים בישראל – השוואה של אלו עם מאגר הנתונים המוצג כאן ושימוש בכלים מחקריים נוספים יכולים לשמש בעתיד בכדי לבחון את ההצעות המועלות במחקר זה.

מילות מפתח: רשות הטבע והגנים, נמייה, דלק, גירית הדבש, גירית מצויה, סמור

Introduction

Despite the relatively rapid changes in habitats sometimes caused by anthropogenic factors in much of the world, responses of the biological systems can lag behind; and many environmental changes are themselves ongoing. Therefore, understanding the specific factors that underlie biological responses may require observations over long periods of time. Such observations are often non-existent or are limited to the small regions typically covered by specific studies, which hinders interpretation of changes. In Israel, the Israel Nature and Parks Authority (INPA), the governmental authority responsible for nature conservation, has been recording observations of Israeli wildlife for several decades, observations that may help detect and possibly later explain various trends and changes in biological parameters over the respective, long, time period. These data have been collected mainly by INPA staff and include information at various levels of detail per record, with the basic being date and location (including coordinates) of the observation. Data collection has been enhanced in recent years since palm-top computers were distributed among rangers. This started in 2008 in one region and all regions were so covered by 2010. These data are stored as a free access dataset (ww2.bgbm.org/natureinfo) that can be queried by observations of specific species or lists of species in particular regions.

Israel has a relatively rich fauna and flora of diverse origins (e.g. Ethiopian, Saharan, Oriental and Palaearctic), and a mosaic of eco-regions, from Alpine to extreme desert, condensed in a small area (Tchernov & Yom-Tov 1988). These environmental and faunal characteristics, coupled with the large INPA dataset, can make the country a model for studying the spatial response of species to various direct and indirect human influences on habitats. This article reviews trends in the distribution of non-lutrine small carnivores in Israel, as reflected from observations in the INPA dataset. The analysis covers Egyptian Mongoose *Herpestes ichneumon*, Ratel *Mellivora capensis*, Eurasian Badger *Meles meles* (*M. canescens*, sensu del Cerro *et al*. 2010), Marbled Polecat *Vormela peregusna* and Stone Marten *Martes foina*. These species represent African, Palaeotropical and Palaearctic species, small- to medium-sized species, species occupying various habitats and with diverse feeding ecologies, and species with varying commensal tendencies. Eurasian Otter *Lutra lutra* also inhabits Israel but was not included in this analysis: its aquatic lifestyle exposes it to pressures different from those faced by non-aquatic species, and its population is surveyed annually by the Society for the Protection of Nature Israel. It thus deserves a separate

discussion. Common Genet *Genetta genetta* was sometimes mentioned to live in Israel (e.g. Aharoni 1930), but the reports, all from long ago, have been disputed and suggested to be either incorrectly located or, if genuinely from Israel, referring to Marbled Polecat (Kock 1983). This conclusion is strongly supported by the lack of Common Genet records in Israel in recent decades. Similarly, Tristram (1888) wrote that Least Weasel *Mustela nivalis* occurred around Mount Tabor, but this species has never been found otherwise in Israel and Tristram's (1888) record, for which no specimen is known, is thus assumed to be in error.

Two of the analysed species, Marbled Polecat and Ratel, are recognised as threatened in Israel (Vulnerable and Endangered, respectively) mainly through anthropogenic factors (Dolev & Perevolotsky 2002). The same species are believed to have decreasing global populations (Begg *et al*. 2008, Tikhonov *et al*. 2008), although only Marbled Polecat is globally threatened (as Vulnerable; Tikhonov *et al*. 2008). The other species are not categorised as threatened, in Israel or globally, and are believed to show stable population sizes globally (not assessed locally in Israel). Since the anthropogenic factors in Israel are not species-specific, review of long-term observations on the presence of small carnivores may help to determine the responses of each species to different changes in the environment or human-inflicted threat and to explain the trends that are presented by each species.

Methods

Analysed data

A total of 3,308 records of small carnivore (all in Mustelidae and Herpestidae) sightings was retrieved from the INPA database. These records come from all regions of Israel, with Israel defined in the INPA database as the former British Mandatorial Palestine (i.e. including Samaria and Judea regions) and the Golan Heights, and the time period 1980 to the end of 2010. The 349 records of Eurasian Otter were excluded from the analysis (see Introduction). Four records of other species were discarded because their coordinates lay far outside Israel (e.g. middle of the Mediterranean Sea), presumably as a result of mistyping. Another record was removed because the date (1909) could not be confirmed. Hence, 2,954 records were analysed.

Data quality

The sightings in the database were collected mainly by INPA rangers and scientists, but also by other researchers and field staff from other institutions, conservation organisations or academia. All observers are experienced in identifying the various species (sightings reported by lay people are not recorded) and, therefore, the records analysed are believed generally reliable. Data collection has been incidental to other activities and, thus, reporting rates and efforts of the rangers are unlikely to be similar in all regions; observers will differ in their reliability in identifying the subject animals; and there may be errors in recording exact positions of observation. But these factors are unlikely to produce long-term directional trends, especially given the large total number of records and the large difference in numbers of records per species. For each species, spatially outlying records are discussed below in more detail, to assess the possibility of their inaccuracy.

Scope of analysis

Data were collected incidentally to other activities, with sampling effort varying between regions and time periods. They cannot provide precise information about abundance of taxa. However, several factors suggest that the analysis can provide insights on long-term trends: small carnivores in Israel are not observed particularly often (see previous paragraph for number of sightings over 31 years); their natural history and thus detectability is not expected to change over time; many observers contributed to the database; and there were many observations for most species throughout the duration of the database. Artificial biases of the sampling, such as change with time in relative spread of observer effort across habitats, regions and times of day and night, or bias for or against specific species, need to be carefully considered and are mentioned where they may explain certain observations. Nonetheless, these factors are not expected to have consistent, gradual trends, so are unlikely to cause apparent long-term trends in distribution or relative number of sightings for different species.

Data interpretation and analysis

Sighting locations were transferred to KML format using the Excel to KML tool by Earth Point (http://www.earthpoint.us/ExcelToKml.aspx). This allowed the superposition of record locations data onto Google Earth map for interpretation of the species distributions.

For testing significance of changes in the relative number of sightings for the various species the Pearson product-moment correlation coefficient (r) was used. Arcsine transformation was used on the proportion data of the number of sightings in each species from the total number of sightings in all species and significance was tested using the Student's T distribution with two degrees of freedom. The sample size was seven, with six time periods of five years (1980–1984, 1985–1989, 1990–1994, 1995–1999, 2000–2004, 2005–2009) and 2010 treated separately. The data were grouped because of the low number of sightings for some species in single years and because of the potentially larger effect of differing sampling efforts if data from single years would be treated. Year 2010 was included in the analysis because of the large number of sightings in this year, which add important data, but treated separately in order to keep the rest of the 5-year groups, which cover continuously the rest of the study period, comparable, if needed. Because relative, rather than absolute, numbers are compared, the fact that time spans in this group differ does not compromise the statistical analysis.

Geography

The names of the various regions used in this article (Fig. 1) reflect a commonly used geographical division based on topography and habitat types. A further, gross, sub-division to north, central and south of Israel is here made, with the north including regions 1–7 and 10a in Fig. 1, the south including regions 20 and 21, and the central, the remainder.

The geographical borders mentioned in this study do not necessarily reflect any recognised or proclaimed international or other geopolitical borders or the political views of the author.

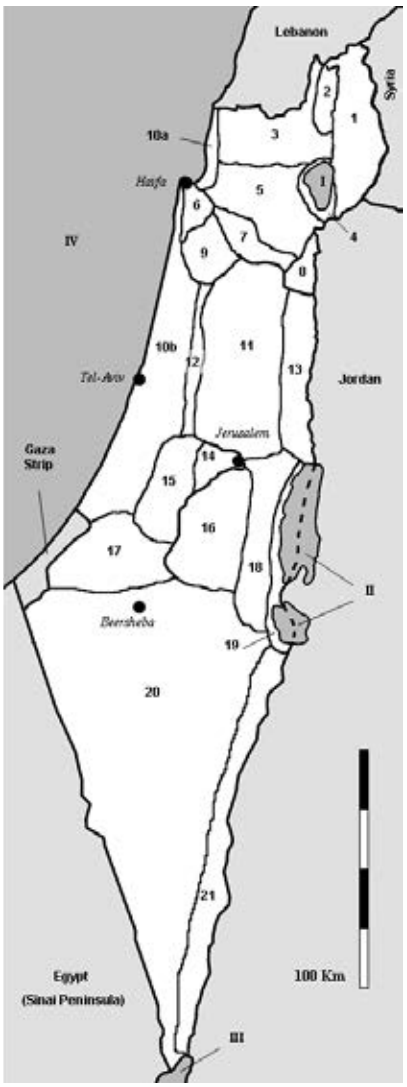

Fig. 1. Israel (white) showing geographical regions used in the text: 1) Golan Heights; 2) Hula Valley; 3) Upper Galilee; 4) Sea of Galilee lowlands; 5) Lower Galilee; 6) Carmel Mountain; 7) Jezre'el Valley; 8) Beit-She'an Valley; 9) Menash'e Highlands; 10) Coastal Plain (a-northern; b-central and southern); 11) Samaria Mountains; 12) Samaria Foothills; 13) Jordan Valley; 14) Jerusalem Mountains; 15) Judean Lowlands; 16) Judea Mountains; 17) Lakhish Region; 18) Judea Desert; 19) Dead Sea Valley; 20) Negev; 21) Arava. Countries and regions not included in this study are coloured light grey. Lakes and seas are coloured dark grey: I) the Sea of Galilee; II) the Dead Sea; III) the Red Sea; IV) the Mediterranean Sea.

Individual species patterns and trends

Table 1 summarises the number of sightings of each species in the INPA database over the review period.

Ratel *Mellivora capensis*

The INPA database holds few (33) Ratel sightings, but these come from all regions of Israel. This small number hinders determination of the species's distribution. Originally, Ilani (1979) suggested that the Ratel's distribution in Israel is fragmented and consists of four discrete populations: a) in the northern Coastal Plain and the western slopes of the Upper and Lower Galilee; b) in the Hula Valley and bordering mountain slopes of the Golan Heights and eastern Upper Galilee; c) the Judean Lowlands and Lakhish Region; and d) the northern Arava Valley. However, several sightings since the 1980s come from between these suggested ranges: the central Coastal Plain, central and western Negev, the Jordan Valley, and the higher areas of the Galilee and Golan Heights. These sightings, although few, suggest at least some contact between the proposed sub-populations, even if rare. The alternative, of growing sub-populations with expanding ranges, seems unlikely because of the continuously decreasing number of sightings. From 1980 to 1984 there were 13 sightings, which came from various areas of the country. The number of sightings for each 5-year term decreased steadily, dropping to just a single in 2005–2009 (and none in 2010). Ilani (1979) estimated the population size to be 45–85 animals in Israel. Given the varying sampling effort over the study period the number of sightings is not necessarily directly proportional to the population size (see Methods), but, nonetheless, the steady decline in number of sightings is a strong indication that the population is most probably declining. Since the population was already suggested to be small before the study period (Ilani 1979) the species might be more threatened in Israel than is currently considered (Endangered; Dolev & Perevolotsky 2002), quite possibly on the brink of extinction, and requires strong and immediate action to protect it. Even local, incidental events, such as a malicious, indiscriminate poisoning by a single farmer, could have a devastating effect of what seems to be a very small remnant Ratel population in Israel.

The decreasing and small number of sightings obscures biogeographical trends. Sightings from 1980 until 1989 came from all regions of Israel. During 1990–1999 all sightings

Table 1. The number of recorded sightings of each species of small carnivore* in Israel recorded in the INPA database for each species in each 5-year period 1980–2009, and in 2010.

Species	Ratel *Mellivora capensis*	Marbled Polecat *Vormela peregusna*	Stone Marten *Martes foina*	Eurasian Badger *Meles meles*	Egyptian Mongoose *Herpestes ichneumon*	Total
Period						
1980–1984	13	52	59	85	61	270
1985–1989	9	71	140	227	259	706
1990–1994	6	11	57	92	61	227
1995–1999	2	16	94	118	192	422
2000–2004	2	10	60	137	129	338
2005–2009	1	15	71	176	393	656
2010	0	3	11	71	250	335
Total	33	178	492	906	1,345	2,954

*excluding Eurasian Otter *Lutra lutra*.

came from the adjacent regions of the Judean Lowlands, the Lakhish Region, the southern Coastal Plain and the western Negev. But in 2000–2010, all sightings in the INPA database came from northern parts. Yet, sightings are so scarce that it is impossible to rule out that small numbers persist in other regions but have not, by chance, been recorded recently by INPA. This may be supported by four 2006–2009 sightings recorded in a different source (Society for the Protection of Nature in Israel) that come from various regions: Negev Desert, Judean Mountains and the Galilee.

Marbled Polecat *Vormela peregusna*

The distribution of Marbled Polecat in Israel shows relatively high affinity with open habitats, including intensively cultivated areas. Most observations come from the central part of the country, which encompasses areas such as the Coastal Plain, the Samaria Foothills and Judean Lowlands and the Lakhish Region. Where not built on, these areas are mostly intensively cultivated; natural habitats are mainly open or semi-open. In the north, Marbled Polecat is also more often found in cultivated areas such as the Jezre'el, Beit-She'an or Hula valleys, with relatively few observations from the higher elevations of the Upper Galilee and Golan Heights. This affinity with open habitats including cultivated areas often brings Polecats near human settlements and there are several records from the vicinity of large cities, such as Rehovot, Rishon-Le'Zion and Herzliya, in the heavily urbanised centre of Israel, with one record coming from an agricultural enclave in the heart of the largest metropolitan area in Israel, just outside Tel-Aviv. Nevertheless, whilst most records come from mainly open habitats in the mild-climate regions of Israel, there are isolated records from other regions, with most of them reliable (experienced observers, animals in hand). There is one record from within the city of Jerusalem, two more from the Samaria Mountains and another from the Hebron area, all areas of higher elevation, cooler climate and with less intense traditional agriculture or no agriculture at all. There are also records from arid, warmer areas, such as the central part of the Jordan Valley and the northern and central Negev (near Beersheba and Kibbutz Retamim, respectively), which all offer green paths (seasonal streams) and patchy cultivated areas for Polecats to move along or forage in. However, the scarcity of observations from these areas suggests that the mountainous regions of central Israel, as well as the arid regions that border the more populated and cultivated areas, are marginal areas for Polecats, supporting either small or temporary populations. This pattern, based on 178 records, contradicts suggestions that Marbled Polecat is mainly a desert and steppe species (Tikhonov *et al*. 2008, Wilson & Mittermeier 2009), even though in some countries in the Levant some sightings support this suggestion (e.g. Nader 1991, Saleh & Basuony 1998). Generally in Israel, Polecats seem to prefer agricultural areas. When found in natural habitats, only a handful of sightings come from desert areas (with none more recent than 1991) and more, but still relatively few, come from the steppe climate regions of the southern Judean Lowlands and the Lakhish Region.

The locations of Polecat sightings have shifted gradually towards the cooler north of the country (Fig. 2). Between 1980 and 1994, the southernmost records in the INPA database came from as far south as Kibbutz Retamim (latitude about 31°03'20"N) with other observations coming from the agricultural areas in the north-western Negev. Reports from the southern, arid regions also came from other sources during the 1970s and 1980s (see Dolev & Perevolotsky 2002). However, between 1995 and 2004, the southernmost observation was already from a northern location (latitude 31°32'02.4"N), with some more observations coming from slightly more to the north (just north of the Gaza Strip), and from 2005 onwards the southernmost observation was from near the city of Rehovot (about 31°51'30"N), a total shift of over 80 km north. Furthermore, despite overall many more sightings recorded in the centre of Israel than the north, this trend reversed after 1999 and since 2000 more sightings are recorded from the northern part of Israel.

This apparent northward shift in distribution by Marbled Polecat may, however, not reflect changing habitat preferences, but human activities. It is too difficult to distinguish between the possible effects of the several factors that may contribute to the pattern, to be sure of its cause(s). One major factor seems to be the increase in synanthropic species such as Golden Jackal *Canis aureus* and Red Fox *Vulpes vulpes*. These species have been the main beneficiaries among mammals from the increase of available garbage near human settlements in Israel (Yom-Tov & Mendelssohn 1988) and already have been suggested to contribute to the extinction or the shift in distribution of desert species in Israel (Sand Cat *Felis margarita* and Sand Fox *Vulpes rueppellii*, respectively; Dolev & Perevolotsky 2002). These species might out-compete Polecats for prey or even prey directly on the smaller Polecats. A second factor might be the foreign labourers, coming to Israel for agricultural work, who brought their customary hunting practices to the country and in some areas caused and may still cause pressure on local wildlife. Hunting was concentrated, measured by numbers of traps found, in the north-western Negev, the Lakhish Region and the central Coastal Plain and Samaria Foothills among other areas (Yom-Tov 2003), areas that overlap with Marbled Polecat distribution. Although Polecats were not directly observed among the species caught, other small carnivores (Egyptian Mongoose, Eurasian Badger and Eurasian Otter) were; and many small species (rodents, birds, reptiles and amphibians) were either actively hunted or caught as by-catch (Yom-Tov 2003). So, it is fair to assume that Marbled Polecats would also be either targeted or caught by mistake. A third, possibly major, factor might be the domestic/feral cat *Felis* population in the country. These cats in Israel predate wildlife, including endangered species (Brickner-Braun *et al*. 2007). Therefore, cats could possibly out-compete the Marbled Polecat for food given their similar diets or even prey on Polecats directly given the usually larger size of the cats. This factor, if indeed real, is also expected to influence more significantly the smaller or isolated Polecat populations in marginal areas or the Polecat populations in the centre of Israel, which harbours a much more dense human and, hence, feral cat populations.

Other factors, such as more frequent series of drought years in Israel (1989–1991, 1999–2001, 2004–2011), changes in agricultural practices in some regions, such as the increase in citrus-fruit growing in the north-western Negev or increase in greenhouse agriculture instead of open land, and increasing habitat fragmentation due to road construction and heavier traffic, may also contribute to the northward shift in Polecat distribution in Israel. Regardless of the specific cause, the spe-

Fig. 2. Changes in the reported distribution of Marbled Polecat *Vormela peregusna* in Israel over 1980–2010, based on records obtained from the INPA database. The distribution area that includes all sighting locations for the time period, excepting the southernmost sighting (a black circle), is coloured dark grey (left) 1980–1994, (centre) 1995–2004 and (right) 2005–2010.

cies should be monitored closely: the results here of decreasing distribution, coupled with its overall decreasing relative rate of recording (see 'Community trends'), support its classification as threatened; given the rate of these changes, an updated assessment might be warranted.

Stone Marten *Martes foina*

Stone Marten is a temperate Palaearctic species, which in its entire distribution range occupies habitats ranging from forests to rocky and semi-open areas, including near human settlements, up to an elevation of 4,000 m (Wilson & Mittermeier 2009). However, in Mediterranean ecosystems the species uses various kinds of wooded areas more than cultivated or urban areas (Santos & Santos-Reis 2009, Pereira *et al*. 2012). This study suggests that in Israel, the species shows this latter pattern. Early records (1980–1984) came from two separate regions – northern Israel, mainly from the Upper Galilee and Golan Heights regions, and from the Jerusalem Mountains. These regions are characterised by mostly rural settlements separated by dense or semi-open areas of natural Mediterranean woodland or planted pine *Pinus* forests, whence came most observations. However, the disjunct pattern was possibly a sampling artefact, because in the next decade (1985–1994) reports from the Samaria Mountains, which connect the Jerusalem area to the Jezre'el Valley and Lower Galilee, accumulated. This area had no or very little INPA presence before that time, reflecting its different geopolitical status. Similar to the Upper Galilee or Jerusalem Mountains, it is also characterised by mostly rural settlements but, unlike in the latter two, these are separated by a more open habitat (of anthropogenic origin) or by areas of traditional agriculture. Nevertheless, vegetation, even if lower, less dense or of different species composition, is still found in the region and can offer shelter to Martens.

The later period, between 1995 and 2010, showed a relative stability in the area of distribution, but two trends are worth mentioning: Stone Marten appearance in the western and southern slopes of the Carmel Mountain, and a relative reduction in sightings in the Jerusalem and Samaria Mountains. These might be artefacts of sampling effort, but genuine change is possible. The south-western area of the Carmel Mountain had a series of large forest fires (>50 ha) during the 1980s (Tessler *et al*. 2010), which could explain the lack of sightings from the region in that decade and in the early 1990s. These fires however brought changes in forestry management protocols in the region: focus on natural recovery of native vegetation, planting of native Mediterranean woodland species, active reduction of mono-species pine forest that had been planted in the past, and the limiting of its re-growth (Harpaz 1992). More natural forest supports more diverse, local fauna, so its recovery probably would benefit species such as Martens (Ashkenazi 2004). The decrease in sightings in the Jerusalem Mountains might also relate to forest fires, since the region suffered a series of large ones (>50 ha) in the 1990s and early 2000s (Tessler *et al*. 2010). The decrease in sightings in the Samaria Mountains might reflect a change in the geopolitical situation, which saw areas transferred to civil jurisdiction,

including environmental issues, of the Palestinian Authority in the years following the Oslo Accords that were signed between Israel and the Palestinians, and thus INPA presence in Samaria decreased significantly.

Overall, the 492 Marten sightings suggest a distribution covering all Israel's mountainous regions in the Mediterranean climate zone, from sea-level to the highest elevation of over 2,000 m of Mt Hermon, the northernmost point of the Golan Heights. The distribution also shows that the Marten keeps true to its origin as a temperate or colder climate species, with more sightings coming from cooler regions of the Upper Galilee, Golan Heights and the Jerusalem area, and fewer from warmer areas such as the Lower Galilee or the Carmel. It is difficult to determine, however, if the populations in the warmer areas are viable or represent temporary activity of individuals dispersing to the edges of the cooler areas or between the two main distribution areas. The sightings also suggest that Martens avoid urban areas but do approach and even enter small settlements, with observations including animals entering houses and needing to be removed by INPA rangers. Two reported sightings from the eastern slopes of the Samaria Mountains, a semi-arid region with only low vegetation along seasonal streams and sparsely distributed settlements, are inconsistent with the range suggested by the rest of the records. These sightings are from or near vegetated areas (a stream canyon; an agricultural area) and may be explained by dispersal along green routes, but the distance from all other observations and the atypical surrounding area (relative to otherwise reported and observed Stone Marten habitat) suggest that these sightings may be transients or misidentifications. The absolute number of Marten sightings in each 5-year period ranges from 57 to 140 and has no apparent trend. And given that the distribution is stable, possibly slightly expanding, Stone Marten conservation status in Israel is probably secure.

Eurasian Badger *Meles meles*

Eurasian Badger is the second-most sighted small carnivore species in Israel with 906 records in the INPA database. This is somewhat surprising for an animal that prefers continuous or fragmented wooded habitats in Mediterranean ecosystems (Remonti *et al*. 2006, Santos & Beier 2008, Lara-Romero *et al*. 2012) and is at the edge of its range: Israel is its southernmost distribution (Kranz *et al*. 2008, Wilson & Mittermeier 2009). Furthermore, the sightings cover all regions of Israel, including desert regions. Overall, most sightings (about 500) indeed come from the north, which is generally less urbanised, with more areas of natural, wooded habitats and cooler climate. However, close to 400 sightings come from the central parts of Israel, which are on average lower in elevation and warmer, with denser human population and mostly open habitats, often cultivated. Indeed, in some of the 5-year periods there were more sightings from the centre than from the north. Eurasian Badger has also been recorded in arid regions, such as the Jordan Valley all the way south to the Dead Sea and the northern and western Negev, where it is associated with agricultural areas. The southernmost observation comes from the central Arava, a very arid region with isolated settlements and adjacent patches of cultivated areas. This record is over 90 km from the nearest other record, but it was made by INPA's Chief Veterinarian and is, therefore, presumed reliable. This sighting, and others from the southern deserts, suggest that Eurasian Badger can disperse over large tracts of arid land between patches of suitable habitats.

The study period probably had only relatively small changes in Eurasian Badger distribution. The only major trend is the decrease and eventual cessation of sightings from desert areas, with the last recorded sighting in the south in 1995. Possible reasons for this, such as competition with synanthropic species and poaching by foreign labourers, were discussed in detail under Marbled Polecat. Other regions of Israel provided sightings throughout the study period, although there have been fluctuations in numbers or density of observations in some regions. The Hula Valley and its flanking eastern Upper Galilee and Golan Heights mountains, and the western slopes of the Jerusalem Mountains, showed the most stable, and the Lakhish Region the sparsest and most fluctuating, sighting abundance. The two former regions resemble described preferred Badger habitat, with intense agriculture, wealth of water courses and partially wooded areas (Hula Valley and flanking mountains) or relatively densely wooded areas with patches of poultry-rearing areas and cultivated land (Jerusalem Mountains), while the latter (Lakhish Region) is a drier, warmer, open area of mainly cultivated land with only relatively small and fragmented patches of wooded areas.

Absolute numbers of Eurasian Badger sightings have fluctuated, ranging from 85 to 227 in different 5-year terms, with no evident trend. Therefore, despite the lack of recorded sightings from desert areas in the last 15 years of the analysis period (1996–2010), overall the Eurasian Badger population in Israel is probably secure.

Egyptian Mongoose *Herpestes ichneumon*

The Egyptian Mongoose is by far the most commonly sighted small carnivore in Israel, with 1,345 sightings in the INPA database. These sightings are highly unevenly distributed. In other regions it is commonly associated with riparian habitats amid open or low-vegetation areas (Palomares & Delibes 1993, Cavallini & Palomares 2008, Matos *et al*. 2009, Wilson & Mittermeier 2009) and these habitats boast the most records in Israel as well. In Israel, which is a dry country with relatively few natural water bodies, many sightings come from anthropogenic wetland habitats. Most Egyptian Mongooses were sighted in the Hula Valley, the Beit-She'an Valley and the central Coastal Plain. These regions have many water courses (natural or human-manipulated) and aquaculture ponds that would resemble preferred mongoose habitat. Other sightings, although less dense, come from along water courses such as the Jordan River or the continuously or seasonally flowing streams of the Coastal Plain, and from near some man-made water reservoirs such as the Nitzanim Lake. In areas that cannot directly be associated with wetland habitats, the Galilee, Golan Heights, Jerusalem Mountains and Lakhish Regions, sightings are fewer. Here it is possible that mongooses have been using anthropogenic food sources such as open rubbish dumps or discarded animal carcases (mainly from the poultry industry). Also, it is probable that the animal never strayed far from small, local springs, ponds and reservoirs or other small-scale water bodies. Further support for the connection between mongooses and wetlands in Israel is the rarity of sightings from desert areas. Of the 1,345 sightings, only two came from desert habitats not beside wetland habitats, one each

from the southern Judean Desert and the northern Arava; both in 1988, from highly experienced observers. This rarity does not seem to be because of heat intolerance. Mongooses inhabit some of the hotter areas of Israel such as the southern Jordan Valley and the Dead Sea Valley: in these, a river (Jordan Valley) or a string of near-shore freshwater springs (Dead Sea) may provide favourable habitat and also a corridor for dispersal between agricultural areas. However, without such habitats, Egyptian Mongoose may not be able to establish a population or possibly even disperse regularly. Some may manage to travel along stream-beds (perhaps after seasonal floods; no direct evidence for this) and maybe survive as individuals or small, isolated populations for short periods.

The high affinity of Egyptian Mongoose for wetlands, and that most of these habitats in Israel are, at least to some degree, manipulated by humans including control over water flows, prevented major changes in its distribution. Sightings have been recorded from all the Mongoose's major distribution areas throughout the study period. There were some fluctuations in marginal, less suitable areas with fewer records, such as the Lakhish Region or the cultivated areas of the north-western Negev.

The number of Mongoose sightings in Israel has fluctuated significantly, from 61 to 393 per 5-year period, but showed no consistent trend. Between 2000–2004 and 2005–2009 the number of sightings more than tripled (129 to 393). This might represent a start of an ongoing increase, as in 2010 alone 250 sightings were recorded. The significance of this possible trend is discussed below in relation to number of sightings of other species.

Community trends

The sightings in the INPA database also reflect trends that are not unique to a single species, but seem to be common to several species, sometimes to all.

Record disappearance from the southern deserts of Israel

All species analysed excepting Stone Marten were recorded from the south of Israel (the Negev and Arava regions). The absolute number of the sightings from the south and the proportion that these sightings constitute of the total sightings for each species are different, but a common trend to all was that towards the end of the study period the number of sightings in desert areas in the south decreased. The proportion of the sightings from the southern deserts fluctuated in the first half of the study period, ranging from 0.74% to 1.76%, and later decreased to 0.24%; since 2000 there are no observations from the southern deserts. This trend is clear, although not quite statistically significant (N = 7, r = -0.709, t = -2.248, p = 0.074).

Two major factors that could have been responsible for this trend, increased numbers of synanthropic species and poaching by foreign labourers, were discussed above in detail under Marbled Polecat. They are likely to have had their strongest effect on small, localised and fragmented populations, such as those of the small carnivores in the southern deserts. Although artificial sampling biases might have also contributed to the periodic changes, especially the fluctuations in the early part of the study period, it is unlikely that artificial biases alone would produce zero observations over 17 years: the last recorded small carnivore sighting was from 1995. Therefore, it is strongly suggested here that populations of small carnivores in the southern deserts decreased significantly over the study period.

Changes in the proportion of individual species records

The total numbers of sightings for all species together and for most individual species over the study period varied, with no obvious trend (Table 1). However the proportion of total sightings per species (Fig. 3) did change: proportions of Stone Marten, Marbled Polecat and Ratel sightings among the total decreased significantly (Stone Marten, n = 7, r = -0.817, t = -3.169, P = 0.025; Marbled Polecat, n = 7, r = -0.871, t = -3.967, P = 0.011; Ratel, n = 7, r = -0.829, t = -3.316, P = 0.021) while Egyptian Mongoose increased (n = 7, r = 0.891, t = -4.379, P = 0.007). Eurasian Badger was the only species to show no significant trend in the proportion of sightings.

Over the study period, sampling effort and rate of reporting have changed. In recent years, for example, INPA field staff use palm-top computers enabling immediate reporting of sightings. This new technology has brought a major increase in the number of reports (335 small carnivore sightings in 2010 alone versus a highest total of 706 sightings in any previous 5-year period, that of 1985–1989). Surveys that are held periodically, focusing on either broad groups (e.g. carnivores, mammals) or regions, scientific studies, and changes in personnel may also affect numbers of reports. Therefore, the absolute number of sightings cannot indicate the abundance of individual species or small carnivores in general. Also, the relative difference among the numbers of sightings for the studied species in a given point of time cannot indicate the true relative difference among their numbers or abundance, since differences in natural biology or morphology make species vary in their detectability. For example, Egyptian Mongoose is the only diurnal species among the five studied and, therefore, more sightings of this species are expected, relative to its numbers, than of the four nocturnal species.

Nonetheless, I suggest that the observed change in relative encounter rates over time (above) does reflect true changes in the abundance of the species relative to each other. Although the artificial factors mentioned above and others mentioned earlier might bias the observations of a single species in a spe-

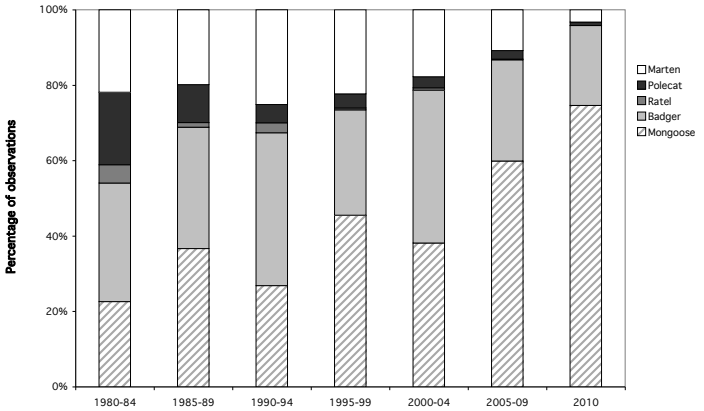

Fig. 3. The percentage of the total number of sightings in Israel contributed by each species of small carnivore, excluding Eurasian Otter *Lutra lutra*, to the INPA database in each 5-year period, and in 2010.

cific time period, I suggest that since these are either limited in time (e.g. a survey), not expected to change over time (e.g. natural biology or detectability) or not expected to show a consistent, gradual, directional trend (e.g. inclination to report an observation in a specific species, i.e., a report bias), they cannot be responsible for the statistically significant, long-term, gradual change in the relative number of sightings in the different species.

This suggested change in relative abundance in itself still does not make it possible to conclude whether the proportions of sightings of individual species changed because Egyptian Mongoose became more common and numbers of other species remained stable or because other species decreased but Mongoose populations remained stable. Nonetheless, coupling this observed change with other data, such as the decreasing distribution area of Marbled Polecat, decreased number of observations in the centre of Israel of Stone Marten, and sharp decrease in sightings of Ratel, suggests that the populations of these three species are declining, which, at least partly, may explain their lessening relative encounter rate. A second factor that may contribute to the observed change in relative encounter rate may be the gradual improvement in the condition of water bodies in Israel. The re-flooding of parts of the Hula Valley, developments to wetland protected areas, a Governmental programme to reconstruct riparian habitats, and tightening regulations on water pollution (e.g. Bar Or 2004, Ministry of Environmental Protection 2004, 2007, 2010) may have favoured Egyptian Mongoose, which shows the highest affinity for wetlands, and, hence, increased its relative abundance over other species. It is difficult to estimate how important these factors have been, if they work synergistically or separately or whether other factors, such as indiscriminate poisonings by farmers, have been responsible for the reported changes in relative numbers of sightings and, suggestively, in the relative abundance.

In sum, these statistically significant changes over the study period suggest quite strongly that Egyptian Mongoose has been becoming relatively more common than the rest of the small carnivore species in Israel.

Conclusions

More than 30 years of recording sightings of small carnivores in Israel show that, at least partly, anthropogenic factors influence small carnivore distribution and relative abundance. Furthermore, circumstantial connections can be suggested between specific factors and trends in the analysed data. Some factors seem to influence all species, while others may influence a single species, depending on its biology and habitat preferences. Increased abundance of synanthropic species and poaching by foreign labourers plausibly negatively affected all small carnivore species, and may be responsible for the lack of recorded sightings in the southern deserts during the last two decades. On the other hand, increased availability and quality of riparian and wetland habitats due to human activities may have benefited mainly Egyptian Mongoose and forest fires possibly had a direct negative, but ultimately positive, effect on Stone Marten. Since individual factors influence different species or have opposite affects on different species, a change in the relative number of sightings, which is suggested to represent relative abundance, is apparent. Ratel and Marbled Polecat seem to be decreasing in numbers and/or distribution and their regional conservation status may need to be re-assessed; Stone Marten and Eurasian Badger show relative stability; and Egyptian Mongoose is becoming more common, at least relative to all other species.

This study has used the information from only one database for which, moreover, there has been no way to assess the reliability of species identifications. Further analysis and study of absolute numbers of small carnivore species in Israel, analysing data from additional databases, specimen collections and other sources and investigation of factors with unknown differential effect such as poisoning, should be performed and would add much to the discussion presented here. The national conservation status of Ratel and Marbled Polecat is particularly in need of clarification.

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An orange-coloured Collared Mongoose *Herpestes semitorquatus* from Aceh, Sumatra, Indonesia

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Abstract

Two camera-trap photographs from central Aceh in July 2012 confirm Collared Mongoose *Herpestes semitorquatus* occurrence in the north of Sumatra, Indonesia, and comprise the first undoubted record of the species on Sumatra since 1917. They fit with the few previous Sumatran records in being of an orange-red animal, and with the three previous Sumatran records (one provisional) with accurate altitude information in being from the lowlands. More records from the island are necessary to determine Collared Mongoose's conservation status there.

Keywords: camera-trap, colour variant, extension of known range, lowland forest, rediscovery

Garangan Ekor Panjang *Herpestes semitorquatus* oranye berwarna merah dari Aceh, Sumatra, Indonesia

Abstrak

Dua foto hasil kamera-trap dari bagian tengah Aceh pada bulan Juli 2012 memberikan konfirmasi keberadaan spesies Garangan Ekor Panjang *Herpestes semitorquatus* di Sumatra, Indonesia sebagai catatan valid pertama sejak catatan terakhir pada tahun 1917. Catatan yang disertai foto ini sesuai dengan beberapa laporan sebelumnya mengenai keberadaan satwa berwarna merah-oranye ini. Bersama dengan tiga catatan sebelumnya (satu catatan sementara) memberikan informasi akurat keberadannya di dataran rendah. Data-data tambahan lain dari pulau Sumatera diperlukan untuk menentukan status konservasinya di pulau ini.

Introduction

Three species of mongoose *Herpestes* are known from the Indonesian island of Sumatra, but much remains to be clarified about the distribution, abundance and natural history of each species there: Short-tailed Mongoose *H. brachyurus*, Collared Mongoose *H. semitorquatus* and Small Asian Mongoose *H. javanicus*. This paper aims to clarify the status of *H. semitorquatus* on Sumatra.

The three species are usually readily distinguishable in the hand, but under field conditions (including many camera-trap photographs) records frequently have to be left as unidentified mongooses. This difficulty of field identification contributes directly to the poor understanding of each species's status on the island. *Herpestes brachyurus* and *H. semitorquatus* are larger than *H. javanicus*, with head-and-body lengths (HB) of up to 0.45 m. The two differ in the length of the tail which is less than 55% of HB in *H. brachyurus* and over 60% of HB in *H. semitorquatus*, by the pale neck-stripe invariably shown by *H. semitorquatus* but never by the other species, and by the warmer brown overall colour of *H. semitorquatus* compared with the blackish-brown coloration with orange speckling in *H. brachyurus* (Payne *et al*. 1985). *Herpestes javanicus* is a small mongoose of HB about 0.25–0.41 m, a tail of 60–80% of HB, and varying in colour but never showing a light stripe on the neck (Corbet & Hill 1992).

Of these three species on Sumatra, *H. brachyurus* has its status best documented, with van Strien (1996) and Jennings & Veron (2011) tracing records widely across the island. There seem to be only two historical locality records of *H. semitorquatus*. Two animals (including the holotype of *H. s. uniformis*) were collected from Ayer Taman in Ophir District in West Sumatra adjacent to Gunung Paseman on 4 May 1917 (Robinson & Kloss 1919). Jentink (1894) documented one specimen from Soekadana, South Sumatra, which he had originally assumed to be from Soekadana in west Borneo, but re-allocated to Sumatra because the collector was based there. It is indeed unlikely that a collector sending specimens from a place of the same name as his base but on another island would not have made this explicit at the time, supporting Jentink's (1894) alteration. There may be only one Sumatran record, and that provisional, of *H. semitorquatus* since 1917: one camera-trapped in the Harapan Rainforest, Jambi province, east Sumatra, in 2010 (Ross *et al*. 2012).

Herpestes javanicus is also known from few records on Sumatra. Sody (1949) described five specimens from northern Sumatra as the new subspecies *H. j. tjerapai*. Frechkopf (1931) provided a brief description of a small mongoose from Aceh, which conforms to *H. javanicus* in size, and as which he identified it. Jennings & Veron (2011) traced in total nine *H. javanicus* specimens from Sumatra and mapped four localities on the island, all in the northernmost fifth; they speculated that the species might not be native there. Sody (1949: 164) wrote that "probably the occurrence of this animal in Sumatra is restricted to Atjeh [Aceh], where, most certainly, it is not uncommon". Hagen (1890) reported *H. javanicus* to be very common in Aceh, specifically mentioning, however, that is was not known from Deli (Medan) or anywhere else south of Aceh. Its current status in Sumatra is highly unclear.

Anderson (1875) described a new species of mongoose, *H. rafflesii*, from Sumatra, which Corbet & Hill (1992), van

Strien (2001) and Wozencraft (2005) all ascribed to *H. javanicus*. However, Wells (1989: 90) wrote that "pelage colour differs from all other mongooses seen in this study [of, primarily, peninsular Malaysian mongooses] and skull condition is that of a young juvenile. However, long, coarse body hair and conspicuously down-curved rather than level dorsal profile of the cranium remove it from the *auropunctatus–javanicus* complex. Chasen (1940) probably correctly guessed it to be *H. semitorquatus*". In fact, Chasen's (1940: 140) view seems to have been more than a guess: "according to an old note of mine there is an old skin of an immature example of this form from Sumatra in the British Museum labelled as the type of '*H. rafflesi* (*sic*)', but I cannot make out that the name was ever published". Anderson (1875: 282) characterised the specimen as "uniformly rich ferruginous, paler on the head and feet. The hairs with no trace of annulation, and in this respect differing from all other Asiatic mungooses [*sic*] . . . it is a small animal . . . a little larger than a ferret [*Mustela furo*], and has a tail as long as its body". All these characters, save overall size (which might be smaller than fully grown, reflecting its immaturity) fit *H. semitorquatus*. Notably, Robinson & Kloss (1919) diagnosed the new race of *H. semitorquatus* that they named from Sumatra, *H. s. uniformis*, because it "differs from the typical form from Borneo in having the whole upper surface uniform with no trace of speckling caused by annulation of the hairs, except on the crown". Thus, it seems distinctly possible that the unique type of *H. rafflesii* represents another Sumatran specimen of *H. semitorquatus*, although without having examined the specimen, which is apparently in the Natural History Museum, U.K. (BMNH 1855.12.24.225; Wells 1989), directly, it is not possible to say.

Recent camera-trap records from the islands of Borneo and Sumatra show mongooses exhibiting variably rich reddish-orange pelage; the extremes are startlingly different from the warm-brown colour of *H. semitorquatus* generally found on Borneo (Ross *et al*. 2012). These animals differ from *H. brachyurus* and resemble *H. semitorquatus* in both pelage pattern (pale neck-stripe) and structure (specifically, tail length proportionate to HB). In Sabah, northern Borneo, this morph is rare, comprising only about 5% of *H. semitorquatus* records (Ross *et al*. 2012). Ross *et al*. (2012) presented only one camera-trap record of an orange-coloured mongoose from Sumatra, from Harapan Rainforest. This animal was also probably *H. semitorquatus*, based on structure and pelage colour, but viewing angle prevented determination of whether it had a pale neck-stripe. This individual, and the three historical Sumatran specimens of *H. semitorquatus* described above and confirmed to be this species, are all orange-red in colour (Ross *et al*. 2012). Perhaps the only historical source to discuss orange coloration in Sundaic mongooses, Schwarz (1947), is difficult to interpret because he considered *H. semitorquatus* conspecific with *H. brachyurus*. He seems to have seen no *H. semitorquatus* specimens from Sumatra, and in speaking of "the great rarity of the red mutant", mentioned explicitly only one "red phase" animal (from the Sungai [= River] Kapuas, in West Kalimantan, Borneo; National Museum of Natural History specimen 142340; p. 80). This is presumably similar in tone to the bright orange animals discussed by Ross *et al*. (2012), although when this specimen was originally adverted, Lyon (1907) made no reference to its overall colour.

Record

During a brief training workshop for local rangers in protected forest near Jantho Wildlife Reserve, central Aceh, three camera-traps were set for a five-day period, 3–7 July 2012, along a small river in primary forest at about 280 m altitude (as recorded by a GPS Garmin 60Csx receiver), at 5°19'38.4"N, 95°35'26.0"E (datum of WGS84; Fig. 1). Single images that show an orange-coloured mongoose were made at each of 16h11 on 5 July and 17h45 on 7 July (Fig. 2). It is unknown whether the same individual appears in both pictures. They clearly show the chief feature diagnostic of *H. semitorquatus* among mongooses of the Greater Sundas, the pale neck-stripe. Moreover, the tail looks too long for *H. brachyurus* (although its tip is not visible in the picture) and neither *H. brachyurus* nor *H. javanicus* is known to occur, anywhere in its range, in this bright orange pelage. Indeed, Sody (1949: 164) specifically noted that in *H. j. tjerapai* of Aceh "there is no trace of red or brown in the fur"; we do not know whether this is representative for all Sumatran specimens of the species.

The local rangers who took part in this camera-trapping workshop were unfamiliar with this animal, identifying it as a 'musang' (civet) and not 'bambun' (mongoose). There is, however, often confusion between the various long-bodied small carnivores in Sumatra, and 'musang' is a common generic term.

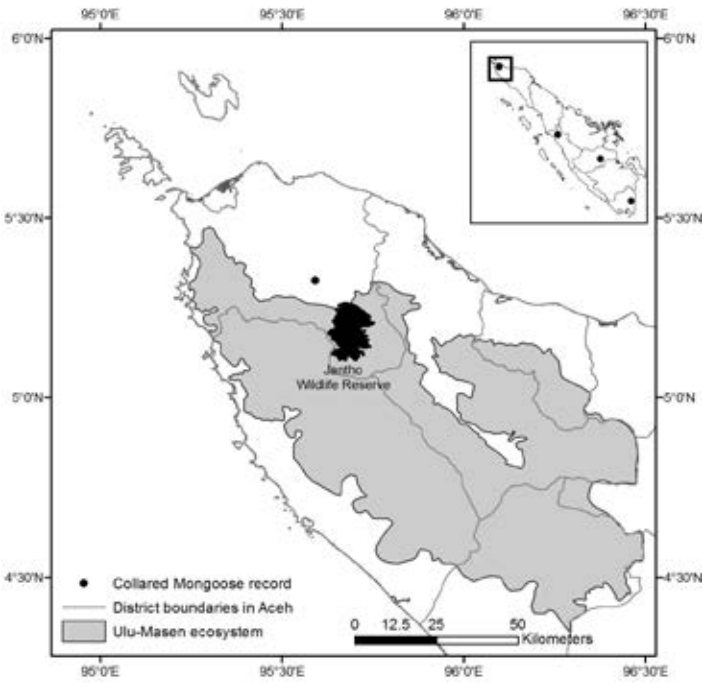

Fig. 1. Location of Jantho Wildlife Reserve, Aceh province, and the four records of Collared Mongoose *Herpestes semitorquatus* (one provisionally identified) from Sumatra, Indonesia.

Fig. 2. The two images of the orange-coloured Collared Mongoose *Herpestes semitorquatus* from near the Jantho Wildlife Reserve, central Aceh province, Sumatra, Indonesia, in July 2012.

Discussion

The biological significance of the rarity of *H. semitorquatus* records from Sumatra is difficult to assess, given the limited recent publication of survey information using methods likely to generate records (i.e., records other than those traced here may exist), and the caution required in identifying field records of mongooses in Sumatra to species. Extensive camera-trapping in Kerinci Seblat National Park, in west Sumatra's Barisan Mountains and not far (about 400 km) from the two specimens reported by Robinson & Kloss (1919), recorded no mongooses at all (Holden 2006). Given that in Kerinci Seblat NP camera-traps were sometimes positioned to capture small carnivores (and recorded them many times), and that similar camera-trapping programmes in Cambodia regularly capture Crab-eating Mongoose *H. urva* (Holden & Neang 2009), a fairly similar-sized species, it seems likely that *H. semitorquatus* is either rare in or absent from the surveyed parts of Kerinci Seblat NP. The fauna of Sumatra remains remarkably poorly known, and *H. semitorquatus* is just one of a number of species for which its basic conservation status on the island remains highly unclear (e.g., among species endemic to the island, Sumatran Mountain Muntjac *Muntiacus montanus*, Hoogerwerf's Pheasant *Lophura* (*inornata*) *hoogerwerfi*, Sumatran Ground Cuckoo *Carpococcyx viridis*, Schneider's Pitta *Pitta schneideri*, Rück's Blue Flycatcher *Cyornis ruckii*, Sumatran Cochoa *Cochoa beccarii* and Black-and-white Laughingthrush *Garrulax bicolor*; Hurrell 1989, BirdLife International 2001, Zetra *et al*. 2002, Sözer *et al*. 2006, Brickle 2007, Shepherd 2007, Timmins *et al*. 2008), even to the extent of uncertainty whether some quite distinctive species occur on the island at all (e.g.: Great Slaty Woodpecker *Mulleripicus pulverulentus* and Fishing Cat *Prionailurus viverrinus*; Duckworth *et al*. 2009, Lammertink *et al*. 2009).

All Sumatran *H. semitorquatus* records with altitude information are from the lowlands: the two specimens of Robinson & Kloss (1919) were from 300 m altitude, the Harapan photograph from 70 m and the Jantho WR records at 280 m. Higher elevations characterise Kerinci Seblat NP, and might explain the lack of photographs of *H. semitorquatus* from there. Too little of the camera-trapping reported in Holden (2006) took place below 300 m to comment on the species's status in the lowlands. By contrast, both *H. semitorquatus* and *H. brachyurus* in Borneo live up to well over 1,000 m (Payne *et al*. 1985), with specific locality records of *H. semitorquatus* from Bario, Sarawak, at 3,700 feet (about 1,200 m; Davis 1958), and from Gunung (= Mt) Dulit at 4,000 feet (about 1,350 m; Hose 1893). Whether there is a real difference in altitudinal use between Sumatra and Borneo, or whether the few Sumatran records all by chance are in the lowlands, is not yet clear.

As well as being apparently the first certain record of *H. semitorquatus* on Sumatra since 1917, the present Jantho record, roughly 1,000 km from the Harapan Rainforest, is a considerable extension of the known range based on the *H. semitorquatus* records here assembled. Together with the three previous localities (taking the Harapan record as valid), it suggests that the species occurs at least locally throughout the island.

So far, all five *H. semitorquatus* specimens and photo-records from Sumatra are orange individuals (see above), suggesting a prevalence of this form very different from that in Sabah. However, with so few records of the species from Sumatra to date, further records are needed to confirm the ratio of orange to brown animals on the island (if the latter indeed occur at all).

Further records of *H. semitorquatus* with precise altitude from Sumatra will increase understanding of its altitudinal distribution there: if it is restricted to lowland forest, it may be highly threatened on the island, because these altitudes are being particularly rapidly deforested (Jepson *et al*. 2001, Gaveau *et al*. 2009, 2012). It would also be useful to determine conclusively the identity of *H. rafflesii*, and in the process reassess various other museum specimens of *Herpestes* from Sumatra to check that they have been assigned to the correct species.

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Has Colombian Weasel *Mustela felipei* been overlooked in collections?

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Abstract

Colombian Weasel *Mustela felipei* is one of the least recorded carnivores of South America, and it is known from only six confirmed records. We addressed recent suggestions that it might be more widely represented in collections than is currently recognised, reflecting its similarity in appearance to Long-tailed Weasel *M. frenata*, by surveying specimens of *Mustela* weasels from South America in 26 mammal collections. We found no new Colombian Weasel specimens. Colombian Weasel specimens come from four localities in Colombia and one in Ecuador; reports from other localities lack objective verification, and we consider that such reports should not be used to define the species's known distribution range.

Keywords: Long-tailed Weasel, mammal collections, *Mustela frenata*, specimen review, survey

¿Ha sido la Comadreja colombiana *Mustela felipei* pasada por alto en colecciones?

Resumen

La Comadreja colombiana *Mustela felipei* es uno de los carnívoros menos registrados en Suramérica y sólo es conocida de seis registros corroborados. Recientemente se ha sugerido que la especie podría estar mejor representada en colecciones que lo que actualmente se reconoce, por ende intentamos resolver esta inquietud. Una revisión de ejemplares de la Comadreja de Cola larga *M. frenata* provenientes de Colombia, Ecuador y Perú ha sido recomendada con el objetivo de encontrar posibles ejemplares de la Comadreja colombiana erróneamente determinados. En el presente trabajo realizamos una evaluación de ejemplares de *Mustela* de Suramérica en 26 colecciones de mamíferos. Encontramos que ejemplares de la Comadreja colombiana provienen de cuatro localidades en Colombia y una en Ecuador y los reportes de otras localidades carecen de pruebas objetivas. No encontramos ejemplares adicionales de la Comadreja colombiana y consideramos que los registros que no pueden ser verificados objetivamente, así como sus localidades, no deberían incluirse para la definición del ámbito de distribución de la especie.

Palabras clave: colecciones de mamíferos, Comadreja de Cola larga, determinaciones erradas, evaluación de especímenes, *Mustela frenata*

Introduction

Colombian Weasel *Mustela felipei* is perhaps the rarest carnivore of South America (Schreiber *et al*. 1989), judging by its low representation in specimen collections. The potential distribution and conservation status of Colombian Weasel was considered by Burneo *et al*. (2009), Ramírez-Chaves & Mantilla-Meluk (2009) and Tirira & González-Maya (2009), and its intraspecific variation by Ramírez-Chaves & Mantilla-Meluk (2009). It has a restricted known distribution in the Andes of Colombia and Ecuador, between 1,525 and 2,700 m a.s.l., with records from only six confirmed specimens from five localities (Ramírez-Chaves & Mantilla-Meluk 2009).

Tirira & González-Maya (2009) and González-Maya *et al*. (2011) suggested that Colombian Weasel is potentially more widely represented in collections than is currently recognised, and recommended a check of Colombian, Ecuadorean and Peruvian specimens of the similar-looking Long-tailed Weasel *M. frenata* in case any were misidentified Colombian Weasels. Published statements about Colombian Weasel habitat and ecology (e.g. Burneo *et al*. 2009) contain many contradictions, because most of them are speculations not based on reliable data. Two previous published records of Colombian Weasel were found to be misidentifications of Long-tailed Weasel (Ramírez-Chaves & Mantilla-Meluk 2009). Therefore, we reviewed identification of *Mustela* specimens from South America, including the third congener in the region, Amazon Weasel *M. africana*, in many natural history museums and collections. The aims were to clarify the number of Colombian Weasel specimens in collections, and to attempt to document more information on this poorly known carnivore's distribution.

Methods

Mustela specimens from South America in 26 collections were reviewed directly and through digital pictures. Direct examination took place in 14 collections: *Colombia*: Colección Teriológica Universidad de Antioquia (CTUA), Medellín; Museo Colegio San José (CSJ), Medellín; Colección Zoológica Universidad de Nariño (PSO-CZ), Pasto; Instituto Alexander von Humboldt (IAvH), Villa de Leyva; Instituto de Ciencias Naturales, Universidad Nacional de Colombia (ICN), Bogotá; Museo de Historia Natural-Universidad del Cauca (MHNUC), Popayán; Museo Universidad Distrital Francisco José de Caldas (MUD), Bogotá; Universidad del Valle (UV), Cali. *Ecuador*: Museo Escuela Politécnica Nacional (MEPN), Quito. *Germany*: Zoologische Staatssammlung München (ZSM), Munich. *U.K.*: Natural History Museum (BMNH), London. *U.S.A.*: Museum of Comparative Zoology, Harvard University (MCZ),

Boston. *Peru*: Museo Universidad San Marcos (MUSM), Lima. *Venezuela*: Colección de Vertebrados, Universidad de los Andes (CVULA), Mérida. At the American Museum of Natural History (AMNH), New York, U.S.A, only one specimen was examined, that which was already identified as Colombian Weasel.

Additionally, we searched for records of *Mustela* from South America in the MaNIS (2011) and GBIF (2011) portals. We checked if the specimens had been published before and evaluated the morphological description given in the publications; if we found no evidence that the specimens had been published previously, we viewed pictures (when possible) to identify them to species. External and cranial morphology differs sufficiently between Amazon, Colombian and Long-tailed Weasels for digital pictures to allow firm identification. Specimens reviewed using pictures are housed in 11 collections: Museo de Historia Natural, Universidad de Caldas (MHNUCa) in *Colombia*; United States National Museum in the Smithsonian Institution (USNM), Los Angeles County Museum (LACM), Lousiana State University Museum of Natural Science (LSUMZ), Museum of Vertebrate Zoology at Berkeley (MVZ), Slater Museum of Natural History at the University of Puget Sound (PSM), Santa Barbara Museum of Natural History (SBMNH) and Donald R. Dickey Bird and Mammal Collection at the University of California, Los Angeles (UCLA) in *U.S.A.*; Estación Biológica Doñana (EBD) in *Spain*; Uppsala Universitets Zoologiska Museum (EM), Göteborgs Naturhistoriska Museum (GNM) and Naturhistoriska Riksmuseet (NRM) in *Sweden*.

Identifications were based on diagnostic characters available in the description of Colombian Weasel (Izor & de la Torre 1978) and direct comparisons with Long-tailed and Amazon Weasels.

Results

Collections survey

We reviewed 198 specimens of the genus *Mustela* from Brazil, Colombia, Ecuador, Peru and Venezuela housed in 26 collections, 169 directly and 29 by digital pictures. Of these, 187 were Long-tailed Weasels, six were Amazon Weasels and four were Colombian Weasels. All four Colombian Weasel specimens (three in Colombian collections and one in AMNH) were reported previously as this species (Schreiber *et al.* 1989, Alberico 1994, Ramírez-Chaves & Mantilla-Meluk 2009). MEPN, Ecuador, has been suggested to hold at least one Colombian Weasel specimen (without accession number: Albuja & Rageot 2005, Burneo *et al*. 2009), but only specimens of Amazon and Long-tailed Weasels were found at this collection. Based on the morphological and morphometric characteristics given by Albuja & Rageot (2005), the specimen reported as Colombian Weasel is a misidentification of a Long-tailed Weasel (Ramírez-Chaves & Mantilla-Meluk 2009). The records of Amazon Weasel reviewed from Brazil (MCZ 30802), Ecuador (MCZ 36324) and Peru (USNM 255119) were also reported previously (Hall 1951, Izor & de la Torre 1979, Izor & Peterson 1985). Of the three species, Long-tailed Weasel was the most represented in the collections with 187 South American records from Bolivia, Colombia, Ecuador, Peru and Venezuela. No specimens of Colombian Weasel misidentified as other species were found.

Data portals

We found a total of 189 South American *Mustela* specimens in MaNIS (2011) and 355 records (254 specimens, 101 records based solely on observations) in GBIF (2011). Only 26 of the specimens reviewed directly by us appear to be registered in these databases.

Mustela felipei – In MaNIS (2011), three specimens are identified as Colombian Weasel (two from Colombia and one from Ecuador). In GBIF (2011), we found 31 records (all from Colombia) but only four have voucher specimens. The other 27 records (from the Department of Antioquia, Colombia) are based on Restrepo Llano *et al.* (2010) and constitute uncorroborated observations in unpublished technical reports. The validity of these records cannot be assessed, because no evidence for identification is provided. The three specimens found in both MaNIS (2011) and GBIF (2011) are well known (Field Museum [FMNH], Chicago, U.S.A: FMNH 70999 Holotype, FMNH 86745 Paratype (Izor & de la Torre 1978); and AMNH 63839). The additional specimen in GBIF (2011), IAvH 7434, is also well known (Ramírez-Chaves & Mantilla-Meluk 2009). A specimen from Colombia (Department of Cauca, Munchique; NRM 580210) appears in GBIF (2011) identified as Colombian Weasel, but the pictures clearly show it to be a Long-tailed Weasel, as previously identified in Hall (1951).

Mustela africana – Seven specimens identified as Amazon Weasel in MaNIS (2011) are from Brazil (three), Ecuador (one) and Peru (three); the same specimens were found in GBIF (2011), plus two without locality. Although few Amazon Weasel specimens are in the databases, approximately 30 specimens were known to Schreiber *et al*. (1989). Of the seven specimens with locality data in MaNIS (2011) and GBIF (2011), we reviewed three. All seven were reviewed and corroborated previously by other authors: FMNH 106488 from Amazonas, Río Juruá, Cruzeiro do Sul, Brazil; MCZ 30802 from Río Tocantins, Cameta, Brazil; MCZ 36324 from Oriente, río Tatún Yacu, Ecuador; and AMNH 61813 from Junín, Chanchamayo, Valle del Perene, 1,200 m, Peru, were all reviewed by Izor & de la Torre (1978); USNM 255119 from Chanchamayo, Peru, and AMNH 98552 from Loreto, Peru, were reviewed by Izor & Peterson (1985); and AMNH 37475 from Pará, Brazil, was reviewed by Allen (1916a). Of the two specimens without locality in GBIF (2011), one (EBD 28055, skull only, without data), lacks the cranial characteristics of Amazon Weasel, but it is impossible to know if it is Long-tailed Weasel or a weasel from outside the Americas. The second one (NRM 584892) was not reviewed by us and its identification needs to be corroborated.

Mustela frenata – In MaNIS (2011), 174 specimens appear identified as Long-tailed Weasel (Bolivia 6, Colombia 57, Ecuador 33, Peru 31 and Venezuela 47). GBIF (2011) gave a total of 238 specimens, from Bolivia (6), Colombia (93), Ecuador (55), Peru (34) and Venezuela (50). Sixty-eight of these specimens still need corroboration: four from Bolivia, 29 from Colombia, 13 from Ecuador, nine from Peru and 13 from Venezuela. The rest were previously reviewed by Lönnberg (1913), Hollister (1914), Allen (1916a, 1916b), Hall (1935, 1938, 1951), Izor & de la Torre (1978), Anderson (1997), Voss (2003) and Ramírez-Chaves & Mantilla-Meluk (2009), and sufficient detail of their morphology including morphometrics is included in those sources to be confident that none shows the diagnostic characteristics of Colombian Weasel.

Discussion

Morphology

Externally and cranially Colombian Weasel differs sufficiently from Long-tailed Weasel for confusion over specimen identification to be unlikely (see Izor & de la Torre 1978, Ramírez-Chaves & Mantilla-Meluk 2009), despite the suggestion of Tirira & González-Maya (2009) that both species look similar. Colombian Weasel has inflated auditory bullae posteromedially and its mesopterygoid fossa is wide; both characters differentiate it from Long-tailed and Amazon Weasels (Izor & de la Torre 1978). Externally the soles of the feet of Colombian Weasel lack fur, in contrast to those of Long-tailed and Amazon Weasels (Izor & de la Torre 1978, Ramírez-Chaves & Mantilla-Meluk 2009). Two other external characters differentiate Colombian Weasel from Long-tailed Weasel: its ventral oval mark concolorous with the dorsum, and its short tail without a terminal black tip. Long-tailed Weasel has a black tail-tip; both Amazon and Colombian Weasels lack this. Amazon Weasel is larger than Colombian Weasel and its dark ventral stripe extends until close to the neck (Izor & de la Torre 1978). These are not features, however, that allow ready separation on field views, and reports not based on specimens may be at high risk of misidentification.

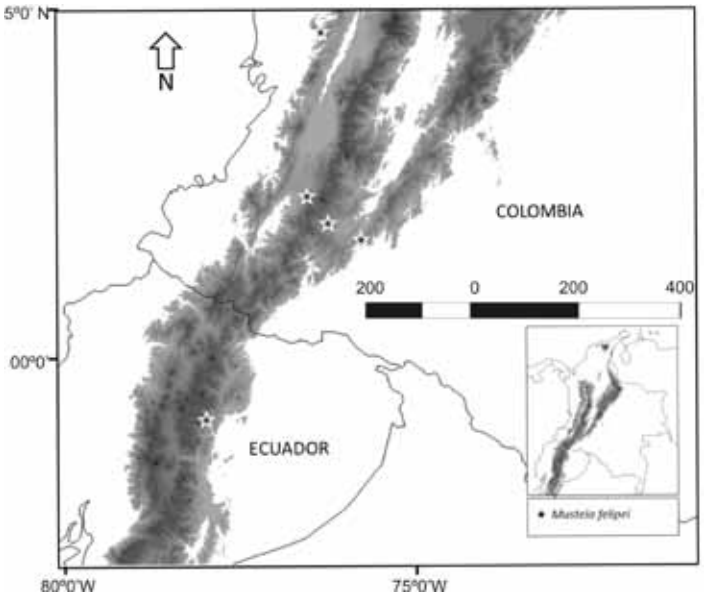

Fig. 1. Verified records of Colombian Weasel *Mustela felipei* across its world distribution. The species is only known from five localities. Elevations along the Andes that range between 1,000 and 3,000 m a.s.l. are shaded light grey and those higher than 3,000 m a.s.l. are dark grey.

Misidentified specimens

We found no Colombian Weasels misidentified as Long-tailed or Amazon Weasels. This does not support the idea that Colombian Weasel is potentially more numerous in collections than is currently recognised. Review of collections was intensive enough to indicate that the possibility of finding a new specimen in existing mammal collections is low, especially from Colombia where of 90 specimens of *Mustela* reviewed, only three belong to Colombian Weasel. Future research priorities should focus on field work, as already urged by Tirira & González-Maya (2009).

Although 68 specimens identified as Long-tailed Weasels in the data portals were not corroborated, their misidentification seems very unlikely, at least in the U.S.A. (52 of these 68 specimens are deposited in the AMNH, FMNH and USNM), where carnivore curatorial work is well developed (e.g., Izor & de la Torre 1978). A total of 191 *Mustela* specimens from South America in several museums of Europe and the U.S.A. were identified as Amazon Weasel (nine specimens) and Long-tailed Weasel (182) by Hall (1951: 401) who noted a probably "unnamed race" of Long-tailed Weasel that is "dark colored and has the color of the underparts so much restricted as to suggest that it belongs to the race *aureoventris*", collected in Baeza, Ecuador. The specimen in question (AMNH 63839) has already been found to be a Colombian Weasel (Schreiber *et al*. 1989, Ramírez-Chaves & Mantilla-Meluk 2009). Given that Hall (1951) noticed this specimen, and mentioned no more of similar description, it seems highly unlikely that presently misidentified Colombian Weasel specimens lie among those that Hall (1951) reviewed.

Locality records of Colombian Weasel

Only five localities are confirmed for Colombian Weasel (Fig. 1), four in Colombia and one in Ecuador (Ramírez-Chaves & Mantilla-Meluk 2009). Other recent sources have given different numbers. Emmons & Helgen (2008) stated that Colombian Weasel was known from ten localities, but listed only three and did not consider the record from Alto de Galapagos (Alberico 1994; on the limits between the Departments of Valle del Cauca and Chocó in the Cordillera Occidental of Colombia) in their map of the species's distribution.

Burneo *et al.* (2009) listed Colombian Weasel as unconfirmed at five localities in Colombia. They stated that presence at Cueva de los Guacharos (Department of Huila, Colombia) was not validated by a specimen, but this locality is confirmed by specimen IAvH 7434 (Schreiber *et al*. 1989, Ramírez-Chaves & Mantilla-Meluk 2009). The other four such localities, Chivatá-Boyacá, Santa Rosa de Cabal-Risaralda, Almaguer and Munchique-Cauca, do indeed seem to lack any voucher specimen or other objective evidence. Munchique was based on Casas (2007), yet the original source itself stressed that the presence of the named mammals must be verified because the information was not based on field work. Chivatá-Boyacá came from Bernal (2004), a source containing many obvious mistakes, and for which all species were apparently identified through field observation, yet it includes various rodent and bat species that cannot be identified with certainty under such conditions. These two seem particularly likely to be in error. Two localities from Ecuador in Burneo *et al.* (2009), Valle de Tumbaco and Mera, are based on misidentifications of Long-tailed Weasel. The confusion over the purported MEPN specimen from Valle de Tumbaco is discussed above, and presence in Mera is based on Rageot & Albuja (1994) where, however, the only species of *Mustela* included is *M. frenata*; *M. felipei* is not mentioned.

Burneo *et al*. (2009) and Tirira & González-Maya (2009) cited Schreiber *et al*. (1989) as the source of the *M. felipei* record from Valle de Tumbaco, Ecuador, with a specimen in MEPN; but Schreiber *et al*. (1989) referred to specimen AMNH 63839 from Napo, Baeza, and the specimen in MEPN was mentioned in Albuja & Rageot (2005). Additionally, Tirira & González-Maya (2009) omitted the above-mentioned record from Cueva de Los Guacharos. As was discussed above, there

seem to be no specimens of Colombian Weasel at MEPN. This means that the only confirmed record from Ecuador is AMNH 63839 (Ramírez-Chaves & Mantilla-Meluk 2009).

The overall reliability of an occurrence dataset is associated with the reliability of each record. The use of "observations that lack conclusive physical evidence . . . to establish the presence or geographic range of rare species is inherently unreliable and can lead to errors with substantial negative impacts on conservation decision making and resulting conservation efforts" (McKelvey *et al*. 2008: 549). For this reason, records of *M. felipei* that lack evidence to allow their objective review should not be accepted unless evidence of their validity can be found. Given the great paucity of records of this weasel, such evidence when not given should be actively sought because, for various reasons, it may exist but be omitted from survey reports. However, some records highly likely to be in error have already been used to define and model the distribution of Colombian Weasel in some sources (see above), which may well have led to misleading conclusions.

In conclusion, marked diagnostic cranial and external characteristics of Colombian Weasel specimens preclude confusion of specimens with the other South America *Mustela* species. Consistent with this, the present review finds no evidence that Colombian Weasel is underreported through misidentification of specimens in mammal collections. Field records of Colombian Weasel should be accepted only where identification is objectively verifiable by reliable evidence such as photographs or videos showing diagnostic characters, diagnostic DNA evidence, or live or dead specimens (see McKelvey *et al*. 2008).

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Appendix 1. Specimens of South American weasels *Mustela* reviewed.

Acronyms are expanded in the text. *Photographs reviewed.

***Mustela africana* : BRAZIL:** MCZ 30802, Rio Tocantins, Cameta. BMNH 26.1.8.10, Pará, Monotucú, Capinsal. BMNH 5.1.25.1, Pará, Dominha. **ECUADOR:** MCZ 36324, Oriente, Rio Tatu Yacu. **PERU:** BMNH 24.12.12.24, Moyobamba. USNM 255119*, Chanchamayo.

***Mustela felipei* : COLOMBIA:** IAvH 7434, Huila, Palestina, P.N.N. Cueva de Los Guacharos, valle del río Suaza. UV 7483. Límite departamentos Valle del Cauca y Chocó; Alto de Galápagos, cordillera Occidental. ICN 19131, no specific locality. **ECUADOR:** AMNH 63839, Napo, Baeza, arriba.

***Mustela frenata* : COLOMBIA:** ANTIOQUIA: ICN 8754, Venecia, Finca El Esiderio. CTUA collector number DMC 85, Municipio de Guarne, Vereda Piedras Blancas. BMNH 76.8.8.10, Medellín. BMNH 76.8.8.11, Medellín. CSJ 238, 384, 397, 419 Medellín, Santa Elena. BMNH 21.7.1.8, Jericó, near to Cauca River. BMNH 98.10.3.3, Valdívia. BOYACÁ: IAvH 7214, Venta Quemada, sitio Alto de Venta Quemada. ICN 267, 1929, Soatá. CALDAS: MHNUCa 247*, Municipio Neira, vereda Caldas. MHNUCa 418*, Manizales, morro Sancancio. MHNUCa 1105*, Villamaría, Parque Nacional Natural Los Nevados, Santa Isabel. ICN 15164, Manizales, Sitio La Elvira, Reserva Río Blanco. ICN 15165, Manizales, Sitio Bocatoma Olivares, reserva Río Blanco. ICN 16733, Manizales, río Blanco. CAUCA: NRM 580210*, Munchique, El Tambo. LACM 056413*, Las Guacas. MHNUC 57E, Popayán, Cajete. MHNUC 58E, Popayán. MHNUC 84, Popayán. MHNUC 86, Popayán. ICN 9926, El Tambo. ICN 9927, El Tambo, Munchique. ICN 9928, El Tambo. BMNH without number, 20 miles NE of Quilichao. CHOCÓ: UV 10127, San José del Palmar. CUNDINAMARCA: MVZ 104950*, Department boundary, NE Villa-Pinzón. MVZ 114428*, Cañon de Las Catedras, 4 km SW Mosquera. IAvH 1231, Bogotá, Parque La Florida. ICN 1925, Bogotá, Ciudad Universitaria. ICN 3507, Bogotá, Sabana de Bogotá. ICN 8734, Bogotá, barrio Meisen. ICN 3824, Carretera entre Fontibon y el aeropuerto El Dorado. ICN 3825, cerca de Zipaquirá. ICN 1053, Cajicá. ICN 266, Funza. ICN 11017, Junín, Reserva Biológica Carpanta. ICN 12890, La Vega, Vereda Sabaneta, finca La Rosita, al pie de la escuela. ICN 12992, La Vega, Vereda Rosario, finca Llano de Primavera, cerca a río Tabacal. ICN 803, Sopó, río Teusaca. ICN 13681, Subachoque, Vereda La Cuesta, finca El Roble. ICN 4435, Tenjo. MCZ 27561, Fusagasugá. MCZ 27194, Fusagasugá. MCZ 27195, Guasca. MCZ 19859, Laguna del Verjon. MCZ 27560, Choachí. MCZ 20103, Choachí. BMNH 98.11.7.6, Castillo, Bogotá. BMNH 95.8.1.13, Zambrias, N. Bogotá. BMNH 54.1.11.3, Bogotá. BMNH 98.11.7.5. HUILA: IAvH 1591, Acevedo, P.N.N. Cueva de Los Guacharos. IAvH 5748, Pitalito, vereda Palestina. MAGDALENA: IAvH 1650, IAvH 1777, IAvH 1826, Sierra Nevada de Santa Marta, cerro de San Lorenzo. NARIÑO: PSO-CZ RNLP 389, Reserva La Planada, Finca Santa Rosa. PSO-CZ RNLP 376, Reserva La Planada. PSO-CZ RNLP 382, Reserva La Planada. NORTE DE SANTANDER: ICN 10985, Arboledas, vereda Cinera, finca La Palmita. RISARALDA: IAvH 5749, P.N.N. Ucumarí, entre El Cedral y El Ceilán. TOLIMA: CTUA collector number DMC 227, Cajamarca. VALLE DEL CAUCA: UV 11480, Vereda La Olga, Yumbo, 1,850 m. UV 4898, 4899 Rio Raposo, Buenaventura. UV 9920, Pichindé, Cali. UV 7126, 7127, 7130, 7131, 7132, Candelaria. UV 10179, Obando. UV 6801, Buga. UV 7128, El Carmelo, Candelaria. UV 7129, El Carmelo, Candelaria. UV 2325, 4114, Campus Uni, Melendez, Cali. UV 4321, Laguna de Sonso, Municipio Guacarí. UV 11964, Vereda La Lloreda, Corregimiento Galicia, Municipio Buenaventura. UV 12188, CIAT, Palmira. UV 13816, KM 10, Carretera Buga - Buenaventura. IAvH 913, Ex-colección del departamento de Biología. IAvH 914, Jamundí. IAvH 746, Carretera Silvania, El Soche. COLOMBIA: BMNH 45.9.18.14. CSJ 043, 044. **ECUADOR:** USNM 548396*, Pastaza, Mera, cerca al río Pastaza. SBMNH 8949*, Pichincha, Guapalo Valley; Cumbaya Stream, near San Pedro River. PSM 14337*, Oriente. MCZ 52664, Pallatanga. MCZ 52700, Occidente, Calacali. MCZ 52730, Cotopaxi, Latacunga. MCZ 38689, MCZ 38690, Tunguraqua Province, Lamos (Baños). BMNH 97.11.7.29, Ibarra. BMNH 99.2.18.10, BMNH 99.2.18.11, BMNH 99.2.18.12, BMNH 99.2.18.8, BMNH 99.2.18.9, Quito. BMNH 34.9.10.89, BMNH 34.9.10.91, San Antonio, 15 miles W. of Quito. BMNH 14.4.25.13, BMNH 14.4.25.14, 3°04'S, 78°50'W. BMNH 54.640 Cerro de Tuga. BMNH 99.99.7, Cañas. BMNH 97.11.7.30. BMNH 14.4.25.15. GNM-Ma.ex. 1645* and skull: GNM-Coll.an. 17834, Guapulo, near River Machangara, 8,500 feet. GNM-Ma.ex. 1646* and skull: GNM-Coll.an. 17835, Guapulo, near River Machangara, 8,500 feet. GNM-Ma.ex. 1647* and skull: GNM-Coll.an. 17836, Pichincha, above Quito, 10,000 feet. GNM-Ma.ex. 1648* (skull missing), "Carapungo", 6.5 miles N of Quito, 8,400 feet. GNM-Ma.ex. 1649* and skull: GNM-Coll.an. 17838, Santo Domingo de los Colorados, 1,625 feet. GNM-Ma.ex. 1650* (no skull), near Mindo, W. side Pichincha, 5,000 feet. **PERU:** LSUMZ 18449*, Farmland above Acomayo. LSUMZ 26888*: 'Batan' on Zapalache-Carmen trail. LSUMZ 28013*, LSUMZ 28014*, Unchog, pass between Churrubamba and Hda. Paty, NNW Acomayo. LSUMZ 28029*, Base of Bosque Zapatagocha above (NE) Acomayo. MVZ 114773*, MVZ 139614*, MVZ 139615*, Depto. Puno, Hacienda Calacala, 7 mi SW Putina. EM 46256*, Organero, East Andes. MCZ 41057 Manayioc (Maraynioc), 45 miles northeast of Tarma. MCZ 17040, MCZ 17041, Huancabamba. MCZ 13257, Guadichiri. MUSM 4332, Cajamarca, Jaen. MUSM 2121, Huanuco. MUSM 2120, Puno, Ollachea. MUSM 2119, Huánuco, Acomayo. MUSM 2117, Puno, Chacayani. MUSM 12991, Junin, Cordillera. MUSM 12990, Cusco, Cordillera de Vilcabamba. MUSM 7209, San Martín. MUSM 8746, Cusco, Paucartambo. MUSM 21705, Portachuel, Piura. MUSM 1611, Lima. BMNH 8.1.10.1, Lima. BMNH 26.5.3.8, Celendin. BMNH 22.1.1.18, Ollantaytambo. BMNH 26.5.3.9, Condechaca. BMNH 98.11.6.7, Cuzco, Ocobamba. BMNH 26.2.12, Yanamayo. MUSM 2239. MUSM 2123. MUSM 2122. MUSM 5087. **VENEZUELA:** EBD_CSIC 11301*, Caracas, Los Teques, Miranda. UCLA 19334*, Mérida, Montes del Valle. CVULA 1212, Trujillo, Boconó. CVULA 878, Distrito Federal, El Junquito. BMNH 98.7.1.9, Milla. BMNH 14.7.27.2, Cerro del Aguila. CVULA 188, Mérida, Alrededores de Mérida. CVULA 831 Mérida, Monte Zerpa 6 Km N Mérida. CVULA 832, Mérida, El Salado 5 Km N de Ejido. CVULA 833, Mérida, EL Joque, 3 Km NE de Jají. CVULA 998, Mérida, El Mostrenco, 4 Km S de Santo Domingo. CVULA 1019, Mérida, 4 Km N Chachopo. CVULA 1213, Mérida, Urbanizacion La Mata (La Parroquia). CVULA 1214, Mérida, La Matica de La Rosa-San Rafael de Mucuchies. CVULA 1322, Mérida, 2 Km NE de Apartaderos. CVULA 1497, Mérida, Manzano Alto, 14 Km WSW de Mérida. CVULA 2527, Mérida, Páramo La Negra. CVULA 2962, 4399, Mérida, San Rafael de Tabay, 3 Km NE Tabay. CVULA 7024, Mérida, 200 m arriba de La Gran Parada, La Pedregosa. CVULA 7028, 7145, Mérida, Chorros de Milla. CVULA 7144, Mérida, Cacute 5.5 Km SW Mucuruba. CVULA 1292, BMNH 27.11.19.41, BMNH 2.7.28.1, BMNH 98.7.1.8, BMNH 2.7.28.2, ZSM 1925/415, Mérida. BMNH 26.11.4.4. **NO SPECIFIC LOCALITY:** BMNH 34.9.10.92.

First records of Liberian Mongoose *Liberiictis kuhni* in Sapo National Park, southeast Liberia

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Abstract

Liberian Mongoose *Liberiictus kuhni* was photographed three times between November 2011 and February 2012 in two sites within Sapo National Park, southeast Liberia. These photographs, taken during the day in the early and late afternoon, confirm its presence 80 km further south than previously recorded in Liberia. Currently listed as Vulnerable by *The IUCN Red List of Threatened Species*, the species was previously only known from northeastern Liberia and western Côte d'Ivoire. Further survey work is required to establish the limits of its distribution.

Keywords: camera-trapping, daytime activity, extension of known range

Premières observations de Mangoustes du Libéria *Liberiictis kuhni* dans le Parc National de Sapo, au sud-est du Libéria

Résumé

La Mangouste du Libéria *Liberiictis kuhni* a été photographiée trois fois entre novembre 2011 et février 2012 sur deux sites du Parc National de Sapo, au sud-est du Libéria. Ces photographies, prises la journée, en début et fin d'après-midi, confirment sa présence à une distance de 80 km au sud des sites sur lesquels sa présence a été précédemment enregistrée au Libéria. Actuellement classée «Vulnérable» par la *Liste Rouge des Espèces Menacées de l'UICN*, l'espèce n'était jusqu'alors connue qu'au nord-est du Libéria et à l'ouest de la Côte d'Ivoire. Des études complémentaires sont nécessaires pour déterminer les limites de son aire de répartition.

Mots-clés: piège photographique, extension d'habitat, activité diurne

Liberian Mongoose *Liberiictis kuhni* is a poorly documented small carnivore of the area defined by White (1983) as the Upper Guinean Rainforest. Described in 1958 from eight skulls found in northeastern Liberia (Hayman 1958), the first complete specimens were not secured until 1974 (Schlitter 1974) with the first live specimen captured in Gbi National Forest, northeastern Liberia in 1989 (Taylor 1992). It has a primarily dark brown body and a bushy tail, with prominent dark stripes on the neck, which are bordered by white. Compared with other mongoose species, Liberian Mongoose has rather long claws and an elongated snout with small, reduced cheek teeth, but long, sharp canines (Schlitter 1974).

Listed as Vulnerable on *The IUCN Red List of Threatened Species* (IUCN 2012), reliable information on the species's population status and distribution range is not available. However, the population is assumed to be declining: it is hunted for meat using dogs, shotguns and snares (Taylor 1992, Greengrass 2011) and extensive habitat loss is occurring in its range due to logging, mining and conversion to agriculture (FAO 2011). Liberian Mongoose occurs in both primary and secondary forests, and is found mainly in swamp forest and streambeds with deep sandy soils where earthworms, its preferred food source, are abundant (Schreiber *et al*. 1989, Dunham 2011). Known to turn over large areas of the forest floor while foraging, Liberian Mongoose is thought to play an important role as an 'ecosystem engineer' by increasing small-scale ecosystem heterogeneity, affecting seed predation, movement and germination (Dunham 2011). Recorded in the wild in northeastern Liberia and Taï National Park, western Côte d'Ivoire (Goldman & Taylor 1990, Colyn *et al*. 1998), the furthest south it has been found previously in Liberia is Nimbowehn, Gbi National Forest. It was assumed that the species is very likely to occur in similar suitable habitats in adjacent areas, including Sapo National Park (= Sapo NP) in southeast Liberia, approximately 80 km south of Gbi. However, previous attempts to confirm this species's presence in Sapo NP, by live-traps and camera-traps, were unsuccessful (Robinson 1983, Taylor 1992). While a 2010 survey of a commercial hunting camp on the southern border of Sapo NP recorded the killing of two individuals, the identity of the specimens was unconfirmed (Greengrass 2011).

Sapo NP, Liberia's only National Park, comprises an area of 180,365 ha and represents one of the most nearly intact tropical forest ecosystems in Liberia. Contained within one of the largest remaining blocks of the threatened Upper Guinean Forest, Sapo NP consists entirely of lowland rainforest, including swampy areas, dryland and riparian forests. The terrain throughout the park is generally homogeneous, with lower (100–200 m) elevations and gently rolling hills in the southwestern and central parts to higher elevations of approximately 400 m in the steeper ridges of the northeast. Sapo NP harbours an exceptional biodiversity with high rates of endemism and provides one of the last strongholds for several globally Endangered species such as Pygmy Hippopotamus *Choeropsis liberiensis*, West African Chimpanzee *Pan troglodytes verus* and Jentink's Duiker *Cephalophus jentinki*.

In 2001, Fauna & Flora International (FFI) in collaboration with the Liberian government's Forestry Development Authority (FDA) established a long-term faunal biomonitoring programme in Sapo NP, which was re-started in 2007 following the end of the civil war (Waitkuwait & Suter 2001, Waitkuwait 2003, Vogt 2011). In 2008, with the support of the Zoological Society of London (ZSL), the programme was complemented by regular systematic camera-trapping surveys (Collen *et al*. 2011). Surveys were designed to detect wide-ranging and cryptic species (Collen *et al*. 2011). Following O'Brien *et al.* (2010) a grid of 32 infrared heat- and motion- sensitive digital cameras, spaced at 2 km intervals and mounted 40 cm from the ground, was set for a minimum of 35 days and at 24-hour operation mode in each of two different areas of Sapo NP. The centre of each grid square was located using a GPS Garmin map 62s unit, and one camera was secured in an optimal location (e.g. next to a recently used animal trail), in a 100-m radius from the centre of the grid square. Altitudes were measured by a GPS Garmin map 62s unit. All positions are given under the WGS84 datum. No baits or inedible lures were used. One to three surveys were conducted annually. In the southwestern part of Sapo NP (Survey Grid 1), the camera grid was established four times, in January–March 2008, May–July 2009, December 2010 – January 2011 and October–November 2011. In the northern part (Survey Grid 2), the camera grid was established four times, in November–December 2008, February–April 2009, June–July 2011 and February–March 2012 (Fig. 1).

Liberian Mongoose was not recorded before late 2011 despite a prior survey effort of 4,500 camera-trap days. Its first photograph was taken on 8 November 2011 by a camera in southwestern Sapo NP, at 5°18'45.6"'N, 8°43'32.6"W and 118 m measured altitude (Fig. 2). It was taken at 14h06, in a swampy area within primary lowland forest. A second record from the northern part of the Park (55 km from the first) was obtained during February 2012, at 25°29'26.5"N, 8°23'18.1"W and 202 m measured altitude (Fig. 3). Two series of pictures of Liberian Mongoose were taken by the same camera, on a gentle slope within primary forest: the first on 8 February at 16h58, the second on 13 February at 14h05. No photograph showed more than one animal.

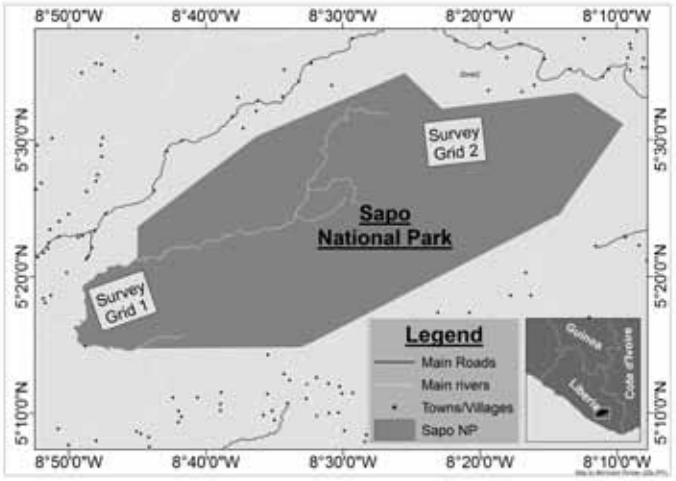

Fig. 1. Sapo National Park, Liberia, showing the location of the two camera-trap grids used in 2008–2011.

Fig. 2. The first photograph of a Liberian Mongoose *Liberiictis kuhni* in Sapo National Park, Liberia: 8 November 2011. © FFI/FDA/ZSL

Fig. 3. The second record of Liberian Mongoose *Liberiictis kuhni* in Sapo National Park, Liberia, in the north: 13 February 2012. © FFI/FDA/ZSL

These first verifiable records of Liberian Mongoose in Sapo NP provide valuable information on the distribution range of this poorly documented species. Explanations for the comparatively low detection rate and the fact that the animal was not recorded before the fourth year of the ongoing camera study at present remain speculative and require more investigation. The survey was not specifically designed for this species, but to detect medium to large forest-dwelling species. It further has been found that effective detection distance is strongly positively related to species body mass and weakly negatively to species average speed of movement (Rowcliffe *et al*. 2011). In the context of our study it is plausible that, at least in part, low detection rates are explained by the small body size of *L. kuhni*. However, comparison with detection rates of ground-living mammal species of similar or lower size/weight class at the same time suggest that this is not the case. Table 1 shows the number of trap events over the same time period of several species of similar or lower weight than Liberian Mongoose, namely African Brush-tailed Porcupine *Atherurus africanus,* two species of the large-spotted genet complex (*Genetta bourloni* and *G. pardina*), Marsh Mongoose *Atilax paludinosus*, Fire-footed Rope Squirrel *Funisciurus pyrropus* and Red-legged Sun Squirrel *Heliosciurus rufobrachium*. Compared

Table 1. Number of trap events of selected mammal species similar to or lighter than Liberian Mongoose *Liberiictus kuhni* in weight, during two camera-trapping surveys in Sapo National Park, Liberia, 2011–2012.

Species[1]	Weight (kg)[2]	Number of trap events[3]	
		November 2011	February 2012
Atherurus africanus	1.5 – 4.0	111	35
Genetta bourloni	1.2 – 3.1	17	10
Genetta pardina	1.2 – 3.1	10	10
Atilax paludinosus	2.2 – 5.0	39	57
Funisciurus pyrropus	0.16 – 0.30	47	13
Heliosciurus rufobrachium	0.25 – 0.40	6	39
Liberiictis kuhni	2.0 – 2.3	1	2

[1]English names are given in the text. Species recorded, but heavier than Liberian Mongoose, are excluded from the table.
[2]after Kingdon (1997).
[3]Following previous authors (e.g. O'Brien *et al.* 2003) each 'trap-event' is an independent photographic event, taken at least 30 minutes apart in cases where the same social group may be involved in successive pictures.

with capture frequencies of these species, records of Liberian Mongoose remain few. While this might relate to behavioural reasons, it might also indicate rarity of this species in Sapo NP.

Due to a history of illegal settlements of armed artisanal gold miners in the central and southern parts of the park, until recently security restricted monitoring and field research in Sapo NP to the southwestern and northeastern parts. However, since the successful evacuation of most miners in late 2010, the biomonitoring programme was consequently extended over a wider area, and data collection will commence in these formerly inaccessible parts. It is hoped that the ongoing camera-trap study will reveal further information on Liberian Mongoose. Further survey work should also be carried out to determine the limits of its distribution throughout Liberia.

Acknowledgements

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Observations of small carnivores in Jakarta wildlife markets, Indonesia, with notes on trade in Javan Ferret Badger *Melogale orientalis* and on the increasing demand for Common Palm Civet *Paradoxurus hermaphroditus* for civet coffee production

Chris R. SHEPHERD

Abstract

Six species of small carnivores were recorded during spot checks carried out in wildlife markets in Jakarta, Java, Indonesia, in 2010 and 2012, including Javan Ferret Badger *Melogale orientalis*, a little-known species rarely observed in trade. Most numerous was Common Palm Civet *Paradoxurus hermaphroditus*, which is increasingly being taken from the wild for the production of *kopi luwak* ('civet coffee'). This trade, and the trade in small carnivores overall in Indonesia, should be carefully monitored. Laws in place to protect these species must be enforced. More research is required to determine the status of these species and the impacts of trade on their conservation.

Keywords: kopi luwak, Leopard Cat, *Prionailurus bengalensis*, wildlife trade

Pemantauan kelompok karnivora kecil di beberapa pasar satwa Jakarta, Indonesia, dengan penekanan pada perdagangan biul *Melogale orientalis*, serta peningkatan permintaan pada luwak *Paradoxurus hermaphrodites* untuk produksi kopi luwak

Abstrak

Enam jenis kelompok karnivora kecil tercatat saat dilakukan pemantauan pada beberapa pasar satwa di wilayah Jakarta, Indonesia, pada tahun 2010 dan 2012. Salah satunya adalah biul *Melogale orientalis*, sebagai jenis yang jarang dijumpai dalam perdagangan. Jenis yang paling banyak adalah luwak *Paradoxurus hermaphroditus,* dimana semakin meningkat penangkapannya dari alam untuk kepentingan produksi kopi luwak. Perdagangan ini, serta perdagangan lainnya pada kelompok karnivora kecil di Indonesia, perlu dipantau dengan seksama. Penerapan perlindungan pada satwa-satwa tersebut perlu ditegakkan. Penelitian lebih lanjut sangat dibutuhkan guna menetapkan status dari jenis tersebut serta akibat dari adanya perdagangan terhadap konservasinya.

Introduction

Wildlife trade is a severe threat to vast numbers of species in Indonesia, yet few resources are dedicated to understanding and addressing it (Shepherd 2010, Nijman *et al*. 2012). Further monitoring and researching of the trade is needed to gauge the conservation status of affected species better, and ultimately to inform authorities so that effective conservation measures are implemented and enforced.

Indonesia's wildlife markets are well known for offering a wide variety of species for sale, many of which are sold in violation of national laws and policies (Shepherd *et al*. 2004, Shepherd 2010). Small carnivores are amongst the vast number of species in these markets (Shepherd 2008), sold as novelty pets, for food and for use in production of civet coffee. However, little concerted effort has been put into protecting and researching these species in Indonesia and the conservation impacts of hunting and trade are largely unknown.

'Small carnivores' are taken here to include not only Herpestidae, Mephitidae, Mustelidae, Prionodontidae and Viverridae, but also cats (Felidae). Few species of small carnivores are protected by Indonesian law (Shepherd 2008). All Felidae species in Indonesia are protected, but within the other five families included here, only eight of the 24 species are (Table 1).

The intentions behind this paper are to raise awareness of and interest in small carnivore conservation, to provide current data of the trade and legal status, and to encourage the Indonesian authorities and conservationists alike to take further steps to protect Indonesia's small carnivores.

Methods

Three visits were made to each of the four largest wildlife markets in Jakarta, the capital city of Indonesia: Pramuka, Barito, Kartini and Jatinegara (21 July 2010; 10 December 2010; 15–16 June 2012). Birds make up most of the species in these markets, so they are generally known as 'bird markets', with the exception of Kartini which sells mostly aquarium fish and reptiles. The Jatinegara market is known for having more mammals than any of the other three. In addition to the markets, a flora and fauna exhibition (known locally as *Flona*) in Jakarta was also surveyed, on 16 June 2012, because many wildlife dealers set up stalls at this exhibition and sell wildlife, mostly reptiles. Markets for this study were thoroughly surveyed by the author, with all openly displayed wildlife in each market observed and all target species counted and recorded.

Observations

Four markets were surveyed three times, and an exhibition once, and small carnivores were observed in all locations

Table 1. Status of small carnivores (families Herpestidae, Mephitidae, Mustelidae, Prionodontidae and Viverridae) in Indonesia.

English name	Species name	Protected	*IUCN Red List*
Herpestidae			
Short-tailed Mongoose	*Herpestes brachyurus*		LC
Small Asian Mongoose	*Herpestes javanicus*		LC
Collared Mongoose	*Herpestes semitorquatus*		DD
Mustelidae			
Oriental Small-clawed Otter	*Aonyx cinereus*		VU
Hog Badger	*Arctonyx collaris*	X	NT
Eurasian Otter	*Lutra lutra*	X	NT
Hairy-nosed Otter	*Lutra sumatrana*	X	EN
Smooth Otter	*Lutrogale perspicillata*		VU
Yellow-throated Marten	*Martes flavigula*		LC
Javan Ferret Badger	*Melogale orientalis*		DD
Indonesian Mountain Weasel	*Mustela lutreolina*		DD
Malay Weasel	*Mustela nudipes*		LC
Mephitidae			
Sunda Stink-badger	*Mydaus javanensis*	X	LC
Prionodontidae			
Banded Linsang	*Prionodon linsang*	X	LC
Viverridae			
Binturong	*Arctictis binturong*	X	VU
Small-toothed Palm Civet	*Arctogalidia trivirgata*		LC
Otter Civet	*Cynogale bennettii*	X	EN
Hose's Civet	*Diplogale hosei*		VU
Banded Civet	*Hemigalus derbyanus*		VU
Sulawesi Civet	*Macrogalidia musschenbroekii*	X	VU
Masked Palm Civet	*Paguma larvata*		LC
Common Palm Civet	*Paradoxurus hermaphroditus*		LC
Malay Civet	*Viverra tangalunga*		LC
Small Indian Civet	*Viverricula indica*		LC

LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, DD: Data Deficient

Table 2. Species of small carnivores observed in Jakarta's wildlife markets during spot-checks (2010, 2012).

Market	Date	Species					
		Javan Ferret Badger *Melogale orientalis*	Small Indian Civet *Viverricula indica*	Common Palm Civet *Paradoxurus hermaphroditus*	Small-toothed Palm Civet *Arctogalidia trivirgata*	Small Asian Mongoose *Herpestes javanicus*	Leopard Cat *Prionailurus bengalensis*
Pramuka	21 Jul 2010						
	10 Dec 2010			1		1	
	15–16 Jun 2012						
Jatinegara	21 Jul 2010		1			1	4
	10 Dec 2010		3	8	1		2
	15–16 Jun 2012	5		12			
Barito	21 Jul 2010						
	10 Dec 2010						
	15–16 Jun 2012						1
Kartini	21 Jul 2010						
	10 Dec 2010					3	
	15–16 Jun 2012						
Flona Fair	15–16 Jun 2012			4			
Totals		**5**	**4**	**25**	**1**	**5**	**7**

(Table 2). During these visits, 47 small carnivores representing six species were observed, 37 of which were in Jatinegara. Of the 47 small carnivores observed, Common Palm Civet *Paradoxurus hermaphroditus* was the most numerous (25 animals; Fig. 1.), followed by Leopard Cat *Prionailurus bengalensis* (seven), Javan Ferret Badger *Melogale orientalis* (five), Small Asian Mongoose *Herpestes javanicus* (five), Small Indian Civet *Viverricula indica* (four) and Small-toothed Palm Civet *Arctogalidia*

Fig. 1. Common Palm Civets *Paradoxurus hermaphroditus* in markets for sale for the production of civet coffee (Photo: Chris R. Shepherd/TRAFFIC Southeast Asia).

trivirgata (one; not of the endemic Javan race, *A. t. trilineata*). All small carnivores observed in trade were live, with no dead animals observed for sale in these markets.

Other mammals, all native to Indonesia, were observed during these visits, including Common Treeshrew *Tupaia glis*, squirrels (Sciuridae), Sugar Glider *Petaurus breviceps*, Long-tailed Macaque *Macaca fascicularis*, Javan Langur *Trachypithecus auratus*, Sunda Slow Loris *Nycticebus coucang*, Javan Slow Loris *Nycticebus javanicus*, Large Flying-fox *Pteropus vampyrus* and a smaller unidentified bat species.

Discussion

Of these six species observed, only Leopard Cat is protected under Indonesian law. However, according to Indonesian law, species that are not protected may only be traded domestically or internationally following a harvest and export quota system. Of the five non-protected species, only Common Palm Civet has a quota for capture and trade, of 270 individuals per year. This quota specifies that these Common Palm Civets are to be sold live as pets. All the species observed in this study are listed as Least Concern by *The IUCN Red List of Threatened Species* (IUCN 2012), with the exception of Javan Ferret Badger, which is listed as Data Deficient.

Javan Ferret Badger

Javan Ferret Badger is endemic to the Indonesian islands of Java and Bali; very little is known about it, and it seems to have never been studied in depth in the wild (Duckworth *et al*. 2008). The first observation of this species in trade, to the author's knowledge, was of a single animal observed in the Jatinegara market in Jakarta on 16 July 2011 (Kim 2012). Kim also reported advertisements of this species for sale on the internet in Java during 2010–2011, and mentioned hearing of occasional trade in the markets of Jakarta and Surabaya. While Kim was able to photograph this animal, the dealers did not permit photographs during the visit in June 2012. According to the dealers, these 2012 animals were captured locally in Java (exact locations not given). Identification of ferret badgers to species is extremely difficult, but it is very unlikely that any species of non-native ferret badger are being traded: no imports have ever been recorded, local demand seems minimal, and the dealers claimed these specimens were locally caught. The two dealers with this species in June 2012 were asking IDR 500,000 (USD 53) each. It is impossible to determine volumes or trends based on these few records, but because hunting for trade may be a significant threat, further monitoring and investigation of the trade in Java is necessary. Given the restricted range of this species, and the potential threats of both habitat loss and trade in this heavily human-populated region, Indonesian authorities should consider providing this national endemic with full legal protection.

Common Palm Civet

Hunting and trade are listed in the *IUCN Red List* as a threat to the Common Palm Civet (IUCN 2012). Throughout this species's range it is killed as a pest or for consumption (Shepherd & Shepherd 2010) and captured for trade as pets (Schreiber *et al*. 1989, Shepherd 2008). While there is a quota in place in Indonesia, it is largely ignored by hunters and traders and is not enforced by authorities (Shepherd 2008).

During this same period (on 12 June 2012), researchers visited the wildlife market in Denpasar, Bali, and observed approximately 25 Common Palm Civets for sale. The dealer in the wildlife market in Denpasar told the buyers, evidently in an attempt to make a sale, that the Common Palm Civets were used to make *kopi luwak*, 'civet coffee' (E. V. Goode *in litt*. 17 June 2012). Kopi luwak is made from coffee beans that have passed through the gut of a civet and are later picked from the faeces, and is considered to be the rarest and most expensive coffee in the world (Marcone 2004; Fig. 2.). This coffee has become increasingly trendy and as a result civets are being increasingly captured from the wild and fed coffee beans to mass-produce this blend. The impact of the demand for this fashionable coffee on wild civet populations is yet unknown but may constitute a significant threat, and appears to be in violation of the quota set for pets.

Conclusions and recommendations

Generally, wildlife markets in Jakarta are in effect unregulated. Despite laws in Indonesia protecting many species, and controlling trade of others, these laws are largely ignored and traders in the wildlife markets openly sell a wide variety of species, regardless of their legal status. It is essential that the

Fig. 2. Civet coffee for sale in a market in Sabah, Borneo (Photo: Divya Mudappa).

trade in these markets be monitored, with information used to detect and analyse trends, and to identify conservation concerns. Information should be regularly provided to the authorities who should be urged to enforce Indonesia's laws and take action to shut the illegal trade down, and to prosecute people found violating the laws. Legal issues and conservation impacts of the growing civet coffee industry should be carefully examined and monitored. Efforts should also be made to raise public support for conservation in Indonesia, and ultimately to reduce significantly the demand for these species.

The list of protected small carnivores in Indonesia should be reviewed and revised to reflect better the conservation status of the species so that adequate legal protection is in place. Again, efforts need to be made to ensure legislation is enforced.

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ANNOUNCEMENT

Extension of deadline for the submission of abstracts for the International Badger Symposium (1-4 October 2013)

The organization of the **International Badger Symposium** (http://www.alphawildlife.ca/2013badgersymposium) is going well and we have received submissions from many researchers from all continents. However, we were told that some researchers were in the field these last months and were unaware of our deadline for the submission of abstracts (originally, 15 September 2012). Others forgot about it!

In order to accommodate these researchers, we have postponed the deadline for the submission of abstracts to January 31, 2013. Therefore, you are not too late to submit your abstracts. Please consult the badger website for details about the submission of papers.

We look forward to receiving your contributions.

Gilbert Proulx, PhD, Chair
Emmanuel Do Linh San, PhD, Co-Chair

An observation of several Common Palm Civets *Paradoxurus hermaphroditus* at a fruiting tree of *Endospermum diadenum* in Tabin Wildlife Reserve, Sabah, Malaysia: comparing feeding patterns of frugivorous carnivorans

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Abstract

Common Palm Civets *Paradoxurus hermaphroditus* live solitarily and reportedly interact intra-specifically only rarely, other than as mother–young and as mating associations. Among three individuals observed feeding at a fruiting *Endospermum diadenum* tree, no aggression was noted between either of the two adult males and one female, but agonistic behaviour occurred between the males. Co-feeding seems to be rare in species of subfamily Paradoxurinae, except in Small-toothed Palm Civet *Arctogalidia trivirgata*. By contrast, co-feeding is more frequently observed in other frugivorous carnivorans, distributed in Central and South America, and in Central Africa. Within Asia, there are perhaps regional differences in incidence of co-feeding. These differences are probably based on differing patterns of fruit production between these places.

Keywords: agonistic behaviour, gregarious feeding, social interaction

Satu pemerhatian beberapa Musang Pandan *Paradoxurus hermaphroditus* pada pokok sendok sendok mata udang *Endospermum diadenum* berbuah di Simpanan Hidupan Liar Tabin, Sabah, Malaysia: perbandingan corak makan karnivora yang memakan buah-buahan

Abstrak

Musang Pandan *Paradoxurus hermaphroditus* hidup secara bersendirian dan interaksi intra-spesies jarang dilaporkan, kecuali perhubungan di antara ibu dengan anak dan di antara pasangan mengawan. Pemerhatian terhadap tiga individu Musang Pandan yang sedang makan di pokok Endospermum diadenum yang berbuah, menunjukkan bahawa tiada kelakuan agonistik di antara dua individu jantan dewasa dengan seekor betina. Tetapi, kelakuan agonistik telah diperhatikan berlaku di antara individu jantan. Kelakuan makan-secara-bersama jarang sekali dilaporkan terhadap spesies di bawah subfamily Paradoxurinae, kecuali Musang Akar *Arctogalidia trivirgata*. Sebaliknya, kelakuan makan-secara-bersama adalah lebih kerap diperhatikan terhadap spesies furgivora-karnivora yang terdapat di bahagian Amerika tengah dan selatan, dan juga Afrika tengah. Di Asia pula, mungkin terdapat perbezaan insiden kelakuan makan-secara-bersama iaitu bergantung kepada wilayah. Perbezaan ini mungkin disebabkan oleh perbezaan dalam pola penghasilan buah di wilayah-wilayah yang berlainan.

Introduction

Common Palm Civet *Paradoxurus hermaphroditus* is a carnivoran weighing 2–5 kg as an adult. It is widespread in tropical and subtropical Asia (Patou *et al*. 2010). It lives in a broad array of natural habitats and survives well in human-modified areas (Corlett 1998). It is highly frugivorous (Joshi *et al*. 1995, Grassman 1998, Su Su & Sale 2007, Nakashima *et al*. 2010a) and thus has been regarded as an important seed dispersal agent (Rabinowitz 1991, Nakashima & Sukor 2010, Nakashima *et al*. 2010a, 2010b). Due to its nocturnal habit, little is known about its social relationships in the wild.

Telemetry in the Royal Chitwan National Park in Nepal and Huai Kha Khaeng Wildlife Sanctuary in Thailand detected high male–male and male–female home-range overlap (Rabinowitz 1991, Joshi *et al*. 1995). So far, no studies have been conducted on social interactions between males, and between males and females. This paper reports male–male and male–female social interactions in one observation at a fruiting *Endospermum diadenum* tree in Tabin Wildlife Reserve (hereafter, Tabin).

Tabin (5°05'–5°22'N, 118°30'–118°55'E) lies about 50 km north-east of the town of Lahad Datu, in east Malaysian state of Sabah, on the island of Borneo. Tabin was heavily logged in the 1970s and 1980s, leaving mainly regenerating mixed dipterocarp tropical rainforest dominated by pioneer species such as *Neolamarckia cadamba* and *Macaranga bancana* (Rajaratnam *et al*. 2007). Common Palm Civets inhabiting Tabin eat mostly fruits of pioneer plants such as *Leea aculeata*, *Endospermum diadenum* and some species of fig trees *Ficus* (Nakashima *et al*. 2010a).

On the cloudy evening of 20 August 2011, the crown of a relatively large fruiting *Endospermum diadenum* (about 50 cm diameter at breast height [DBH], about 30 m tall) was watched from about 20 m from the tree, from a concealed position on the ground to prevent animals detecting the observer. The tree was along the western boundary of Tabin, adjacent to a mature oil palm plantation 20 or more years old, and its canopy was connected to an adjacent (non-fruiting) tree (species not known; about 20 cm DBH) approximately 25 m tall. All observations were aided by 8×36 binoculars and a 120-lumen headlamp with red filter. The height of the tree and the locations of focal animals were measured by a laser rangefinder. Care was taken not to shine lights continuously or directly onto the focal animal. Sex was determined by visual check of the sexual

organ. On 19 August we had happened to find a Common Palm Civet feeding in the focal tree, so we decided to observe this tree the next night. Observation ran from 18h00 until 02h00.

Observations

At 19h55, a male Common Palm Civet (hereafter male 1) came to the tree and started foraging (28 m up). At 20h08, a female came to the tree and started foraging until 21h16 when it climbed down the tree. The male and female civets always stayed at least 5 m apart. No aggression was seen. After the female's departure, male 1 continued to forage in the tree. At 22h35, another male, smaller than male 1 (hereafter male 2) came to the tree and started foraging. Ten minutes later (22h45) male 2 climbed down the tree quickly, and growling was heard for nine minutes. The exact location of this growling was not clear, but during this time male 1 could be seen clearly, and was not growling. Male 1 continued to forage and did not climb down the tree. At 23h29, male 2 climbed up the tree again, and male 1 immediately made an aggressive move towards male 2. Male 2 reacted by climbing down the tree. Ten minutes later, male 2 climbed up the tree again and started feeding. Male 1 came close to male 2, but was not aggressive. At 23h43, male 2 stopped feeding and went down, crossing branches into the adjacent tree. They showed no particular behaviour to each other, until 23h48 when male 1 suddenly ran towards male 2 and both climbed down the adjacent tree. At this time, growling was heard. Then, male 2 was detected growling on a liana straddling the tree adjacent to the fruiting *Endospermum*. Male 1 was not observed thereafter. At 00h14 male 2 climbed into the fruiting tree and continued foraging, for 1½ hours (Fig. 1).

Discussion

Common Palm Civets live mainly solitarily (Joshi *et al*. 1995), but in addition to the obvious needs of mother–young and mating associations, may interact directly with each other, at least occasionally. Duckworth (1997) also observed two individuals close to each other in a fruiting tree in Laos. Moreover, he reported interspecific encounters of this species once each with two other species of subfamily Paradoxurinae, namely a Small-toothed Palm Civet and a Masked Palm Civet. Both cases were accompanied by loud screaming calls. Rajamani *et al*. (2002) also reported an arboreal intra-specific interaction between Brown Palm Civets *Paradoxurus jerdoni*, involving two animals making loud prolonged spitting/brawling noises. In these cases the animals' sexes were not specified. Species of *Paradoxurus* may tend to vocalise when two animals encounter each other.

Fig. 1. Times of presence of three Common Palm Civets *Paradoxurus hermaphroditus* in a fruiting *Endospermum diadenum* tree, Tabin Wildlife Reserve, Sabah, Malaysia, on 20 August 2011. (Dashed lines indicate that the individual was not under observation and was, almost certainly, outside the fruiting tree. Vertical lines indicate that it was entering or leaving, respectively, the fruiting tree. Solid horizontal lines indicate its presence in the fruiting tree.)

In Common Palm Civets, the degree of intraspecific co-feeding in the fruiting tree may vary by region or season. In Tabin, we conducted nocturnal surveys for nine months and observed a mother and baby feeding in the same tree once, and two male Common Palm Civets growling at each other in a fruiting tree of *Ficus racemosa*. In Kulen–Promtep Wildlife Sanctuary, Cambodia, Common Palm Civets visiting a salt-lick were photographed in groups of 1–5 individuals (Edwards 2012), but it is unclear if the group members were family or not (S. Edwards *in litt*. 2012). Also in Cambodia, Iseborn *et al*. (2012) surveyed in Veun Sai–Siem Pang Conservation Area, and never observed Common Palm Civets feeding in a group (T. Iseborn *in litt*. 2012). Meanwhile, at Guning Halimun, Java, Indonesia, although sex was not checked, four Common Palm Civets and five Small-toothed Palm Civets were observed feeding in the same tree together at once without interaction (Eaton *et al*. 2010, J. Eaton *in litt*. 2012).

The other species belonging to subfamiliy Paradoxurinae are widely distributed across Asia. Only Small-toothed Palm Civets *Arctogalidia trivirgata* are often seen foraging companionably in duos or even larger groups (e.g.: Duckworth 1997, Borissenko *et al*. 2004, Eaton *et al*. 2010, Moore 2011, MN pers. obs.). In Danum Valley Conservation Area, Sabah, Malaysia, we observed four individuals of this species feeding on *Ficus binnendijkii* in June 2012, but could not specify their sex. Brown Palm Civets are usually solo but observations of two together are not unusual (Mudappa 2001, N. Prakash *in litt*. 2012). By contrast, but similar to Common Palm Civet, Binturong *Arctictis binturong* and Masked Palm Civet *Paguma larvata* seem in general to feed solitarily (MN pers. obs.). Unfortunately, there seems to be presently too little information on Golden Palm Civet *Paradoxurus zeylonensis* to determine its feeding sociality.

Other tropical continents hold several frugivorous carnivorans, namely Kinkajou *Potos flavus* and the olingos *Bassaricyon* in Central and South America, and African Palm Civet *Nandinia binotata* (not closely related to Asian palm civets, despite its English name; Nyakatura & Bininda-Emonds 2012) in Central Africa. Ecological information on these carnivorans is patchy, but at least Kinkajou and African Palm Civet have been reported to feed gregariously. Kays & Gittleman (2001) reported that Kinkajous occasionally fed together with consistent social grouping in large fruiting trees in the lowland forest of Parque National Soberania in the Republic of Panama. Male–female combinations followed by female–juvenile were most frequently observed. Interestingly, male–male combinations were also observed several times. Regarding African Palm Civet, Charles-Dominique (1978) reported that male–male and female–juvenile co-feeding combinations in fruit-trees. Meanwhile, males of both animals have been reported to fight each other, perhaps reflecting a dominance relationship. There is particularly little information on olingos, but at least Beddard's Olingo *B. beddardi* and Bushy-tailed Olingo *B. gabbii* have been observed in groups occasionally, and these

groups have also been reported feeding on individual fig trees (Mendes-Pontes *et al*. 2002, Gonzales-Maya & Belant 2010).

This information suggests that gregarious feeding of frugivorous carnivorans is less common in Asia than in South America and Africa. Within Asia, there may also be regional differences. Considering that fruit production differs between continents (van Schaik *et al*. 1993) and between regions (Wich & van Schaik 2000, Wich *et al*. 2011), these differences are probably based on variation in patterns of fruit production between these places. More field research is needed to allow confident generalisation of patterns of co-feeding in frugivorous carnivorans.

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Small-toothed Palm Civet *Arctogalidia trivirgata* records from human-influenced habitats in Vietnam

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Abstract

Small-toothed Palm Civet *Arctogalidia trivirgata* is rather rarely included on mammal survey lists for Vietnamese protected areas. This has often led to its being declared rare, and therefore a priority for national small carnivore conservation. Evidence from outside Vietnam suggests that this paucity of records in Vietnam is due at least largely to the reliance on inappropriate survey methods, i.e. ground-based camera-trapping and diurnal surveys, that will fail to record this nocturnal, very arboreal civet. Presented here are several recent confirmed records from both protected and non-protected areas in Vietnam, all of which have undergone major anthropogenic disturbances, including hunting and illegal logging. The ability of this species to survive in these areas where most similar-sized or larger animal species have become reduced or extirpated indicates that it is not a conservation priority among Vietnam's mammals. Consideration of other information from throughout its range suggests that the conservation focus for this genus should be on the Javan taxon *A. (t.) trilineata*. These records from Vietnam have also extended the documented altitude range for this species in Vietnam to above 1,000 m a.s.l, consistent with other parts of the species's range, and have added a habitat type not previously recorded for the species: *Melaleuca*-dominated wetland forest.

Keywords: camera-trapping, conservation priorities, conservation status, habitat use, spotlighting

Ghi nhận Cầy tai trắng *Arctogalidia trivirgata* tại các sinh cảnh chịu tác động bởi con người ở Việt Nam

Tóm tắt

Cầy tai trắng *Arctogalidia trivirgata* thường ít được ghi nhận trong các kết quả khảo sát thú tại các khu rừng đặc dụng ở Việt Nam. Do vậy, chúng thường được xem là loài hiếm và là loài thú ăn thịt nhỏ cần được ưu tiên bảo tồn ở cấp quốc gia. Các bằng chứng từ những khu vực ngoài Việt Nam cho thấy việc có ít ghi nhận loài này ở Việt Nam chủ yếu là do phương pháp khảo sát không thích hợp, ví dụ sử dụng bẫy ảnh đặt trên mặt đất và khảo sát ban ngày sẽ không ghi nhận được loài thú ăn đêm và chuyên hoạt động trên cây này. Bài báo này trình bày một số ghi nhận chắc chắn gần đây về loài cầy tai trắng tại các khu vực được bảo vệ lẫn không được bảo vệ nhưng đều chịu nhiều tác động của con người, bao gồm cả săn bắn và khai thác gỗ trái phép. Khả năng tồn tại ở những nơi mà các loài thú có kích thước tương tự hoặc lớn hơn loài này suy giảm hoặc bị tuyệt diệt cho thấy đây không phải là loài cần ưu tiên bảo tồn ở Việt Nam, và ở cấp độ vùng, nên tập trung bảo tồn phân loài ở Java *A. (t.) trilineata*. Từ các ghi nhận mới này, giới hạn về độ cao phân bố của loài ở Việt Nam được mở rộng lên đến 1.000m so với mặt nước biển, phù hợp với vùng phân bố của loài ở những khu vực khác, và sinh cảnh rừng tràm với ưu thế loài *Melaleuca* là sinh cảnh được ghi nhận mới so với các ghi nhận trước đây.

Introduction

The wide deployment of camera-traps across Southeast Asia over the last 15–20 years has generated many images of small carnivores and, although these were rarely the target species of the survey in question, where their records are collated and published, they have advanced considerably the understanding of species' conservation status (e.g. Holden 2006, Than Zaw *et al*. 2008), including of some globally threatened species (e.g. Veron *et al*. 2006, Dang & Le 2010, Gray *et al*. 2010). Small-toothed Palm Civet *Arctogalidia trivirgata* occurs almost throughout Southeast Asia, and into adjacent northeast India and southern China (Corbet & Hill 1992). It has been found by many surveys using methods other than camera-trapping, often frequently (e.g. Duckworth 1997, Walston & Duckworth 2003, Duckworth & Nettelbeck 2008, Eaton *et al*. 2010, Low 2010, Moore 2011). By contrast, most camera-trap surveys do not find this species, even when they are of long duration, use many camera-trap sites, and are within habitat-types likely to be used by this species (e.g. Azlan 2006, Azlan & Lading 2006, Suzuki *et al*. 2006, Than Zaw *et al*. 2008, Holden & Neang 2009, Johnson *et al*. 2009, Lau *et al*. 2010, Gray & Phan 2011). Although some of the former surveys might have been in areas where Small-toothed Palm Civets do not occur, there are many camera-trap surveys that have not found the species at sites where remains of dead animals or live field sightings showed it to be present (e.g. Conforti 1996, Walston & Duckworth 2003, Borissenko *et al*. 2004, Wells *et al*. 2005, Holden 2006, Long & Minh 2006, Belden *et al*. 2007, Wilting *et al*. 2010, and, apparently, Cheyne *et al*. 2010, Mathai *et al*. 2010, Brodie & Giordano 2011). By contrast, we traced no surveys where Small-toothed Palm Civet was camera-trapped, but not found by spotlighting, where this latter method was used. The species is categorised as Least Concern on *The IUCN Red List of Threatened Species* (IUCN 2012).

Over a century ago, Small-toothed Palm Civet's use of Coconut *Cocos nucifera* plantations on Bunguran, in the Natuna islands (Indonesia) was remarked (Miller 1901). Relatively few recent records from highly modified habitats have been published, such as those from Bukit Kiara Recreational Park, West Malaysia (Eaton *et al*. 2010) and Singapore, where Small-toothed Palm Civet is one of only two civet species (without suspicion of captive origin) persisting in the island's remaining small forest isolates (Chua *et al*. 2012). The species is highly arboreal (e.g. Payne *et al*. 1985, Duckworth & Nettelbeck 2008), and arboreality is sometimes considered *a priori* to increase the sensitivity of species to human pressures, particularly habitat disruption (e.g. Ochoa & Soriano 2001). This seems reasonable, given the possibility for canopy change to affect such species' daily movements, episodic dispersal, food sources, sleeping sites and other resources. A general, and understandable, tendency for wildlife surveys to occur in areas likely to be of high importance to threatened species means that there are few hard data giving evidence to the extent to which Small-toothed Palm Civet survives in fragmented, isolated, heavily degraded and/or heavily hunted areas.

This note presents observations of Small-toothed Palm Civets from several sites in Vietnam, in both protected and non-protected areas, where habitat has been highly degraded and fragmented. Even by regional standards, Vietnam has a high human population density, very heavy hunting (including in most protected areas) and pervasive wildlife trade, of which civets are a key part (Bell *et al*. 2004, Roberton 2007). It is therefore unlikely that species which are highly sensitive to hunting and/or habitat disturbance will be found widely and easily in the country away from relatively well-protected sites. Spotlighting has been relatively little-used as a survey technique in Vietnam to date (or, at least, there are few available survey results from the method), and some such surveys (e.g. Le *et al*. 1997) have focused on deciduous forest which, based on confirmed records from throughout the species's range, is not thought to be suitable habitat for Small-toothed Palm Civet (Roberton 2007).

Records

Ke Go Nature Reserve – Khe Net proposed Nature Reserve, Ha Tinh and Quang Binh provinces

Ke Go Nature Reserve (NR) and Khe Net proposed NR comprise lowland evergreen forest but are presently 'paper parks'. Evidence of anthropogenic disturbance, both past and current, can be seen almost throughout both nature reserves and extends into some of their least accessible parts, such as the tops of the small but fairly steep hills. There are indications of high levels of hunting (about 1,200 cable snare traps were recorded in approximately 30 km^2 over several weeks of surveying, in October–November 2006 and March–May 2010) and illegal logging (Willcox *et al*. in prep. a). Over the course of the March–May 2010 survey, 17 illegal logging/hunting camps were recorded, chainsaws were heard on at least four occasions and approximately 130 domestic buffaloes *Bubalus bubalis* were recorded (Willcox *et al*. in prep. a). Although there are few published quantifications of such human activities from other surveys in either protected or non-protected areas in Vietnam with which to compare, clearly many people use, illegally, the Ke Go–Khe Net lowland landscape. A 1996 survey of Ke Go NR (Le *et al*. 1999) classified vegetation types into four broad categories based on the level of human impact: lightly disturbed broad-leaved evergreen forest, heavily disturbed broad-leaved evergreen forest, plantation, scrub and grassland. Lightly disturbed broad-leaved evergreen forest is primary forest, and though commercial tree species are selectively logged from these patches of forest, much of this vegetation type remains little changed. Heavily disturbed broad-leaved evergreen includes areas that have been completely cleared and are now secondary forest, and some areas that have managed to retain some plant species and structure associated with primary forest, despite heavy anthropogenic disturbance.

A targeted small carnivore survey of approximately 100 hours of spotlighting and 1,300 camera-trap-nights during October 2006 – March 2007 and January–July 2010 recorded Small-toothed Palm Civet three times. On 18 March 2010, one individual spotlit at 20h00 in lightly disturbed primary broad-leaved evergreen forest at approximately 300 m a.s.l. (18°07'N, 105°54'E) gave a clear view for about 5 seconds only 4–5 m away. On 26 March 2010, at 20h10, one was seen in secondary broad-leaved evergreen forest at about 150 m a.s.l. (18°06'N, 105°56'E), in a small tree, about 3 m from a well-used path, 15 m from a small stream, 50 m from the field team's camp and 100 m from an active hunters' camp. The final confirmed record was on 28 April 2010 at 21h30, when one was seen in a tree covered with thick woody creepers in heavily disturbed primary evergreen forest at approximately 160 m a.s.l. (18°07'N, 105°55'E), 15 m to the side of the main pathway, for about 4 seconds through binoculars until it disappeared into the foliage.

The three confirmed records for Small-toothed Palm Civet at this site were more than for Common Palm Civet *Paradoxurus hermaphroditus*, and were exceeded, among small carnivores, only by ferret badgers *Melogale*. This suggests that it is one of the more common small carnivores left in this landscape.

U Minh Ha Fishery and Forestry Enterprises, Ca Mau province

On the moonless, warm and cloudy night of 4 September 1010, at about 21h30, a Small-toothed Palm Civet was seen in a Custard-apple tree *Annona reticulata*, a non-native fruit species, at 9°31'N, 104° 57'E in the U Minh Ha Fishery and Forestry Enterprises (FFEs). Once disturbed, it ran along the main branch, down the trunk to the ground and away from view, an unusual behaviour for this arboreal species, which typically escapes through the canopy (DHAW pers. obs.). This was presumably because the *Melaleuca cajuputi* trees next to the *A. reticulata* were too weak to support the civet's weight. This sighting was amid a young (about five years old) *M. cajuputi* plantation, with canal embankments lined with banana and other fruit trees which had been planted and left untended by local people. The nearest extensive older forest is U Minh Ha NP, which is approximately 30 years old and 40 km away. The nearest forest on dry land, of the sort sometimes assumed to be typical of the species, i.e. evergreen forest (e.g. Roberton 2007), is approximately 150 km away. The U Minh Ha FFEs are active forestry enterprises, and their *M. cajuputi* and *Acacia* plantations are commercially harvested in large quantities (Fig. 1). Local people live within about 50 m of the observation

site and during a previous spotlighting session (3 September 2010), two hunters were seen scouring the banks in the same area using torches, accompanied by six dogs. A bank near this sighting had six cable-snares, although only one was seen elsewhere on the survey. Relative to the authors' observations of hunting pressures in Vietnam's protected areas, hunting using cable-snare traps seems to be scarce, but human activity (with dogs) high. Nylon nets (strongly corded, suitable for catching medium-large species of fish; Fig. 2) were placed along most of the banks, reportedly to help catch Sunda Pangolins *Manis javanica*. Apparently, hunters search the banks using torches and dogs; any tree containing something marketable is cut down, while other animals are caught on the ground or in one of the nets.

Total survey effort for the U Minh Ha FFEs was approximately 800 camera-trap-nights and 40 hours spotlighting. This produced confirmed records for three other small carnivore species; six for Common Palm Civet, 23 for Leopard Cat *Prionailurus bengalensis* and five for Small Asian Mongoose *Herpestes javanicus*. These three species were recorded mainly by camera-traps. There were few suitable pathways for spotlighting in the U Minh Ha FFEs, so nearly all spotlighting involved going along canals in a small boat with a loud outboard engine, allowing search only of vegetation along the canal embankments. Controlling pace and noise, important when spotlighting for small carnivores, was difficult. The low number of Small-toothed Palm Civet records relative to the camera-trapped species may reflect limitations of spotlighting in this habitat type, more than Small-toothed Palm Civet's relative status in this area.

Fig. 1. *Melaleuca cajuputi* being harvested with a Jackfruit tree *Artocarpus heterophyllus* on the canal embankment. This is typical habitat for this field site. U Minh Ha FFEs, Ca Mau Province, December 2010.

Fig. 2. An example of the hunting nets that lined the canal embankments, U Minh Ha FFEs, Ca Mau Province, September 2010.

Ta Kou Nature Reserve, Binh Thuan province

Ta Kou Nature Reserve (NR) is characterised by a dry coastal monsoon climate and includes a 10,762 ha coastal sandy flat area dominated by deciduous dipterocarp trees, and 1,000 ha of evergreen and semi-evergreen forest on the 697 m high Ta Kou Mountain (Hoang *et al*. 2010). Approximately 45,000 people live in the buffer zone, and the nature reserve's biodiversity is threatened by hunting, illegal encroachment and over-exploitation of non-timber forest products (Birdlife International 2004, Luu 2008). The survey site on the mountain has evergreen forest dominated by species of figs *Ficus*. Near the top, mixed broadleaf and bamboo forest is also found.

A spotlighting survey of approximately 40 hours from 17h00 to 23h00 during May–July 2009 and January–April 2010 on Ta Kou Mountain resulted in nine sightings with a total of 18 'animals' (not necessarily all different individuals) in an area within 10°48'39"–54"N, 107°53'56"–57'57"E (all coordinates for this site use the WGS84 datum), whilst about 15 hours spotlighting in the lowland area of the NR resulted in no sightings. The disturbance in the surveyed area gives it the highest level of encroachment in Ta Kou Mountain, although hunting signs were relatively few compared with the other three field sites. The area receives over 200,000 visitors (by day and night) annually, most of whom come to visit its famous pagoda, which has the largest statue of a reclining Buddha in Vietnam.

All Small-toothed Palm Civet sightings were made within about 600 m of the reclining Buddha statue and of the 1.2 ha that was cleared by the NR's management for two pagodas, a cable car station, a guesthouse and restaurants, all for tourists. Hunting traps were rarely seen on Ta Kou Mountain during these surveys in 2009 and 2010, but a group of 20 cable-snares (with an ensnared dead Leopard Cat) and a box trap set for primates were seen. No hunting with guns or crossbows was seen.

The first sighting was made on 1 May 2009 at 19h40. One animal was observed on a small Malaysian *Eugenia* fruit tree (10°48'39"N, 107°53'56"E) planted near the edge of the forest. The distance between animal and observers was 14 m. It appeared to be a juvenile with a head-and-body length less than 400 mm (Fig. 3). The animal showed no fear and kept feeding while spotlit and photographed. After 10 minutes, it moved to another branch, away from the reach of the spotlight.

The second sighting, on 11 July 2009, at 20h45, was of one animal photographed (Fig. 4) feeding on a tall fig tree *Ficus* (10°48'43"N, 107°57'57"E). The animal, an adult male, was about 20 m above ground and about 5 m from the statue. After 5 minutes' observation from about 25 m range, it retreated into the forest.

Fig. 3. Small-toothed Palm Civet *Arctogalidia trivirgata*. Ta Kou Nature Reserve, Binh Thuan Province, 1 May 2009.

Fig. 4. Small-toothed Palm Civet *Arctogalidia trivirgata*. Ta Kou Nature Reserve, Binh Thuan Province, 11 July 2009.

Four Small-toothed Palm Civets were observed and photographed in a tall fig tree (at 10°48'44"N, 107°53'56"E) on 27 January 2010, at 19h40 (Fig. 5). The animal–observer distance was more than 20 m. Near the Civet group was one Indian Giant Flying Squirrel *Petaurista philippensis*. Both species were eating fruits of the same tree, with no conflict. After over 20 minutes' observation, all animals moved away in the same direction.

On 28 January 2010, at approximately 20h30, six Small-toothed Palm Civets were observed and photographed feeding in a fig tree, about 30 m from the Buddha statue (10°48'43"N, 107°57'56"E). The animal–observer distance was about 7 m. At 60 m from the first observation, on 28 January 2010, a solitary Small-toothed Palm Civet was observed climbing on some bamboo (10°48'53"N, 107°53'44"E) at 20h50, near the top of the mountain. This animal–observer distance was only 4 m.

On 27 February 2010, at 19h30, a pair of Small-toothed Palm Civets was observed in a small Java rose-apple tree *Syzygium* near a small stream at 490 m a.s.l. (10°48'51"N, 107°57'42"E). The animal–observer distance was about 7 m. One climbed to a higher branch and retreated into thicker canopy; the other stared at the spotlight, then slowly followed the first.

Fig. 5. Two Small-toothed Palm Civets *Arctogalidia trivirgata*. Ta Kou Nature Reserve, Binh Thuan Province, 27 January 2010.

Fig. 6. Two Small-toothed Palm Civets *Arctogalidia trivirgata*. Ta Kou Nature Reserve, Binh Thuan Province, 20 March 2010.

Fig. 7. Small-toothed Palm Civet *Arctogalidia trivirgata*. Ta Kou Nature Reserve, Binh Thuan Province, 27 April 2010.

Two Small-toothed Palm Civets, which looked to be juveniles, were observed eating figs on 20 March 2010, at about 21h00 (10°48'53"N, 107°57'43"E). The animal–observer distance was 10 m. The animals fed on the figs for 5 minutes after being spotlit and were photographed (Fig. 6). Five days later,

at 21h00, one Small-toothed Palm Civet was observed and photographed on a fig tree (10°48'43"N, 107°57'57"E). After being spotlit the animal stared at the observers for about 3 minutes, and then moved to another branch, away from the reach of the spotlight.

The ninth encounter was on 27 April 2010, at 19h14. A pair of Small-toothed Palm Civets was observed climbing on a small fig tree beside a forest trail (10°48'54"N, 107°57'42"E) (Fig. 7). After observation for about 15 minutes at a distance of 7 m, both civets retreated into the thicker canopy.

Despite a survey lasting over several months, the only other small carnivore species recorded were Yellow-throated Marten *Martes flavigula* and Leopard Cat, each only once or twice. Two captive Large-spotted Civets *Viverra megaspila* were observed in a village near the border of Ta Kou NR, and although exact provenance could not be confirmed, it is very probable they had been sourced from the protected area. The low number of records for other small carnivore species is in obvious contrast to the number of Small-toothed Palm Civet sightings.

Phuoc Binh National Park, Ninh Thuan province

Phuoc Binh National Park (NP), within 11°58'–12°10'N, 108°43'–49'E, covers 19,814 ha, and is on the margins of the Da Lat Plateau. Phuoc Binh NP is covered by hill and montane evergreen broadleaf forest, with some coniferous tree species (Birdlife International 2004). Most of its lowlands have been converted into agriculture. Forested areas up to approximately 1,000 m a.s.l. continue to experience illegal logging and exploitation of non-timber forest products (Tordoff 2002). Above this elevation the forest remains little disturbed, although hunting is prevalent and a key threat to the site's biodiversity (Hoang 2007, Rawson *et al.* 2011), with over 100 cable-snare traps collected during a 10-day survey in 2009 (TVB pers. obs.). During a 10-hour spotlighting survey in August 2009, a Small-toothed Palm Civet was seen at 21h00 on a tree at a measured altitude of 1,024 m a.s.l., in evergreen forest. The animal was 10 m up the tree on a small branch and about 15 m from the observers. On being seen, the civet moved down the tree and approached within 5 m of the observers. It was observed for 5 minutes, and photographed (Fig. 8). The animal then climbed to a higher branch and retreated into the forest.

Fig. 8. Small-toothed Palm Civet *Arctogalidia trivirgata*. Phuoc Binh National Park, Ninh Thuan Province, August 2009.

No other small carnivore species were recorded during the survey. However, Black-shanked Douc *Pygathrix nigripes* and Yellow-cheeked Crested Gibbon *Nomascus gabriellae* were both recorded. The presence of these globally threatened primate species, despite prevalent wildlife hunting and other anthropogenic disturbances, may indicate that the single Small-toothed Palm Civet record is due to low survey effort, rather than an indication of the species's status, and that other small carnivore species may persist in the NP.

Discussion

A previous wildlife survey in the Ke Go Nature Reserve – Khe Net proposed Nature Reserve using diurnal direct observation and ground-level trapping (approximately 50 non-lethal snares set over a maximum of 10 days in mixed forest) failed to find Small-toothed Palm Civet (Eames *et al*. 1994), as did the camera-trapping on the present surveys there (Willcox *et al*. in prep. a). Past camera-trapping in U Minh Thuong National Park, close to U Minh Ha FFEs, also failed to find Small-toothed Palm Civet (Nguyen *et al*. 2004), as did camera-trapping in U Minh Ha National Park and the U Minh Ha FFEs (Willcox *et al*. in prep. b). These records thus add to the many instances elsewhere in South-east Asia (see above) where Small-toothed Palm Civet did not appear on photographs from camera-traps although spotlighting or other techniques showed it to be present. Previous records of Small-toothed Palm Civet across Vietnam with altitude traced by Roberton (2007) came only from the narrow range of 600–750 m; these records extend the documented altitude range of the species from sea-level to over 1,000 m a.s.l., consistent with elsewhere (e.g. Duckworth 1995, 1997).

Dang & Pham (1974) collected two Small-toothed Palm Civet specimens in Hoa Binh province and noted that up until then very few specimens had been lodged in Vietnamese collections. Quoting the villagers around the two collection sites as saying that they very often saw and hunted the species, they themselves opined that it was probably scarce. This thinking probably guided its assignment of the 'Rare' category in the 2000 edition of the Vietnam Red Book (MoSTE 2000) and Near Threatened in the 2007 version (MoST & VAST 2007). Given the records in this paper, the villagers may well have been correct, and these records support Roberton's (2007) suspicion that the species is overlooked, rather than rare, in Vietnam.

The ability of the species to survive in landscapes where hunting, illegal logging and other anthropogenic disturbances are intensive and widespread and where, in some cases, the observation sites are remote from large tracts of less-encroached forest, suggests it is under little threat from these activities. Although this statement is based on incidental sightings from a handful of surveys, all but one of the records (that from Phuoc Binh NP) are the result of intensive field surveys that also collected baseline data on the status of other mammal fauna, including other species of small carnivore, in addition to anthropogenic pressures. The confirmed evidence from these surveys is not contradicted by information from any other Vietnamese site with suitable spotlighting survey.

Hunting and habitat loss appear to have greatly reduced or extirpated most mammal species of a similar and larger size from all four field sites. Intensive camera-trapping that surveyed a number of different habitat and microhabitat types

in Ke Go NR – Khe Net proposed NR produced few mammal records and the fauna was noticeably impoverished. Common Palm Civet, a species commonly active at ground level that is readily recorded using camera-trapping and is known to be tolerant of habitat disturbance (e.g. Su Su 2005), was recorded only twice over the entire survey in this landscape.

Given its persistence in sites where few other mammals of comparable size remain, Small-toothed Palm Civet is unlikely to be a conservation priority in Vietnam. More spotlight surveys in fragmented, isolated, heavily degraded and/or heavily hunted areas would allow a more confident assessment. The addition of 15–20 hours spotlighting into mammal/biodiversity surveys in known Small-toothed Palm Civet habitats could clarify the species's geographical and altitudinal distribution in Vietnam, and keep coarse track of its conservation status, and would be relatively simple. Rigorous population quantification, by contrast, would be challenging: the basic assumptions of available techniques are very difficult to meet when surveying arboreal nocturnal species. Difficulties in applying Distance analysis (or any other line-transect-based population estimation) to nocturnal arboreal mammals were discussed by Duckworth (1998), and similar problems exist for occupancy analysis.

Conservation prioritisation at the site, landscape and species levels is invaluable in optimising the use of limited financial and human resources. The evident positive conservation status of Small-toothed Palm Civet in Vietnam, relative to other small carnivore species, means that survey and conservation resources directed towards sympatric mammal species clearly at high risk of extinction are likely to provide more information of direct management significance. However, the main technique used for intensive wildlife hunting in Vietnam presently is unlikely to affect this arboreal species of civet: ground-level trapping. Should more hunters in Vietnam adopt spotlighting techniques to target arboreal animal species, as observed in the U Minh Ha FFEs, then the conservation status of Small-toothed Palm Civet could conceivably worsen. It is not possible at this stage to speculate meaningfully on how resilient Small-toothed Palm Civet would be to very heavy offtakes. Clear reporting of hunting pressures (specific types and intensities) at field sites, in addition to the spotlighting surveys mentioned in the previous paragraph, will be necessary to track any changes in the species's conservation status.

Whilst Small-toothed Palm Civet in Vietnam presently has an evident positive conservation status, this cannot yet be confirmed for the entire genus. The conservation status of the Javan taxon *A. (t.) trilineata* remains uncertain, and given the paucity of records of it (Eaton *et al*. 2010, Moore 2011) and the possibility that it is a distinct species, clarification of its taxonomic and conservation status is the clear conservation research priority with this genus.

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Detection of Large Indian Civet *Viverra zibetha* in camera-trap surveys in and around Dudhwa National Park in the Terai Region of North India

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Abstract

Large Indian Civet *Viverra zibetha* is a widely distributed small carnivore, but its present distribution in India is poorly documented. In camera-trapping surveys in Dudhwa National Park and adjoining areas, it was recorded in 21 of 538 trap-sites operated between December 2010 and June 2012. Camera-traps were deployed in forests from the sub-Himalayan Nandhour River region to Katerniaghat Wildlife Sanctuary in the Terai Arc Landscape of India. Most records came from Dudhwa National Park. The westernmost location where Large Indian Civet was camera-trapped is the Nandhour region. Possible causes for low capture rates and non-detection of the species in some patches are presented. Data of this nature collected over a longer time-span will clarify the distribution, habitat preferences, ecological attributes and population status of small carnivores such as Large Indian Civet.

Keywords: deciduous forest, extension of known range, fragmentation, monitoring, Terai Arc Landscape

उत्तर भारत के तराई क्षेत्र में दुधवा नेशनल पार्क तथा समीपवर्ती क्षेत्रों में कैमरा ट्रैप सवेक्षण के दौरान बडा भारतीय मुश्कबिलाव (*विवेरा जिवेथा*) की उपस्थिति दर्ज होना

सारांश

बडा भारतीय मुश्कबिलाव (*विवेरा जिवेथा*) विस्तृत भू भाग में पाया जाने वाला छोटा मांसाहारी जीव है, परन्तु भारत में इसकी वर्तमान स्थिति अच्छी तरह लिपिबद्ध नहीं की गयी है। दुधवा राष्ट्रीय उद्यान तथा समीपवर्ती क्षेत्रों में कैमरा ट्रैप कार्य के दौरान, दिसम्बर 2010 से जून 2012 तक यह जीव 538 कैमरा ट्रैप स्थलों में से 21 जगह दर्ज किया गया। ये कैमरा ट्रैप भारत के तराई आर्क भू क्षेत्र में उप हिमालयन नंधौर नदी क्षेत्र से कतर्नियाघाट वन्य जीव विहार तक लगाये गये थे। इस जीव की सर्वाधिक उपस्थित दुधवा राष्ट्रीय उद्यान में दर्ज की गयी। कैमरा ट्रैप के आंकड़े बताते हैं कि तराई आर्क भू क्षेत्र में नंधौर क्षेत्र बडा भारतीय मुश्कबिलाव की पश्चिम दिशा में उपस्थित हेतु अंतिम क्षेत्र है। इस प्रजाति के कुछ क्षेत्रों में कम पाये जाने तथा न दर्ज होने के संभावित कारण प्रस्तुत किये जा रहे हैं। लम्बे समय तक इस प्रकार के आंकड़े जमा करने पर छोटे मांसाहारी जीवों जैसे बडा भारतीय मुश्कबिलाव की उपस्थित, अनुकूल आवास तथा पारिस्थितिकीय जरूरतों जैसे कारक स्पष्ट हो सकेंगे।

मुख्य शब्द– पर्णपाती वन, जंगल का बटना, अनुश्रवण, तराई आर्क भू क्षेत्र

Introduction

Large Indian Civet *Viverra zibetha* is a small carnivore of the family Viverridae with legislative protection under Schedule II of the Wildlife Protection Act (1972) of India; Schedule II represents species listed for prohibition of hunting under the Act (MoEF 1972). Large Indian Civet is categorised as Near Threatened on *The IUCN Red List of Threatened Species* (Duckworth *et al.* 2008). It is widely distributed in Southeast Asia (e.g. Corbet & Hill 1992, Gray *et al.* 2010, Jennings & Veron 2011) and, apparently more sporadically, in Nepal and India (e.g. Prater 1948). Joshi *et al.* (1995) indicated its occurrence in Chitwan National Park (= NP), Nepal, and it has been camera-trapped recently in Parsa Wildife Reserve, Bardia NP and Shukhlaphanta Wildlife Reserve there (N. Subedi, National Trust for Nature Conservation, Nepal, *in litt*. 2012). Within India, Prater (1948) stated that the species occurs in Sikkim, upper Bengal and northeast India, and was a common carnivore of Sikkim and Darjeeling. Although Corbet & Hill (1992), Prater (1948) and Lydekker (1907) showed the species to occur in the Nepal Terai, these authors do not indicate its presence in the Indian Terai states of Uttar Pradesh and Uttarakhand which are near, and in some cases connected with, Civet-occupied areas in Nepal. A report of a Large Indian Civet in Himachal Pradesh (Archana *et al*. 2001), disjunct and well west of the documented Indian range, contains photographs showing it to be based on the erroneous identification of a dead palm civet (Paradoxurinae; K. Kakati *in litt*. 2012). To date, the distribution of Large Indian Civet in India remains poorly documented, and little is known of its ecology from anywhere in its range.

Study sites and methods

Camera-traps were deployed in four forest patches within the area of 29°12'–28°08'N, 79°35'–81°19'E (WGS 1984 datum) along Indian parts of the Terai Arc Landscape, namely: Katerniaghat Wildlife Sanctuary (with camera-trapped area of about 400 km^2, 28°23'–28°18'N, 81°02'–81°19'E); Dudhwa National Park (about 600 km^2, 28°37'–28°20'N, 80°32'–80°55'E); connected forest patches of Kishanpur Wildlife Sanctuary (about 200 km^2, 28°26'–28°13'N, 80°19'–80°29'E) and Pilibhit Forest Division (about 600 km^2, 28°49'–28°19'N, 79°54'–80°20'E); and Nandhour River region (about 400 km^2, 29°13'–29°02'N, 79°35'–80°04'E). Nandhour includes parts of Haldwani, Champawat and Terai–East Forest Divisions. Low-lying Terai habitats in the study area (such as sites within Dudhwa Tiger Reserve)

are represented by the following vegetation types (defined following Kumar *et al.* 2003, Midha 2008): Sal *Shorea robusta*-dominated forests (Dense Sal, Moderately Sal, Mixed Sal and Open Sal forests), other forests (Mixed Deciduous, Tropical Semi-evergreen, Tropical Seasonal Swamps, *Terminalia alata-Acacia catechu-Dalbergia sissoo* forest, *Aegle*-dominated forest) and grasslands (Upland and Lowland Grasslands). In addition to these forest types, in the mountainous regions of the Nandhour and Ladhiya river valleys, stands of montane vegetation including pine *Pinus* and oak *Quercus* are found.

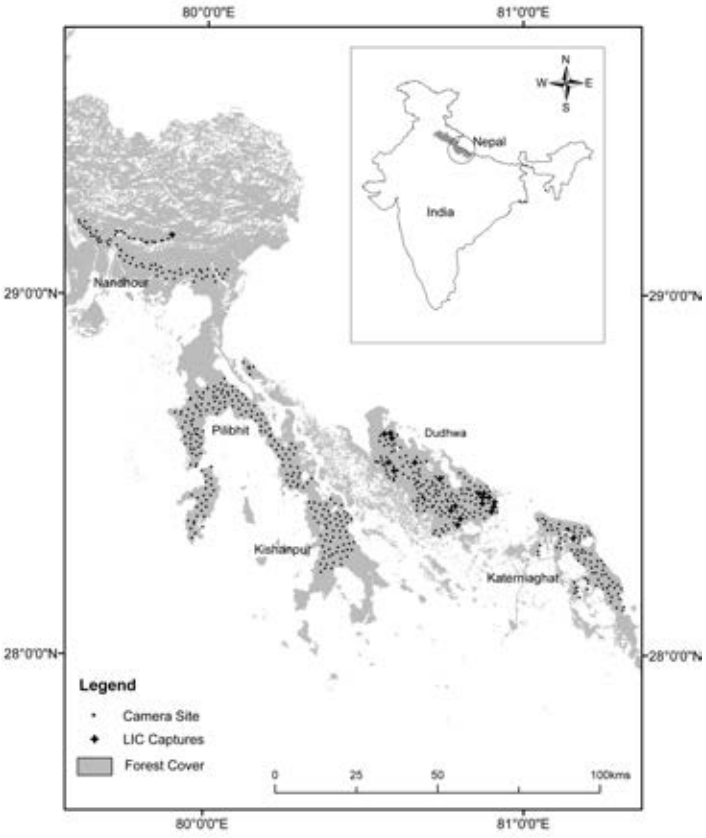

Fig. 1. The survey area in the Terai–Bhabar region, India, 2010–2012, showing camera-trap sites with Large Indian Civet *Viverra zibetha* captures.

Camera-traps surveys, directed primarily towards Tigers *Panthera tigris*, covered over 2,000 km^2 of forest patches (Fig 1). Each camera station, placed about 2 km apart from any other, comprised a pair of cameras facing each other and secured to trees or poles along forest roads or trails, at 45 cm above the ground. Cameras were functional at each site for 15–40 days during which they were operative throughout the 24-hr cycle. No baits or lures were used. They were monitored by field team at intervals of 2–5 days. These surveys, carried out primarily in the winter and spring seasons, are the most exhaustive of their kind in our study area so far. In the Nandhour region, camera-trap survey effort was higher in the lowlands and prominent river valleys than in the interior mountainous zone; we surveyed about 40% of high-quality Tiger habitat here. Table 1 summarises the total effort at each survey site, and the number of independent captures, capture rate and locations of capture of Large Indian Civet at each. 'Independent captures' are photographs that were captured at least 30 minutes from the previous one of the same species (see O'Brien *et al.* 2003). The 'capture rate' is the total number of trap-nights required per independent capture of Large Indian Civet.

Results

We obtained 38 independent captures of Large Indian Civet with effort of over 10,000 trap-nights, recorded in 21 of the 538 camera stations located in Terai–Bhabar region of North India over the period December 2010–July 2012 (Table 1, Fig. 1). The spatial frequency of occurrence (number of sites with capture/total number of sites) of the species in our study area is 0.039. All photographs showed single Civets. All were taken at night.

Of the sites surveyed, Dudhwa National Park recorded by far the highest rate of Large Indian Civet captures (providing 95% of all captures; Figs 2–3), whereas only a single capture each was obtained at Nandhour and at Katerniaghat Wildlife Sanctuary. Survey effort in Katerniaghat was similar to Dudhwa. We obtained no pictures of Large Indian Civet from camera-traps in Pilibhit Forest Division and Kishanpur Wildlife Sanctuary, which together account for about 800 km^2 of the total study area (40% of the overall area, and 40% of total

Table 1. Summary of Large Indian Civet *Viverra zibetha* camera-trap records at different sites in the Terai–Bhabar region, India, 2010–2012.

Site	N° trap stations operated (n° trap-nights)	N° independent captures[1]	Capture rate[2]	Capture locations (outermost)
Pilibhit Forest Division	157 (>2,400)	-	-	-
Kishanpur Wildlife Sanctuary	63 (2,648)	-	-	-
Nandhour (Haldwani, Champawat and Terai – East Forest Divisions)	74 (1,473)	1	1,473	29°09'54"N, 79°53'24"E
Dudhwa National Park	159 (2,626)	36	72.9	28°21'48"N, 80°34'04"E (N); 28°21'48"N, 80°47'38"E (S); 28°25'38"N, 80°54'36"E (E); 28°35'20"N, 80°34'36"E (W)
Katerniaghat Wildlife Sanctuary	85 (>2,100)	1	>2,100	28°19'34"N, 81°9'22"E

[1]See text
[2]Trap-nights per capture of Large Indian Civet

Fig. 2. Large Indian Civet *Viverra zibetha*, Dudhwa National Park, India, 29 February 2012.

Fig. 3. Large Indian Civet *Viverra zibetha*, Dudhwa National Park, India, 24 February 2012.

camera-trap stations). We do not conclusively rule out the existence of Large Indian Civet in this forest patch, but these data clearly suggest that this species, if present there, is scarce.

In addition to Large Indian Civet, Common Palm Civet *Paradoxurus hermaphroditus*, Small Indian Civet *Viverricula indica,* Himalayan (= Masked) Palm Civet *Paguma larvata*, Rusty-spotted Cat *Prionailurus rubiginosus*, Jungle Cat *Felis chaus*, Fishing Cat *Prionailurus viverrinus*, Leopard Cat *Prionailurus bengalensis* and unidentified mongooses *Herpestes* were camera-trapped in the study area.

Discussion

This proof of Large Indian Civet in and around Dudhwa National Park, India, represents a small westward extension of known range for the species, from its occurrence in proximate areas in Nepal (Prater 1948, Joshi *et al.* 1995). The species was either unrecorded or undocumented in previous surveys of this part of India (e.g. De 2001, Jhala *et al.* 2011, Mathur *et al.* 2011, Verma 2011). The marked difference in number of captures between Dudhwa and surrounding sites suggests a genuine pattern in Large Indian Civet status. Habitat or patch connectivity, in combination with factors such as, perhaps, forest type, understorey characteristics, and the types and levels of human activities, may influence the persistence of this species in remnant habitat patches in the Indian Terai.

We believe that this species was previously unrecorded in this region because it appears to occur locally and at low densities. Its nocturnal, forest-dwelling characteristics reduce its contact with humans. Reasons underlying the species's sporadic distribution (and apparent variation in abundance) are hard to pin-point, but several factors may be relevant.

Forest type may be an important determinant for the occurrence of Large Indian Civet. Within Dudhwa, Large Indian Civet captures were predominantly in mixed forest patches of various species composition (comprised of trees such as *Termanalia tomentosa*, *Syzigium cumini*, *Careya arborea*, *Lagerstroemia parviflora* and *Ficus,* in association with *Shorea robusta*). The understorey in such forests is dominated by *Flemengia*, regenerating *Mallotus phillippensis* and a variety of grasses and sedges. Relatively fewer Large Indian Civet captures were recorded in Sal-dominated forests and extensive tall-grassland tracts. Although Kishanpur, Pilibhit and Katerniaghat, the other sites in this study that are classified as Terai habitat, have similar forests, vegetation maps developed by Midha (2008) indicate that mixed forests, where Large Indian Civet were photographed most frequently, are situated primarily in the eastern areas of Dudhwa NP. The Nandhour region is represented by tracts of Sal, mixed montane forests and riparian vegetation, but lacks the marsh lands and grassland tracts found in the other sites.

Additionally anthropogenic pressure, including forest management (clearing of understorey and burning) might also influence small carnivore presence. In general, Nandhour, Katerniaghat and Pilibhit experience higher such pressures, with humans collecting wood and grass, harvesting timber and grazing by cattle, than do Kishanpur Wildlife Sanctuary and Dudhwa NP. Pilibhit Forest Division is a site with intensive commercial tree-felling operations by the state Forest Department.

Finally, it seems reasonable to speculate that the loss of connectivity between these various Indian sites and from proximate Nepal forests might also affect the distribution of small carnivores, which might not disperse effectively across large patches of agriculture, or cross roads and canals in the matrix between forest patches (Mathur *et al.* 2011). This may work in combination with the other factors discussed here. We recommend that long-term Tiger monitoring programmes also maintain a database for species such as Large Indian Civet, and monitor the occurrence of these species in the landscape over time.

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A Spotted Linsang *Prionodon pardicolor* observation from eastern Thailand

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Abstract

A Spotted Linsang *Prionodon pardicolor* camera-trapped on 27 January 2012 in Ta Phraya National Park is the most south-easterly record of the species in Thailand.

Keywords: camera-trapping, Dong Phayayen–Khao Yai Forest Complex, extension of known range, Prionodontidae, Ta Phraya National Park

การพบชะมดแปลงลายจุด *Prionodon pardicolor* ในพื_นท_ีด้านตะวันออกของประเทศไทย

บทคัดย่อ

ชะมดแปลงลายจุด *Prionodon pardicolor* ถูกพบจากการใช้กล้องดักถ่ายภาพเมื_อวันที_ 27 มกราคม 2555ในพื_นท_ีอุทยานแห่งชาติตาพระยาจากตำแหน่งท_ีพบปรากฏอยู่ทางขอบนอกสุดทางด้านตะวันออกเฉียงใต้ของประเทศไทยนามธรรม

Spotted Linsang *Prionodon pardicolor* is a semi-arboreal small carnivore found in much of non-Sundaic South-east Asia, north-east India and southern China (Van Rompaey 1995, Lau *et al*. 2010). It is either rare or elusive in Thailand, because there have been few sightings or collected specimens there, and even current technology (camera-traps) has low detection rates (Lekagul & McNeely 1977, Van Rompaey 1995, Redford *et al.* 2011). The few Thai detections of Spotted Linsang have occurred in several habitat types (forest, grassland, and a mix of scrub and cultivation including plantations), over the elevation range of 560–1,400 m (Van Rompaey 1995, Tizard 2002, Redford *et al*. 2011). Due to the species's perceived tolerance of disturbed habitat and of hunting, Spotted Linsang is listed as Least Concern by *The IUCN Red List of Threatened Species* (Duckworth *et al*. 2008). Its nocturnal and somewhat arboreal habits hinder direct observation, and little is known about the species, including its conservation status (Van Rompaey 1995).

Fig. 1. Spotted Linsang *Prionodon pardicolor* camera-trapped in Ta Phraya National Park, Thailand, on 27 January 2012 at 23h33. Photo has been magnified and cropped.

Ta Phraya National Park, established in 1996, is one of five reserves that comprise eastern Thailand's Dong Phayayen and Khao Yai Forest Complex (DPKY). The park covers 615 km^2 of legally protected land consisting of 75% dry evergreen forest and 25% grassland and scrub (UNEP WCMC 2004). Its long border for its size means that poaching is among the largest threats to its biodiversity (UNEP WCMC 2004).

During a survey for small carnivores within Thailand, we detected a Spotted Linsang on 27 January 2012 at 23h33 with a Reconyx PM75 remote-sensing camera (Fig. 1). It was photographed in dry evergreen forest at 14°07'24.24"N, 102°30'29.88"E (datum WGS84) at approximately 560 m elevation. The species was detected after three months of trapping with 2,504 camera-trap-nights overall and 26 trap-nights at the detection location. No baits or lures were used. The protected area's only previous camera-trap survey, of 985 trap-nights, did not detect Spotted Linsang (Lynam *et al*. 2006). Recently, Redford *et al*. (2011) recorded Spotted Linsang four times in the neighbouring Thap Lan and Pang Sida National Parks, both within the DPKY forest complex. These latter records extended the species's known Thai distribution south, and this record in Ta Phraya National Park extends it eastward by at least 30 km. It is, however, known further to the south-east, in Cambodia (e.g. Holden & Neang 2009).

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Records of Crab-eating Mongoose *Herpestes urva* in Manas National Park, Assam, India

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Abstract

Crab-eating Mongoose *Herpestes urva* was recorded (by direct sighting and camera-trapping) three times in Manas National Park, Assam, India, during 2007–2010, confirming its survival there during a long period of civil unrest.

Keywords: camera-trapping, civil unrest, habitat use

মানাহ ৰাষ্ট্ৰীয় উদ্যানত ৰৱনেউলৰ (*Herpestes urva*) অৱস্থিতি

সাৰাংশ ঃ

মানাহ ৰাষ্ট্ৰীয় উদ্যানত ৰৱনেউলৰ (*Herpestes urva* (হাৰপেষ্টছ আৰ্ভা)) অৱস্থিতিৰ প্ৰমাণ ২০০৭ চনৰ পৰা ২০১০ চনলৈ তিনিবাৰকৈ পোৱা গৈছে (প্ৰত্যক্ষ দৰ্শন আৰু কেমেৰা ট্ৰেপ ব্যৱহাৰৰ দ্বাৰা)। বহু ঘাত-প্ৰতিঘাতৰ মাজতো এই বিৰল প্ৰজাতিৰ নেউল মানাহ ৰাষ্ট্ৰীয় উদ্যানত আজিও দেখা পোৱা যায়। এই প্ৰজাতিৰ ৰৱনেউলৰ অৱস্থিতি সত্য প্ৰমাণিত হৈছে।

মূল শব্দ ঃ কেমেৰা ট্ৰেপ, গণ বিক্ষোভ, বাসস্থানৰ ব্যৱহাৰ

Crab-eating Mongoose *Herpestes urva* is known to use various habitats ranging from open deciduous forest to evergreen forest, from low to high altitudes. Little is known about the species's ecology, demographics and other natural history (Van Rompaey 2001). In India, it is restricted to the northeastern region (Datta *et al.* 2008) and is reportedly fairly common in Assam, Arunachal Pradesh and northern West Bengal (Menon 2003). Datta *et al*. (2008) considered Crab-eating Mongoose to be abundant in Pakke Wildlife Sanctuary, Arunachal Pradesh, comparing its camera-trap capture rates with those of other small carnivores. It is also among the more commonly recorded small carnivores in non-Sundaic Southeast Asia (Duckworth 1997, Than Zaw *et al*. 2008). By contrast, Choudhury (1997a, 1997b) considered that it is seen only rarely in the Indian part of its range.

In Manas National Park (= Manas NP), Assam, India, the long-lasting civil unrest has resulted in declines in various species (Hussain 1989, Rahmani *et al*. 1989). Manas NP faced losing its Greater One-horned Rhinoceros *Rhinoceros unicornis*, and has now only a very small population of Swamp Deer *Rucervus duvaucelii* (Das *et al.* 2009) and a declining population of Hog Deer *Axis porcinus* (pers. obs.). Although these ungulates are now being monitored and are reviving, the lesser-known forms are yet to draw conservationists' attention. So far there is only one published report of Crab-eating Mongoose in Manas NP, during a camera-trap survey for Tiger *Panthera tigris* (Das *et al*. 2007). This note presents three subsequent sightings of this mongoose in the park during 2007–2010, with locations according to the WGS84 datum.

On 25 October 2007 at 13h05, a Crab-eating Mongoose was sighted by JPD and photographed at Fulguri, just touching the Beki river at the end of the dried-up Jungrung stream (26°44'05.6"N, 90°58'30.0"E; elevation 55 m). The animal was running fast towards the river-side and, on realising our presence at about 100 m distance, climbed a slope and disappeared in the undergrowth (Figs 1–2). The vegetation on both sides of the river bed was mixed deciduous forest with dense undergrowth.

Fig. 1. Crab-eating Mongoose *Herpestes urva*, 25 October 2007 at 13h05 in a dry river bed at Fulguri, Manas National Park, Assam, India (J. P. Das).

Fig. 2. Crab-eating Mongoose *Herpestes urva*, 25 October 2007, ascending the dry river-bank, looking at the observer before fleeing into the undergrowth (J. P. Das).

Fig. 3. Two Crab-eating Mongooses *Herpestes urva* camera-trapped on 29 March 2009 in Sorphuli, Manas National Park, Assam, India.

On 29 March 2009, two Crab-eating Mongooses were camera-trapped in the Sorphuli area near a small water-body (26°43'34.42"N, 91°02'54.98"E; elevation 55 m; Fig. 3). This habitat was a moist but drying water-body (10 m radius), shaded with dense mixed vegetation on all sides.

On 27 April 2010, three Crab-eating Mongooses were sighted (by AS) on the way to Kokilabari from Daimary (26°46'20.84"N, 91°01'33.16"E; elevation 100 m). The habitat was again a sandy and rocky dried-up river-bed, emerging from the thick dense semi-evergreen forest on the northern boundary of the park at the international border with Bhutan. On seeing us, the mongooses ran away.

Many small carnivores are not often seen and are hence little known. This species continues to survive in Manas NP despite a significant amount of habitat alteration (Sarma *et al*. 2008) including loss of water-bodies. Researchers tend not to show much interest in small carnivores (Choudhury 1997a, 1997b). Further research could identify if there are any management needs for the species in the national park.

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A record of Striped Hog-nosed Skunk *Conepatus semistriatus* in central Panama, between two known sub-ranges

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Abstract

Striped Hog-nosed Skunk *Conepatus semistriatus* was camera-trapped in central Panama. The photographs, taken in a densely forested area, probably belong to a single, wandering, individual. These photographs represent the easternmost record of *C. semistriatus* in Central America and confirm an earlier, unvouchered, report that its distribution in Panama is larger than previously thought. The record is in the centre of the 700-km wide gap between two sub-ranges, suggesting that the species has a continuous distribution across Central and northern South America.

Keywords: Barro Colorado Nature Monument, camera-trapping, extension of known range, Mephitidae

Registro del Zorrillo *Conepatus semistriatus* entre dos subáreas de distribución conocidas en el centro de Panamá

Resumen

El Zorrillo o Gato Cañero *Conepatus semistriatus* fue fotografiado por cámaras trampa en el centro de Panamá. Las fotografías fueron tomadas en una zona densamente boscosa y pertenecen probablemente a un solo individuo errante. Un reporte anterior indicó que la distribución de la especie en Panamá es más amplia de lo que se pensaba, pero esta se mantuvo sin fotografías o espécimen de respaldo. Nuestras fotografías representan el registro más oriental de *C. semistriatus* en Centroamérica y confirman la extensión de su distribución como se había propuesto anteriormente. Además, el registro se localiza en medio de una zona de 700 km que separa dos conocidas subáreas de distribución, lo que sugiere que la especie tiene una distribución continua a través de Centroamérica y el norte de Suramérica.

Palabras clave: Monumento Natural de Barro Colorado, foto-trampeo, extensión de distribución conocida, Mephitidae

Striped Hog-nosed Skunk *Conepatus semistriatus* is a small carnivore known from three apparently disjunct regions in the Neotropics: from southern Mexico to the western border of Panama; along the South American coastline from Peru to Venezuela; and in an isolated area in eastern Brazil (Fig. 1). In addition, there have been unvouchered records of the species occurring in central Panama (Araúz 2005). Being both nocturnal and solitary, little is known about the basic ecology and behaviour of Central and South American *Conepatus* species (Kasper *et al.* 2009). Hog-nosed skunks are found in both open and wooded areas up to altitudes of 4,100 m, but seem to avoid dense forests (Nowak 2005). In addition, *C. semistriatus* appears to be somewhat adaptable to disturbances and is sometimes found close to human habitation throughout its range (de la Rosa & Nocke 2000, Cuarón *et al.* 2008). Although the species is listed by *The IUCN Red List of Threatened Species* as Least Concern, local populations may be affected by hunting, use of pesticides and due to road kills (Cuarón *et al.* 2008, Alves *et al.* 2009, Kasper *et al.* 2009).

Between 17 and 25 March 2010, ten unbaited camera-traps (Rapidfire RC55, Reconyx Inc.) were deployed in a 1 ha plot on the Peña Blanca peninsula of the Barro Colorado Nature Monument in central Panama (79°53'7.684"W, 9°9'42.985"N; map datum WGS84; measured altitude 48 m). The deployments were part of a larger effort to estimate the abundance and diversity of medium- to large-sized terrestrial mammals in 21 1-ha plots spread across the Barro Colorado Nature Monument, including Barro Colorado Island. The Peña Blanca peninsula is a forest fragment of approximately 1,000 ha that is surrounded by water from the Gatun Lake section of the Panama Canal, and by Teak *Tectona grandis* plantations in the south. The peninsula supports secondary semi-deciduous tropical moist forest. Annual rainfall averages 2,600 mm with a pronounced dry season from mid December until the end of April (Dietrich *et al.* 1982, Windsor 1990).

On 19 March 2010, a male *C. semistriatus* was recorded on two camera-traps spaced 50 m apart. The animal first appeared at 02h54, was detected by the second camera-trap at 04h28, then re-appeared on the first camera-trap at 04h38 (Fig. 2). Another capture was recorded by the latter camera-trap on 20 March, at 01h30. Sets of ten cameras that were deployed in two other parts of the Peña Blanca peninsula and at 18 locations elsewhere in the Barro Colorado Nature Monument did not capture *C. semistriatus*. Camera-trapping effort in the plot where the animal was detected was 80 trap-days, and the total camera-trapping effort for the entire Barro Colorado Nature Monument was 1,717 trap-days.

Habitat use by *C. semistriatus* appears to be diverse. In Brazil, the species is mainly found throughout the Cerrado and Caatinga, i.e., the savannah and shrubland ecoregions, respectively, where it seems to avoid dense forests (Cheida *et al.* 2006, Kasper *et al.* 2009). It has therefore been suggested that extensively forested areas could pose a barrier to the species's distribution in Brazil (Kasper *et al.* 2009). Yet Ferreira (2008) recorded *C. semistriatus* in riparian forests within the Cerrado and Caatinga biomes, but only during the dry season, suggesting that these

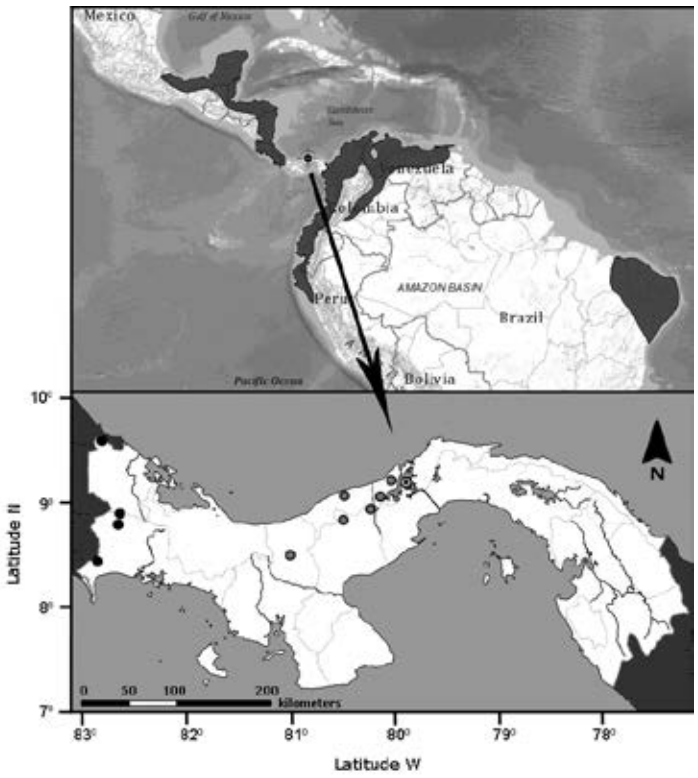

Fig. 1. Upper map: formerly assessed geographical distribution of Striped Hog-nosed Skunk *Conepatus semistriatus* with Peña Blanca peninsula (site of the new record) indicated by a crosshair (map modified from Cuarón *et al.* 2008). Lower map: historical and new records for Panama. Black circles represent museum records (NMNH 2011) while dark grey circles indicate personal observations by Araúz (2005). The Peña Blanca peninsula, in the centre of the Panama Canal, is indicated by a light grey circle with a dark centre.

forests (which are <100 m wide) may serve as a seasonal refuge (Ferreira 2008). In contrast, Medellin *et al.* (1992) captured an adult male *C. semistriatus* in a large primary tropical rain forest in southern Mexico, and in Venezuela a single radio-collared female spent over 60% of her time in closed forests and woodlands, regardless of season (Sunquist *et al.* 1989).

In Panama, observations of *C. semistriatus* all originate from disturbed landscapes, such as forest edges and clearings adjacent to agricultural lands, and coffee plantations surrounded by pastures and secondary forest fragments (Araúz 2005). The new records presented here were located 3.5 to 4 km from the southern land-edge of the densely forested Peña Blanca peninsula, where it adjoins a Teak plantation of roughly 1,000 ha. Beyond this plantation, the landscape is dominated by agriculture and pastures, interspersed with small forest fragments and rural villages. No other records of *C. semistriatus* exist for the Barro Colorado Nature Monument, despite its long history of extensive studies. This suggests that *C. semistriatus* is an uncommon visitor to the densely forested parts of the Canal area, and that our records possibly belong to a single wandering individual.

The historically known distribution of *C. semistriatus* in Panama is based on museum records, all of which originate from localities close to the border with Costa Rica. More recently, Araúz (2005) reported personal observations of the species in the provinces of Veraguas, Coclé and Colón, some

Fig. 2. A male Striped Hog-nosed Skunk *Conepatus semistriatus* captured by two different camera-traps in the Peña Blanca peninsula of the Barro Colorado Nature Monument, central Panama, March 2010.

35 km west of the Peña Blanca peninsula (Fig. 1). Araúz's sightings, albeit unvouchered, indicated that the distribution of *C. semistriatus* in Panama is larger than previously thought, stretching from the Costa Rican border until the western limits of the Panama Canal. Our photographs represent the eastern most record of *C. semistriatus* in Central America and confirm the species's range as proposed by Araúz (2005), extending approximately 300 km east from Cerro Punta, Chiriquí. Moreover, the Peña Blanca peninsula is in the centre of the 700 km-wide gap that separates the known Colombian and Central American sub-ranges of *C. semistriatus*, which suggests that these two sub-ranges may in fact be connected.

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Records of Siberian Weasel *Mustela sibirica* and Yellow-bellied Weasel *M. kathiah* from Makalu–Barun National Park, Nepal

Yadav GHIMIREY* and Raju ACHARYA

Abstract

Two species from family Mustelidae rarely recorded in Nepal, Siberian Weasel *Mustela sibirica* and Yellow-bellied Weasel *M. kathiah*, were recorded for the first time in the Makalu–Barun National Park in eastern Nepal during a field survey in 2009–2010. This is probably the first photograph or video record of each species in the country.

Keywords: camera-trapping, Data Deficient, Least Concern, rhododendron

मकालु-बरुण राष्ट्रिय निकुन्ज, नेपालबाट साईबेरियाली मल्सांप्रो (*Mustela sibirica*) र पितोदर मल्सांप्रोको (*Mustela kathiah*) रेकर्ड

सारांश

नेपालमा बिरलै भेटिने मुस्टेलिडे (Mustelidae) परिवारका दुई मल्सांप्रो प्रजातिहरु, साइबेरियाली मल्सांप्रो (*Mustela sibirica*) र पितोदर मल्सांप्रो (*Mustela kathiah*), मकालु-बरुण राष्ट्रिय निकुन्जभित्र २००९-२०१० तिर गरिएको अध्ययनको क्रममा पहिलो चोटी भेटिएका छन्। यी भिडिओहरु सम्भवतः नेपालमै यिनको पहिलो रेकर्ड हो।

Introduction

Mustela is the largest genus in the family Mustelidae, treated by different authors as containing 14–17 species (Corbet 1978, Corbet & Hill 1980, 1992, Abramov 2000, Macdonald 2001, Wozencraft 2005). Five species, namely Stoat ('Ermine' in North America) *M. erminea,* Siberian Weasel *M. sibirica,* Yellow-bellied Weasel *M. kathiah,* Mountain Weasel *M. altaica* and Stripe-backed Weasel *M. strigidorsa* have been recorded from Nepal (Baral & Shah 2008), although Abramov *et al*. (2008) considered that there were no acceptable records of Stripe-backed Weasel from the country. This paper discusses the first records of Siberian Weasel and Yellow-bellied Weasel from the Makalu–Barun National Park in eastern Nepal. Both species are poorly known in the country (Jnawali *et al.* 2011). Among the carnivores in Nepal, weasels are the most neglected as far as scientific studies are concerned. There have been no studies exclusively targeted to weasels in the country, a situation typical in South and South-east Asia.

Survey area and methods

Makalu–Barun NP covers 1,500 km^2, with 830 km^2 of buffer zone where about 40,000 subsistence agriculturalists reside under the remit of 12 Village Development Committees (VDCs; Zomer *et al*. 2001). Average annual precipitation is 4,000 mm. This protected area exhibits a high diversity of vegetation types: tropical Sal *Shorea robusta* forest below 1,000 m altitude; subtropical *Schima–Castanopsis* forests between 1,000 and 2,000 m; temperate broadleaf forests between 2,000 and 3,000 m; subalpine conifer forest with stands of Himalayan Birch *Betula utilis* and *Rhododendron* between 3,000 and 4,000 m; and alpine pastures above 4,000 m with juniper *Juniperus*, aromatic herbs and dwarf rhododendron *Rhododendron* (Zomer *et al.* 2001).

Camera-trapping was the primary method during a field survey in 2009–2010, with sign surveys also conducted. Twenty-one body-heat sensor camera-traps were placed on trails. Northern Clouded Leopard *Neofelis nebulosa* was the main target species, so camera-traps were mounted on trees at a height of 30–60 cm (Ghimirey *et al.* 2012). The units were operated for the full 24 hour cycle except for those cameras (two units) used in movie mode (for only 20 days in total): these ran in daylight only, because there was no light back-up for the night. Lures or baits were not used during most of the survey, but dried meat was used for a week at one site where apparent Yellow-throated Marten *Martes flavigula* faeces were recorded. Locations are given to the datum of WGS84.

Observations

Siberian Weasel and Yellow-bellied Weasel were camera-trapped once each, in 1,184 trap-nights (Fig. 1). Both records were made with the two cameras in movie mode, during daylight, with no precise time recorded.

A Siberian Weasel was camera-trapped on 15 November 2009 inside Makalu–Barun NP at 27°48'20.58"N, 87°15'51.72"E at a recorded altitude of 3,183 m. The movie was taken in subalpine grassland with scattered rhododendron

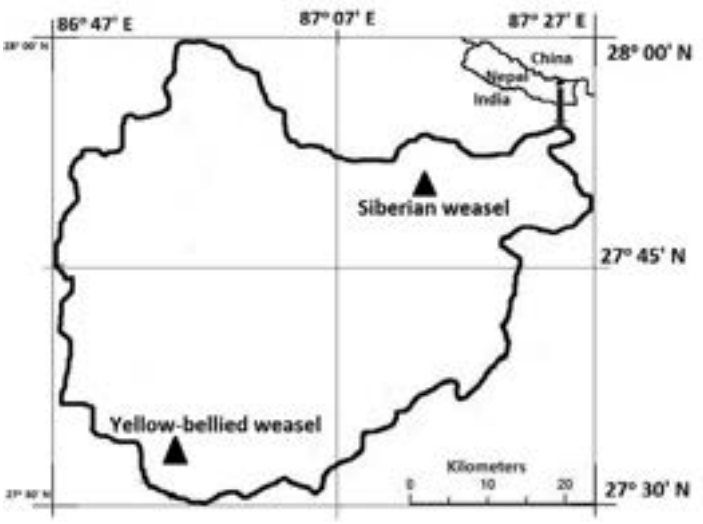

Fig. 1. Makalu–Barun National Park, Nepal, with camera-trap locations of Siberian Weasel *Mustela sibirica* and Yellow-bellied Weasel *M. kathiah*.

trees (locally called 'kurlingo'; a white-flowered species). We also recorded a Yellow-throated Marten pair at the same log where the weasel was captured. Pocock (1941) said that Siberian Weasel occurs only above 3,000 m in Nepal, in accord with this record. The area is within the Saldim valley, a strict nature reserve. The area is undisturbed during most of the year, but some herders keep their cattle and sheep there in summer and monsoon. Hunting and trapping, to which weasels may be vulnerable, are frequent at these times. The video allows no stills of printable quality, but was shared with several people, including A. V. Abramov, who concurred with identification as Siberian Weasel. The animal shows a small black tip to the tail. Although this species's tail is often said to lack a dark tip, A. V. Abramov (*in litt*. 2012) confirmed that such a tip (smaller than on *M. erminea*) is common in the populations in South Asia and China. The video also shows the species's characteristic tail-shape: bushy, thinning to the end.

A Yellow-bellied Weasel was camera-trapped on 9 June 2010, at 27°27'23.04"N, 86°59'54.72"E at a recorded elevation of 2,457 m, in the Sisuwa river valley southwest of the park, in the buffer zone. The habitat is dominated by oaks *Quercus.* During summer and monsoon seasons, the area is disturbed by herders and their livestock; trapping and hunting of the local wildlife is then rampant. People from the nearest villages, Tenchhong and Hoyongla, also frequently visit the area to fetch *Himalayacalamus* (a thin bamboo locally known as *malingay nigalo*) for their household requirements, which affects the habitat of these weasels. This video also gave no printable stills, but the identification was validated by others including Kashmira Kakati and A. V. Abramov.

Discussion

Jnawali *et al.* (2011) assessed Siberian Weasel as nationally Least Concern under *Red List* criteria. However, there are so few data for status assessment of this species in the country that it should arguably be considered Data Deficient. Yellow-bellied Weasel's national status is assessed as Data Deficient (Jnawali *et al.* 2011). These may be the first video or photograph of either species taken in Nepal. Effects of potential threats in Nepal to these species are unknown.

Both these species of weasel are categorised as Least Concern globally by *The IUCN Red List of Threatened Species* (IUCN 2011). There is growing evidence that the tropical Asian weasels are not well surveyed by camera-traps (e.g. Duckworth *et al.* 2006, Abramov *et al.* 2008, Supparatvikorn *et al*. in press), so these species may be more common in Nepal than is suggested by the rarity in camera-trap results. Conservation awareness at local levels in Nepal regarding weasels is extremely low. Most local people do not even know that such species exist in the area. This, coupled with the lack of scientific studies of the species, are serious problems for conservation of weasels in Nepal. The smaller carnivore species like weasels that are rarely recorded by typical survey methods, perhaps because of their small build and skulking behaviour, should be high priority for specific scientific investigation.

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Records of Spotted Linsang *Prionodon pardicolor* from Barsey Rhododendron Sanctuary, Sikkim, India

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Abstract

Spotted Linsang *Prionodon pardicolor* was described from Sikkim, but there are few subsequent records from the state. Three camera-trap records from Barsey Rhododendron Sanctuary in April 2012 constitute only the second photographic record of this species from India.

Keywords: altitudinal range, camera-trapping, nocturnal, northeast India, Prionodontidae

Spotted Linsang *Prionodon pardicolor* inhabits much of north and central Southeast Asia, southern China, Nepal and northeast India (Van Rompaey 1995, Holden & Neang 2009, Redford *et al*. 2011). Although *The IUCN Red List of Threatened Species* categorises it as a Least Concern species (Duckworth *et al*. 2008), it is included under Schedule I of the Indian Wildlife (Protection) Act, 1972, providing it with absolute legal protection. In India, Spotted Linsang has been reported only from the northeastern states, widely but sporadically, as reviewed by Lyngdoh *et al*. (2011) and Mahar & Kaul (2012).

Sikkim is the type locality of Spotted Linsang (Wozencraft 2005) but there seem to be few subsequent records from the state. During recent camera-trapping (using Cuddeback Attack units) at the Barsey Rhododendron Sanctuary (Barsey RS; Ghose *et al*. in prep.), Spotted Linsang was photographed three times at two locations about 1.03 km apart (Fig. 1, Table 1).

Spotted Linsang has apparently been camera-trapped only once previously in India: at Namdapha National Park, Arunachal Pradesh (Mohammed Firoz Ahmed verbally 2012). The closest previous record to Barsey RS is not clear; there are several 19th century specimens from Darjeeling, West Bengal (e.g. Van Rompaey 1995), about 25 km away, but their exact collection locations are not known. Van Rompaey (1995) gave an upper altitudinal limit of at least 2,700 m, 300 m below the Sallery Ridge record (at 3,014 m measured altitude). However, there are two historical records with given altitudes much higher than 2,700 m. Both are from Sikkim: from Latchung in the Jellap pass, at 13,000' (= about 4,000 m; Pocock 1939), and from Jeluk, Lingtam (Sanborn 1932), apparently at 10,500' (= 3,200 m; J. W. Duckworth *in litt*. 2012).

Fig. 1. Spotted Linsang *Prionodon pardicolor* records at Barsey Rhododendron Sanctuary, Sikkim, India; (above) and (right top) at Sallery Ridge, (right bottom) at Sallery Nursery.

Table 1. Camera-trapped Spotted Linsangs *Prionodon pardicolor* in Barsey Rhododendron Sanctuary, Sikkim, India.

Location	Lat. N[1]	Long. E[1]	Recorded Altitude[2]	Habitat type	N° photos[3]	Date and time
Sallery Nursery	27°12'34.95"	88°04'27.52"	2,569 m	Oak forest	1	30 April 2012, 23h44
Sallery Ridge	27°13'5.26"	88°04'40.48"	3,014 m	Mixed conifer forest	2	14 March 2012, 00h17; 19 April 2012, 00h58

[1]Coordinates were recorded from a Garmin GPS 72 receiver set to the datum WGS84.
[2]Altitude was measured using the GPS receiver, validated with a Sunoh SAL 7030 altimeter.
[3]The animals photographed at Sallery Ridge are two different individuals.

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A record of Spotted Linsang *Prionodon pardicolor* from West Siang district, Arunachal Pradesh, India

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Abstract

Spotted Linsang *Prionodon pardicolor* is rarely recorded in India. One held captive near the village of Gankak, West Siang district, Arunachal Pradesh, in March 2011 had been caught incidentally by a villager. There was no indication of any trade demand.

Keywords: Adi tribe, captive, trade, trapping

Spotted Linsang *Prinodon pardicolor* is rarely recorded in the northeastern part of India (Choudhury 1999). The species is found in much of non-Sundaic Southeast Asia, southern China, the northeastern part of India, Nepal and perhaps Bhutan (Van Rompaey 1995, Holden & Neang 2009). Although it has been considered to be rare and uncommon throughout its range, it is presently listed as Least Concern on *The IUCN Red List of Threatened Species* (Duckworth *et al.* 2008). It is in Appendix I of CITES. In India, the species is legally protected under the Wildlife (Protection) Act, 1972 which considers it a Schedule I species, a highly protected species under the act (Anon. 2003). Spotted Linsang records from India are summarised in Lyngdoh *et al*. (2011); in addition, skins and skulls were reported by Katti *et al*. (1990), Soud *et al*. (2010) and camera-trap records by Ghose *et al*. (2012) and, from Namdapaha National Park, Arunachal Pradesh, by Aaranyak (2012). Although records come from a wide scatter of localities in the northeastern part of India, nowhere has the species been found commonly.

During a survey of the All India Tiger Census, a captive Spotted Linsang (Fig. 1) was sighted on 29 March 2011 near the village of Gankak, Pumbe, Yomcha circle of West Siang district, Arunachal Pradesh (28°06'25"N, 94°32'15"E). The animal, kept in a bamboo hut in a patch of *jhum* (shifting cultivation) amid subtropical forest, had been caught by a local villager of the Adi tribe in a trap set for pheasants (Phasianidae) and rats (Muridae). The capture site was reportedly in forest about 5–8 km from this hut. The altitude in this area varies from 800 to 1,200 m a.s.l. The nearest protected area to the reported capture site is Mouling National Park, about 50 km distant. Hunting of Spotted Linsang was reported from West Siang district, apparently 70 km from present record (Kumar 1999). The villager mentioned that he might keep the linsang captive for a long duration or might eat it. It was clear that it was not caught or kept for any sort of trade. No further information was obtained from the village with regard to hunting of linsangs or perceived conflict with them.

Fig. 1. Captive Spotted Linsang *Prionodon pardicolor*, village of Gankak, Arunachal Pradesh, 29 March 2011. Photo copyright: Neeraj Mahar.

No other small carnivore species was recorded on this survey; in Gankak, only skulls and skins of other animals such as Red Muntjac *Muntiacus muntjak*, Asian Black Bear *Ursus thibetanus* and Eurasian Wild Pig *Sus scrofa* were found.

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An observation of Malay Weasel *Mustela nudipes* in Gunung Mulu National Park (Sarawak, Malaysia) with a comment on discriminating this species from sympatric orange mongooses *Herpestes*

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Abstract

Malay Weasel *Mustela nudipes*, restricted to Sundaic Southeast Asia, is currently not considered globally threatened. Little is known about its abundance, ecology and behaviour, and it is typically recorded rather infrequently across its range. A 20-second observation from Gunung Mulu National Park, Sarawak, on the island of Borneo is here used to speculate on the species's behaviour. Physical and behavioural characteristics to differentiate Malay Weasel from sympatric orange-coloured mongooses *Herpestes*, particularly involving suboptimal field observations or camera-trap photographs, are suggested.

Keywords: behaviour, diagnostic criteria, field identification, locomotion, morphology, Mustelidae

Satu pemerhatian terhadap Pulasan Tanah *Mustela nudipes* di Taman Negara Gunung Mulu (Sarawak, Malaysia) dengan ulasan mengenai diskriminasi spesies ini dari cerpelai oren *Herpestes* yang simpatrik

Abstrak

Pulasan Tanah *Mustela nudipes*, terhad di Sunda Asia Tenggara, tidak dianggap terancam. Terdapat sedikit maklumat yang diketahui tentang bilangan (abundance), ekologi dan tingkah laku, dan ia biasanya tidak direkodkan dengan kerap dikawasan taburannya. Satu pemerhatian selama 20 saat di Taman Negara Gunung Mulu, Sarawak di pulau Borneo digunakan untuk memberikan tanggapan mengenai tingkah laku spesis ini. Ciri-ciri fizikal dan tingkah laku untuk membezakan Pulasan Tanah daripada cerpelai oren *Herpestes* yang simpatrik, terutamanya yang melibatkan pemerhatian bidang suboptimal atau gambar kamera-perangkap adalah disyorkan.

Malay Weasel *Mustela nudipes* is restricted to Sundaic Southeast Asia. Duckworth *et al*. (2006) collated records of the species and found no site where it was commonly seen. They noted only one camera-trap record, despite many studies in areas known to host the species. Ross *et al*. (2012) documented orange mongooses *Herpestes* within Malay Weasel's geographical range, finding that these confuse at least some observers. Observations of Malay Weasel that detail the basis for identification as that species are now therefore valuable. Some previous observations may have been in error, but for sight records without photographs, there is now no way of determining which ones are reliable.

We observed a Malay Weasel less than an hour before sunset (sunset = 18h12) on 30 May 2010 in the dipterocarp rainforest undergrowth of Gunung Mulu National Park (Sarawak, Malaysia, Borneo). This observation occurred at about 130 m elevation, within 1½ km of the bridge crossing the Melinau River near Camp 5 (which is at 4°11'53"N, 114°55'55"E) on the northeast side of Melinau Gorge and south-facing slope of Mount Api in the general vicinity of M. Meredith's reported 1988 observation (in Duckworth *et al*. 2006). The sighting lasted roughly 20 seconds, during which time the animal's thick tail with flamboyant yellow-white tip was observed held high, contrasting with its orange-brown body. After breaking cover within 10 m of us, the animal moved away from us to one side of the trail in a zig-zag pattern amidst the extensive, open shrub layer, which appeared to consist in part of tree seedlings establishing post-disturbance. The animal continued in this manner with its tail held up until disappearing from view.

Despite the recent evidence that Malay Weasel and sympatric orange-coloured mongooses *Herpestes* can be confused, and our lack of awareness about such mongooses' existence at the time of this observation, we are confident that this animal was indeed a Malay Weasel, for several reasons. The animal's initial close proximity to us allowed a clear albeit fleeting lateral view of it, its thick tail arching high in rooster-like fashion. Conversely, Bornean mongooses have markedly narrower tails, which taper gradually from the base to the tip (in contrast to the animal we observed) and that often trail lower than their posterior (AJG pers. obs.; Ross *et al.* 2012: Figs 1–5). Second, although the animal moved away from us, the forest gap allowed for a largely unobstructed view of its movements and the yellow-white tip of its tail, which contrasted sharply in the fading light. Sundaic mongooses have not been reported with starkly dichromatic tails (they generally appear more or less uniform with the animal's body colour, if not slightly paler); however, future records may reveal exceptions. Third, the animal's movements were decidedly weasel-like in their characteristic 'stop–start' bounding, a trait apparently unique to *Mustela* among mustelids (Taylor 1989, Schutz & Guralnick 2007), and which we have never observed, nor are aware of others observing, in Asian mongooses.

The orange-brown fur of Malay Weasel, contrasting with

a bright yellow or pale tip to the tail, may represent warning coloration (Banks 1980), or, when accentuated by quick changes in direction, attempts to confuse possible predators. We are unsure if the 'zigzagging' we witnessed was hunting or escape behaviour. As with the 'stop–start' motion, we are not aware of 'zigzagging' having been recorded among Asian mongooses, but it is known in weasels. Zuberogoitia *et al*. (2006) observed American Minks *M. vison* moving through dense cover in Spain "carefully within bramble [*Rubus*] thickets in either a straight line or zigzagging, with the nose held close to the ground" (p. 310) and described a "zigzag" pattern used by these Minks when hunting along a river bank. Additionally, AJG has witnessed a Long-tailed Weasel *M. frenata* moving similarly in U.S.A. while actively foraging in a Utah Prairie-dog *Cynomys parvidens* town.

The reliability of field characters potentially distinguishing Malay Weasel from orange mongooses needs confirmation across age and sex classes, states of moult and behaviour, and range and habitats occupied. Because typical past sighting records of Malay Weasel are now open to question (people cannot explicitly exclude during identification the forms that they do not know exist), future records or revalidations of former ones containing apparently diagnostic characters (physical, vocal or behavioural) observed warrant publication, as for other species long-considered difficult to identify, or for any species outside its accepted range (e.g. Giordano *et al*. 2011). With increased understanding of which characters are diagnostic, these records can be subsequently reviewed. As the world's fauna is further studied, other novel challenges in small carnivore field-identification will doubtless emerge. Sighting records preceding such understanding will always remain challenging to assess retrospectively, so objective evidence (photographs, sound-recordings and specimens) is preferred whenever possible. But, unless camera-trapping techniques can be adapted to detect Malay Weasels effectively, sight-records may be more important in clarifying the distribution and habitat use of this species than for many other small carnivores. As in our case, these records are often incidental to formal surveys, so Malay Weasel runs the risk of remaining underreported.

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An observation of Indian Grey Mongoose *Herpestes edwardsii* mating

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Abstract

Indian Grey Mongoose *Herpestes edwardsii* is among the most common small carnivores of the Indian subcontinent, yet its behaviour and ecology are poorly documented. A pair was observed mating, in open scrub, at 07h30 on 24 September 2009. Each of the several copulations took about 30–40 seconds; they were separated by 2–3 minutes.

Keywords: behaviour, copulation duration, copulation style, India, natural history

Indian Grey Mongoose *Herpestes edwardsii* is one of the most commonly found mongoose species in the Indian subcontinent, occurring from the Himalayan foothills south to Kanyakumari and Sri Lanka, extending westward to Arabia and east to Assam (Veron *et al*. 2006). Pondicherry is a union territory situated in Tamil Nadu, southern India. Pondicherry University campus is situated 10 km north of Pondicherry town, at 12°00'57"N, 79°51'31"E. Its scrub and woodlands support carnivores such as Common Palm Civet *Paradoxurus hermaphroditus*, Grey Mongoose and Golden Jackal *Canis aureus*. Some large birds of prey, such as Indian Eagle Owl *Bubo bengalensis*, exist in the campus. The vegetation is dominated by *Phoenix pusilla*, *Jasminum angustifolium* and *Acacia auriculiformis*, intermixed with plantations of Teak *Tectona grandis* and *Eucalyptus*.

Fig. 1. A pair of Grey Mongooses *Herpestes edwardsii* mating in Pondicherry University campus, India, on 24 September 2009.

Under slightly overcast conditions at 07h30 on 24 September 2009, we were returning from birding in the campus when, in an area dominated by scrub-like vegetation thick with *Jasminum* bushes, with open canopy dominated by *Acacia*, we saw two Grey Mongooses running one behind the other. From behind a large *Jasminum* about 20–30 m from the pair, we silently observed them. They seemed quite oblivious to our presence. The pair exhibited playful behaviour in which they mock-attacked each other for about 5 minutes, after which they copulated about 2–3 times. During copulation, the female lay on her abdomen (Fig. 1), facing her head forward and looking sidewise, whereas the male apparently concentrated on mating, not looking at the surroundings. Each copulation took about 30–40 seconds. after which the male tried to push the female. They remained parted for about 2–3 minutes, then again the female allowed the male to mount again. This behaviour lasted for about 10–13 mins, after which the pair disappeared into bushes. These observations echo those of captives by Frere (1929), who mentioned that "the act (copulation) was repeated half a dozen or more times at intervals of few minutes on each occasion". We could not trace any other information on mating in this species. Prater (1971) noted the post-mating behaviour, but did not detail copulation, and Pocock (1941) made reference only to Frere (1929).

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First record of Honey Badger *Mellivora capensis* from Fars province, Iran

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Abstract

On 4 February 2012, the carcass of an adult Honey Badger (Ratel) *Mellivora capensis* was found in the village of Sar Mashhad in the Dadin area, 120 km southwest of Shiraz city. The Honey Badger appeared to have been shot, presumably by local people. This is the first confirmed record of this carnivore in Fars province; there are only a few records available from anywhere in Iran in recent years. This record is located between two areas of known Honey Badger distribution in Iran, in the southwest and centre, suggesting that they may not, after all, be disjunct.

Keywords: beekeeping, distribution range, mountain woodlands, Ratel

اولین گزارش از رودک عسلخوار *Mellivora capensis* در استان فارس، ایران

چکیده

در 15 بهمن ماه 1390، لاشه یک عدد رودک عسلخوار بالغ در نزدیکی روستای سر مشهد از بخش دادین که در 120 کیلومتری جنوب غربی شیراز قرار دارد یافت شد. این نمونه که احتمالاً توسط مردم محلی مورد هدف قرار گرفته بود، اولین گزارش مستند از این گوشتخوار کوچک جثه در استان فارس است، در حالی که در سال های اخیر گزارش‌های بسیار کمی از این گونه در ایران به دست آمده است. همچنین، این گزارش ما بین پراکندگی گذشته این گونه در جنوب غربی و مرکز ایران قرار دارد.

کلمات کلیدی: گستره پراکندگی، زنبورداری، درختزارهای کوهستانی

Honey Badger (Ratel) *Mellivora capensis* has an extensive range in most of sub-Saharan Africa and through the Middle East as far north as Turkmenistan and southwest Kazakhstan, then eastwards to India and Nepal. But it is considered rare or to exist at low densities across most of its range (Vanderhaar & Hwang 2003, Begg *et al*. 2008).

Honey Badger has a disjunct recorded distribution in Iran (Karami *et al*. 2008). It is believed to be among the rarest mammals of the country and has been recorded only from Dez Wildlife Refuge and Ram Hormoz in Khuzestan province in the southwest; from Boroueiyeh Wildlife Refuge in Yazd province and Khabr National Park in Kerman province in the central part of the country; and from near Gorgan and along the Atrak river in Golestan province in the northeast (Fig. 1; Lay 1967, Harrington & Dareshuri 1976, Etemad 1985, Ziaie 2008). Lay (1967) cited another report by Cheesman (1920) from Baksai on the Iran–Iraq frontier in Lorestan province and that is widely reported as in Iran, but it is in fact in Iraq.

Honey Badgers in Iran are thought to belong to *M. c. indica* and *M. c. wilsoni* in the northeast and southwest, respectively (Etemad 1985). A new subspecies, *M. c. buechneri* was named from Turkminestan (Baryshnikov 2000) and presumably oc-

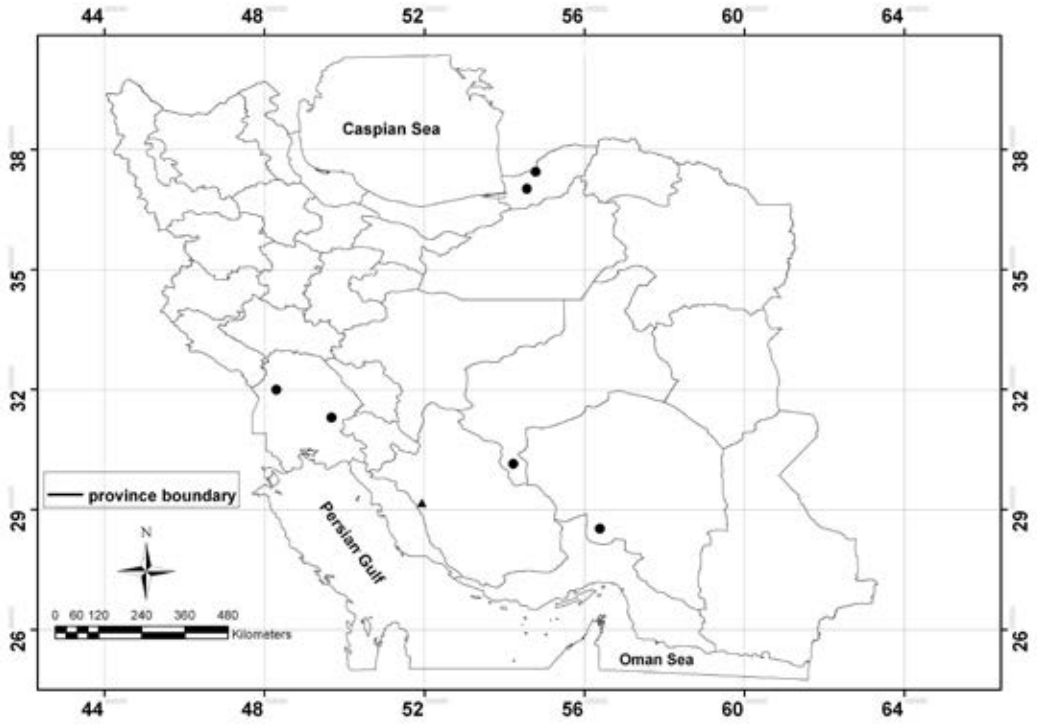

Fig. 1. Confirmed records of Honey Badger *Mellivora capensis* in Iran (circles) taken from Etemad (1985) and Ziaie (2008), and the new locality in Fars province (triangle).

curs in northern Iran (Karami *et al*. 2008). In Iran, this species inhabits a wide variety of habitats such as woodlands, shrub lands around rivers, and also arid and semi arid areas (Ziaie 2008).

On 4 February 2012, a dead Honey Badger was found beside a rural road crossing farmland near the village of Sar Mashhad in the Dadin area (Fig. 2). It seemed to have been killed by gun shot, presumably by local people. The area is located in the west of Fars province, at 29°17'N, 51°44'E and an elevation of 800 m a.s.l., near the border of Bushehr province (Fig. 1).

Dadin is a mountainous area covered with sparse woodland. The main river of this area is the Dadin. *Ziziphus lotus* and *Z. nummularia* are the dominant plant species of Dadin. These plants are important for producing honey, so there are many local people's beehives around this area. All are on the ground, and thus accessible to Honey Badgers. This overlap with Honey Badger range probably leads to some conflict between bee-farmers and this species, as occurs elsewhere in its range (see Begg & Begg 2002), but so far we have no direct information from this area.

Fars province was a gap in the known distribution range of Ratel in Iran, between the southwest and centre. This report suggests that potentially suitable habitats between these two areas should be investigated. Honey Badger status in Fars province could be clarified by more field studies, such as interview with local people and camera-trapping, and also the investigation of possible conflicts with local communities and other threats to the species.

Fig. 2. Dead Honey Badger *Mellivora capensis* in the Dadin area, Iran, 4 February 2012 (photograph: Zolfaghar Salimi).

As the next step, it is important to identify the range and potential dispersal corridors of this species in southwestern Fars province, to assist its conservation. Ratel is a protected species by the Iranian Department of Environment laws, but its effective conservation will require education of local people, and perhaps a monitoring and management plan. If there is significant human–Ratel conflict over raiding of bee-hives, this can often be resolved through hive protection (C. Begg *in litt*. 2012).

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Masked Palm Civet *Paguma larvata* apparently feeding on nectar of *Mucuna birdwoodiana*

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Abstract

Observations made in Hong Kong of Masked Palm Civet *Paguma larvata* visiting *Mucuna birdwoodiana* flowers, apparently feeding on the nectar, suggest that nectar may be an important food source for this species. More field work is needed to answer: how widespread is nectarivory in Masked Palm Civet and other small carnivores, and, how important are Masked Palm Civet and other small carnivores as pollinators of *Mucuna birdwoodiana* and other *Mucuna* species that are currently considered to be bat-pollinated.

Keywords: Hong Kong, nectarivory, pollination, small carnivore

La Civeta Enmascarada de la Palma *Paguma larvata* aparentemente alimentándose del néctar de *Mucuna birdwoodiana*

Resumen

Se realizaron observaciones de la Civeta Enmascarada de la Palma *Paguma larvata* visitando flores de *Mucuna birdwoodiana* en Hong Kong, en las cuales aparentemente se alimentaban de néctar. Estas observaciones sugieren que el néctar puede ser una fuente alimenticia importante para la especie. Se requiere más trabajo de campo para responder: ¿qué tan común es la nectarivoría en la Civeta Enmascarada de la Palma y otros pequeños carnívoros? y ¿qué tan importante es la Civeta Enmascarada de la Palma, y otros pequeños carnívoros, como polinizadores de *Mucuna birdwoodiana* y otras especies de *Mucuna* que actualmente son consideradas polinizadas por murciélagos?

Palabras clave: Hong Kong, nectarivoría, pequeño carnívoro, polinización

On 3 April 2011 at 20h00, a Masked Palm Civet *Paguma larvata* was seen on a flowering *Mucuna birdwoodiana*, a woody liana, in a small patch of *fung shui* wood (a forest patch preserved and/or planted behind a Chinese village to bring good fortune) at 22°18'49.5"N, 114°17'03.7"E and 100 m a.s.l. near Sheung Yeung Village, Clear Water Bay, New Territories in Hong Kong. The civet was about 10 m above ground, just below the tree canopy. Although it was suspected to be feeding on the nectar in the large number of blooming flowers of this vine, it disappeared into the tree canopy before detailed observation could be made. In addition several Leschenault's Rousette bats *Rousettus leschenaulti* were seen visiting the flowers of different individuals of this liana in the forest. The genus *Mucuna* has a wide distribution in tropical America, Africa, Asia and Australia, and the whole genus is considered to be bat-pollinated (Dobat & Peikert-Holle 1985). *Mucuna birdwoodiana* produces large numbers of robust, pale yellow, pungent flowers in long racemes (Fig. 1) in April (Thrower 1983). These flowers appear to be specially adapted to attract fruit bats, such as rousettes, and bat pollination has been confirmed in Hong Kong (Lau 2000). Pollination of plants by mammals other than bats has rarely been reported (Corlett 2004) and Brown Palm Civet *Paradoxurus jerdoni* is the only civet that has been reported to be a pollinator: the observations occurred in the tree *Cullenia exarillata*, while feeding on the flowers (Ganesh & Devy 2000). Masked Palm Civet is reported to eat mostly fruits but will also eat birds, rodents, insects, rodents, shoots and roots, and its diet shifts in relation to fruit availability (e.g. Shek 2006, Zhou *et al.* 2008).

Fig. 1. Raceme of *Mucuna birdwoodiana*, Hong Kong, 30 April 2011.

Because the observation was surprising, against the published record, visits were made in the following nights in the hope of finding the civet again and making more observations to confirm its nectarivory. However, on 4, 5 and 6 April, only Leschenault's Rousettes could be seen visiting the flowers. On 7 April, a Masked Palm Civet was observed on another *Mucuna birdwoodiana* liana in the same forest patch. It was sitting on the liana about 5 m above the forest floor, allowing clear observation. From 21h40 to 22h45, this civet was observed tugging its muzzle among the flowers without chewing, and slowly moving up the liana to reach different racemes on the same plant until it was completely obscured by the thick canopy. In the forest patch just after dark (19h15) the next evening (8 April), a Masked Palm Civet was seen walking along a tree branch at about 5 m above ground, reach a flowering *Mucuna* and display similar behaviour. While observing this animal for about 20 minutes, another Masked Palm Civet was discovered on the same liana, further back among some thick foliage, and apparently feeding on nectar. They stayed on the liana for another 20 minutes. Then one animal moved out of view behind thick foliage. The other fed among the flowers higher in the canopy until 20h31 before disappearing from view. I then left and returned to the forest patch again at 22h10 and observed a Masked Palm Civet apparently feeding on nectar of another *Mucuna* individual until 23h25. Another individual was seen briefly moving on top branches in the canopy at 22h15. During these observations, I heard occasionally the sound of small things dropping to the forest floor beneath the civets; these may have been flowers broken off by the civet. Several Leschenault's Rousettes were seen flying around in the forest and at times landed on *Mucuna* flowers to feed, sometimes within meters of the feeding Civet.

Apparent nectarivory in carnivores has been reported by Yellow-throated Marten *Martes flavigula* feeding on *Cynometra polyandra*, a tree in north-east India (Nandini & Karthik 2007) and by Common Palm Civet *Paradoxurus hermaphroditus* feeding on nectar of Silk-cotton tree *Bombax ceiba* in Nepal (Joshi *et al*. 1995). Photographs of a Masked Palm Civet feeding at Silk-cotton flowers in Hong Kong were taken in March 2006 (http://www.flickr.com/photos/denn) and more sightings of Masked Palm Civet visiting Silk-cotton flowers were made in the area by the photographer and her friends in that season (Denise Chan *in litt*. 2012).

Fig. 2. Masked Palm Civet *Paguma larvata* feeding in *Mucuna birdwoodiana* flowers, Hong Kong, 8 April 2011.

Masked Palm Civet evidently can spend quite a lot of time feeding in *M. birdwoodiana*, presumably on nectar, when it is in bloom (Fig. 2). It also seems that the species may return to feed repeatedly during the rather short flowering period of this liana. In Hong Kong, Masked Palm Civet consumes a lot of fruits, but the availability of fleshy fruits peaks in December and is lowest in May (Dudgeon & Corlett 2004). Hence, nectar may be an important food-source for Masked Palm Civets during a time of the year when few fruits are available. The observations (mentioned above) of Masked Palm Civet repeatedly visiting Silk-cotton flowers, a tree native to tropical South and Southeast Asia and Hainan but only planted in Hong Kong in parks and as roadside trees, further suggest that Masked Palm Civet might readily eat nectar. It would be interesting to determine whether Masked Palm Civet also feeds on nectar of other plant species, how important nectar is in its diet, and how important this small carnivore is as a pollinator to *M. birdwoodiana* and any other species. It might be that nectarivory in Masked Palm Civet and other small carnivores is more common than is documented thus far, because of the nocturnal nature of these animals and the heavily exploited, depleted populations in much of their range make field observations very difficult. The widely adopted method of visual examination of faeces to study diet (e.g. Zhou *et al.* 2008) will not pick up nectar (Joshi *et al*. 1995), although if pollen is also ingested it should be detectable by this method.

What is not clear is how Masked Palm Civets get the nectar from the *M. birdwoodiana* flowers, which are sturdy, papilionaceous with long keel petals that open up later. The calyx is protected by loose hairs (Thrower 1983) which can cause skin rashes in people (Walden & Hu 1976). When checked during the day, damaged flowers could hardly be found on the *M. birdwoodiana* liana and there were only a few fallen flowers scattered on the forest floor. These indicate that Masked Palm Civets did not break into the base of the flowers to get nectar. Do they have tongues long enough to lick nectar from the flowers, or do they wait until the keel petals open? I cannot find information on their tongue morphology; in-depth field study or from observations/experimentation of captive animals would be most informative.

The flowers of *M. birdwoodiana* are robust, mildly pungent with up to 30 flowers in one long raceme. One big liana can produce many racemes and hundreds of flowers open at any one time during the short flowering period. These attributes may be adaptations to attract fruit bats (Dobat & Peikert-Holle 1985), but they also should facilitate use by small carnivores. It would be worth observers paying more attention to other *Mucuna* species during the flowering season, to see if they are also visited by small carnivores and pollinated by them.

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Brown-tailed Vontsira *Salanoia concolor* (Eupleridae) documented in Makira Natural Park, Madagascar: new insights on distribution and camera-trap success

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Abstract

Photographic evidence of Brown-tailed Vontsira *Salanoia concolor* within the Makira Natural Park, northeastern Madagascar, extends the species's known range north and west 60–70 km from previous records and expands its maximum known elevation some 30 m higher, to a recorded elevation of 680 m. *Salanoia concolor* was photographed during two camera-trap surveys (2008, 2010) in the Anjanaharibe region (15°12'09"S, 49°37'20"E) of Makira Natural Park at a total of 10 camera-stations across a 20-station (2008) and 25-station (2010) grid. In addition, *S. concolor* was camera-trapped at four stations within a new camera grid located at 15°16'52"S, 49°46'04"E, 15 km southeast of the Anjanaharibe study site, within degraded forest near the villages of Andongana and Sahavary. *Salanoia concolor* captures and camera-trap success decreased from the 2008 survey (N = 10 and 0.8, SE ± 0.2, respectively) to 2010 (N = 4 and 0.6, SE ± 0.4, respectively). Co-occurrence of *Salanoia concolor* with humans and with domestic dogs *Canis familiaris* was minimal. Likewise, camera-stations recording *S. concolor* did not overlap with those few recording introduced cats *Felis silvestris* and/or *F. catus* (three) or the introduced Small Indian Civet *Viverricula indica* (one). These observations suggest efforts are needed to minimise human encroachment, and to control the spread of introduced carnivores within the natural park.

Keywords: Anjanaharibe forest, introduced carnivores, Malagasy carnivores, photographic sampling

Ny Vontsira Mainty *Salanoia concolor* (Eupleridae) hita tao amin'ny Valanjavaboary Makira: fari-ponenana sy taham-pikarohana vaovao

Famintinana

Ny raki-tsary manaporofo ny fisian'ny Vontsira Mainty *Salanoia concolor* ao amin'ny Valanjavaboary Makira, any avaratra atsinanan'i Madagasikara, dia nahafantarana fa miitatra hatrany amin'ny 60–70 km mianavaratra sy miankandrefan'ny faritra voamarika teo aloha ny faritra itoeran'io karazam-biby io, ary miampy 30 m ny haavo itoerany raha 680 m ny ambony indrindra voarakitra teo aloha. Nandritra ny fikarohana indroa miantoana (2008 sy 2010) natao tao amin'ny faritr'Anjanaharibe (15°12'09"S, 49°37'20"E), dia toerana 10 tamin'ireo toerana 20 (tamin'ny 2008) sy toerana 25 (tamin'ny 2010) nametrahana fakan-tsary no nahitana ny Vontsira Mainty. Nahitana azy ihany koa ny toerana efatra hafa tao amin'ny ala simba manakaiky ny tanànan'Andongona sy Sahavary any amin'ny 15 km atsimo atsinanan'ny toeram-pikarohana ao Anjanaharibe. Nihena ny isan'ny sarim-Bontsira Mainty azo sy ny taham-pahombiazana nandritra ny fikarohana tamin'ny taona 2010 (sary azo = 4; taham-pahombiazana = 0,6) raha miohatra amin'ny fikarohana natao tamin'ny taona 2008 (sary azo = 10; taham-pahombiazana = 0,8). Ity fikarohana ity dia nahatsapana fa vitsy dia vitsy ny *Salanoia concolor* hita tamin'ireo toerana ivezivezen'ny olona sy ny alika *Canis familiaris.* Ary tsy mifanindry amin'ireo toerana nahitana saka-dia vahiny *Felis silvestris* sy/na *F. catus* (telo) na ny karazan-jaboady vahiny *Viverricula indica* (iray) ny toerana nahitana ny Vontsirasavoka. Izany rehetra izany no milaza fa ezaka lehibe no ilaina mba hampihenana ny fivezivezen'ny olona sy ny fiparitahan'ireo biby vahiny mpihinan-kena manta manerana ny Valanjavaboary.

Introduction

The genus *Salanoia* has two species, Brown-tailed Vontsira *S. concolor* (also known as Brown-tailed Mongoose) and the newly discovered Durrell's Vontsira *S. durrelli* (Durbin *et al*., 2010). These are possibly the least known of Madagascar's species of endemic carnivores, which are all in the endemic family Eupleridae (Schreiber *et al*. 1989, Hawkins *et al.* 2008, Goodman 2012). *Salanoia concolor* is listed as Vulnerable by the *The IUCN Red List of Threatened Species* (Hawkins *et al.* 2008) and is believed to be restricted to northeastern rainforests below 650 m (Hawkins *et al.* 2008, Hawkins 2012), while the recently discovered *S. durrelli* has only been found around Lac Alaotra (Durbin *et al*. 2010).

Confirmed records of *S. concolor* are restricted to the Betampona area (Britt 1999, Britt & Virkaitis 2003), Masoala area (Nicoll & Langrand 1989, Schreiber *et al*. 1989, Hawkins *et al.* 2008, Hawkins 2012), Mananara Nord area (Nicoll & Langrand 1989, Schreiber *et al*. 1989), Zahamena area (Hawkins *et al*. 2008), and imprecise localities between Betampona, Zahamena and Masoala (Grandidier & Petit 1932, Albignac 1973; Fig. 1). All observations of *S. concolor* at these sites have been in non-degraded rainforest habitat between 200 and 650 m, and few sightings in the past 15 years have been reported (Hawkins *et al.* 2008, Hawkins 2012). As part of an ongoing study of carnivore ecology in the Makira–Masoala region of northeastern Madagascar, our objective was to assess the presence and relative recording frequency of Brown-tailed Vontsira *Salanoia concolor* within Makira Natural Park, and, if present, to compare its occurrence with that of humans

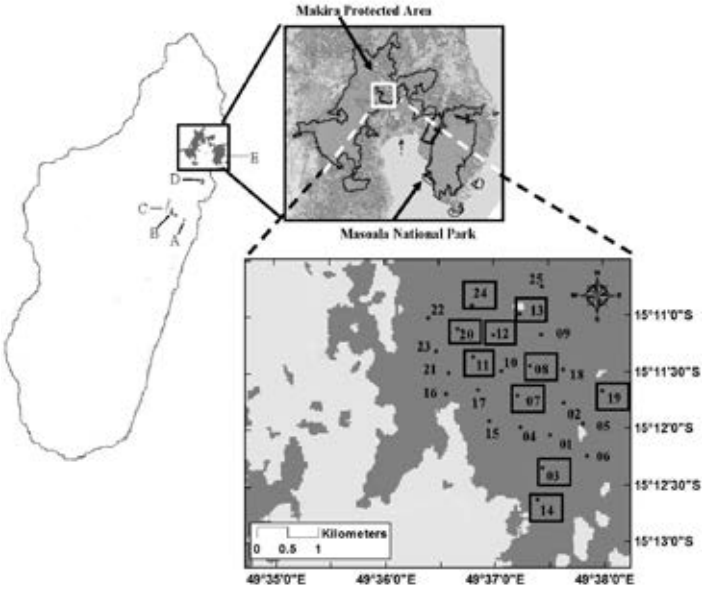

Fig. 1. Madagascar, showing locations of all known documented records of Brown-tailed Vontsira *Salanoia concolor* (A, B, D, E) and Durrell's Vontsira *S. durrelli* (C), and successive insets showing location of the Anjanaharibe study site, and the location of each camera-station (stations 1–20, 2008 and 1–25, 2010). Camera-stations were located inside rainforest habitat (dark grey) with no stations in the degraded/matrix forest (light grey). Boxed locations recorded *S. concolor*. A, Betampona Special Reserve; B, Zahamena National Park; C, Lac Alaotra area; D, Mananara Nord National Park; E, Masoala National Park.

and with those of other carnivores, native and introduced. We predicted there would be avoidance between *S. concolor* and human (non-researcher), introduced domestic cat and/or its wild progenitor *Felis catus* and/or *F. silvestris* (hereafter, 'cat'), domestic dog *Canis familiaris* and Small Indian Civet *Viverricula indica*, based on previous studies of Madagascar's endemic carnivores in Ranomafana National Park (Gerber *et al*. 2010, 2012a).

Study site and methods

Makira Natural Park, a 372,470 ha natural park and 351,037 ha community-managed buffer zone, is the largest protected area in Madagascar and holds the largest remaining contiguous rainforest on the island (Kremen 2003, WCS 2004). Makira Natural Park covers an elevation range from 300 to 1,447 m, incorporates lowland and mid-altitude rainforest, and is believed to contain the highest species richness (all biota combined) in all of Madagascar (Holmes 2007).

We established a camera-trapping grid (centred on 15°11'40"S, 49° 37'13"E) within the Anjanaharibe region of the Makira Natural Park from 7 September to 13 November 2008 and from 18 September to 17 November 2010. Despite the social and political turmoil in the country during this time, habitat and landscape conditions did not change at this site. The study site was located, at its closest point, 2.75 km north-east of the village of Andaparaty and 2.60 km south-east of the village of Sahantaha (Fig. 1) and elevation, recorded using a handheld GPS unit (Garmin 60CSx), ranged from 350 to 690 m. We used both digital (Moultrie D40, Reconyx PC85 and Cuddeback IR) and film-loaded camera-traps (DeerCam DC300) in a grid-like pattern across the landscape to sample carnivores photographically. The 2008 survey consisted of 20 camera-stations and the 2010 survey of 20 stations in the same locations plus an additional five stations (Fig. 1). Camera-stations were spaced 400–600 m apart. Each camera-station held two cameras, operational 24 hr/day, positioned about 20–30 cm off the ground, and placed on opposing sides of existing human trails (0.5–1.0 m wide) and game trails to photograph passing wildlife. We checked cameras every 5–10 days to change batteries and memory cards, and used neither bait nor lure.

We define a 'photographic event' as any point at which an animal triggers the camera (either by movement or body heat), thus providing one to three photographs (depending on camera model) of this individual. We define a 'capture' as one or more photographic events of a given species, at a particular camera-station, that are separated from each other by less than 30 minutes, i.e. the capture lasts a variable period of time and ends when there is a gap of at least 30 minutes before the next photographic event of that species at that camera. Thus, where a duo of the same species was photographed simultaneously, these occurrences constitute a single 'capture' of this species, to reduce problems of non-independence of events. To provide a measure of relative frequency of encounter for each species, we calculated 'trap success' by dividing the number of captures by the total number of trap-nights multiplied by 100 (a trap-night is a 24-hr period during which at least one of two cameras at a particular station was functioning). To examine species associations that might influence *S. concolor* presence we plotted capture locations (each camera-station) for *S. concolor* and introduced carnivores for each year. Finally, our team's continued surveys across the Makira region gave further information on *S. concolor*.

Results

During the two surveys (2008, 2010) we captured six endemic carnivore species (Fosa or Fossa *Cryptoprocta ferox*, Fanaloka or Malagasy Civet *Fossa fossana*, Falanouc or Malagasy Small-toothed Civet *Eupleres goudotii*, Ring-tailed Vontsira or Ring-tailed Mongoose *Galidia elegans*, Broad-striped Vontsira or Broad-striped Mongoose *Galidictis fasciata* and *S. concolor*) and three species of introduced (exotic) carnivores (cat, dog and Small Indian Civet; Table 1). The captures of *S. concolor* (Fig. 2) are the first records within the Makira Natural Park. The recorded elevation range for *S. concolor* captures was 404–680 m. *Salanoia concolor* was captured at more stations in the first survey (2008: 10 captures at eight stations) than in the second survey (2010: four at four stations; Table 1). *Salanoia concolor* was captured both apparently singly (n = 8 captures) and in apparent duos (n = 6 captures) and all captures occurred during daylight, between 05h45 and 17h00. Station 14 was the camera-station nearest to a village (1.75 km) and nearest the forest edge (0.09 km; Fig. 1) to capture the species; no humans were captured there. Additionally, *S. concolor* was not captured at camera-stations with high human trap success or high introduced carnivore trap success (e.g. station 15, where human trap success = 26.2).

We observed minimal co-occurrence between *S. concolor* and domestic dogs, with overlap at only one station in 2008 and none in 2010 (Fig. 3). Only five (19%) of the dog captures

Fig. 2. Brown-tailed Vontsira *Salanoia concolor*, Makira Natural Park, Madagascar, 6 October 2008.

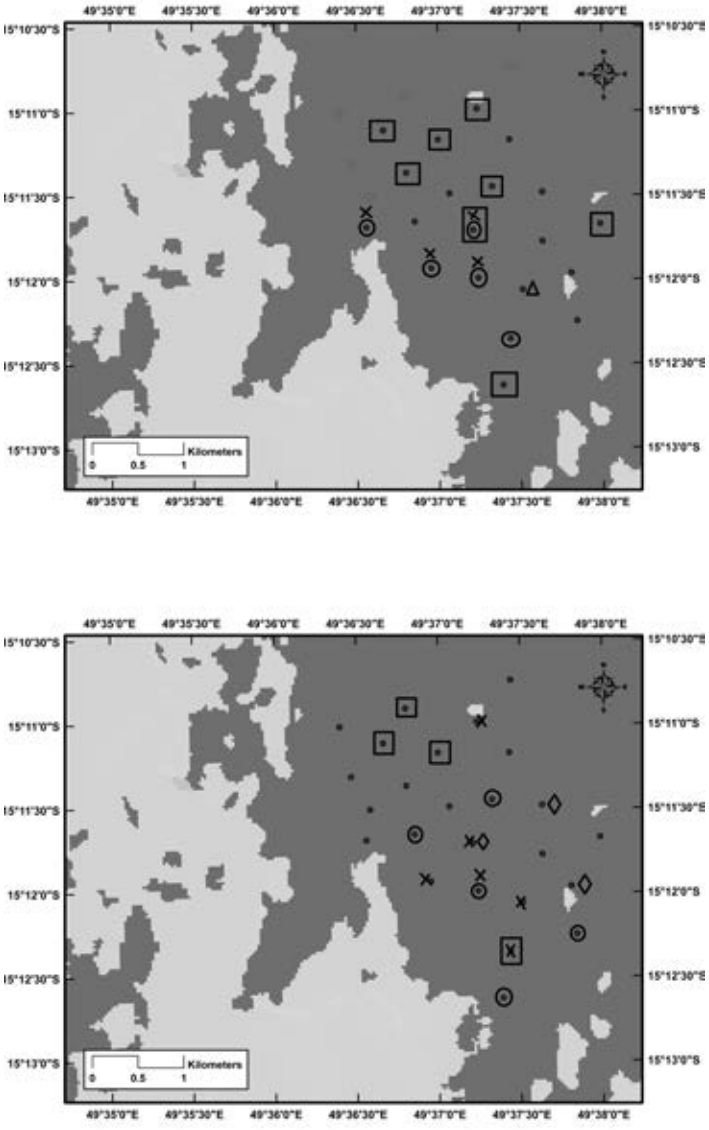

Fig. 3. Distribution of Brown-tailed Vontsira *Salanoia concolor* (□), human (non-researchers) (×), domestic dog (○), introduced cat (◊) and Small Indian Civet *Viverricula indica* (Δ) across the 20-camera-station 2008 survey (A) and the 25-camera-station 2010 survey (B) in the Anjanaharibe study site, Makira Natural Park, Madagascar.

across the two surveys occurred simultaneously (same day and time) with human captures. All these simultaneous captures were located at one station, station 15, during the 2008 survey. Co-occurrence with *S. concolor* and humans (non-researchers) was also minimal: at only one station in 2008 (station 07) and one station in 2010 (station 03). In addition, we did not observe overlap or co-ocurrence of *S. concolor* with introduced cats or Small Indian Civets, although these latter two species were found at few stations (Fig. 3). Compared with 2008, in 2010 humans, dogs and cats seemed more widespread, including, apparently, increased presence within core forest (Fig. 3; Table 1); Small Indian Civet was not recorded in the second year.

Additional surveys across the Makira Natural Park (January–March 2011) photographed *S. concolor* 19 km south-east of the Anjanaharibe forest site, four times (Fig. 4), just outside the park in highly degraded forest by a camera-grid centred on 15°16'52"S, 49°46'04"E, about 2.0 km from the village of Sahavary and Andongana at recorded elevations of 292–399 m.

Discussion

This is the first confirmation of *Salanoia concolor* in the Makira Natural Park, expanding its known range 60–70 km northwards and westwards. To clarify the range of *S. concolor* and connectivity of its populations throughout this region, more surveys are needed across mid- and low-elevation forests throughout the Makira Natural Park.

Hawkins *et al*. (2008) reported that known records for *S. concolor* range in elevation from 200 to 650 m and that significant survey effort in eastern rainforest in recent years in areas above 600 m captured no *S. concolor*; however, the amount of that survey effort in this period that was expended within the species's small known geographic range is not readily available. A capture at 680 m at station 13 is the first *S. concolor* record above 650 m. Station 13 was the highest in the entire camera-grid, so this carnivore may occur in this area even above 680 m. There have been few records of *S. concolor* in the last 15 years (Hawkins *et al*. 2008, Hawkins 2012); the species may be rare and additional research could improve efforts to protect it.

Hawkins *et al.* (2008) reported that *S. concolor* is highly sensitive to human presence and disturbance. Captures from these surveys suggest species avoidance between *S. concolor* and humans. Closer investigation revealed that 67% of all humans photographed (n = 99 individuals; 34% of independent human captures) occurred at one camera-station (station 15) on the forest edge, within 2 km of the village of Andaparaty (Fig. 1). No *S. concolor* captures occurred at this particular camera-station during the two survey periods, suggesting that this species avoids areas with human presence. Of the 25 total camera-stations (combining 2008 and 2010), two captured both *S. concolor* and humans (though not at same time or day), whereas eight had *S. concolor* only and six had humans only (Fig. 3).

Salanoia concolor and Madagascar's co-occurring endemic carnivores are negatively affected by the presence of introduced carnivores, particularly in fragmented and degraded habitat (Farris & Kelly 2011, Gerber 2012a, 2012b). For example, in Ranomafana National Park in southeast Madagascar introduced carnivore capture rates are higher in fragmented and degraded forests, and cat capture rates have a strong

Table 1. Number of photographic captures and the trap success (TS) for carnivore species, introduced species and humans in the Anjanaharibe region of the Makira Natural Park, Madagascar, in 2008 and 2010.

Category	English name	Scientific name	2008	2008	2010	2010
			# Captures[a]	TS[b] (± SE)	# Captures[a]	TS[b] (± SE)
Endemic carnivores			322	24.3 (± 2.3)	246	19.4 (± 2.3)
	Brown-tailed Vontsira	*Salanoia concolor*	10	0.8 (± 0.2)	4	0.6 (± 0.4)
	Broad-striped Vontsira	*Galidictis fasciata*	31	2.4 (± 0.7)	11	1.1 (± 0.5)
	Ring-tailed Vontsira	*Galidia elegans*	16	1.2 (± 0.3)	16	1.2 (± 0.3)
	Falanouc	*Eupleres goudotii*	41	3.1 (± 0.8)	27	2.1 (± 0.7)
	Fanaloka	*Fossa fossana*	184	13.9 (± 3.0)	162	12.2 (± 2.3)
	Fosa	*Cryptoprocta ferox*	40	3.0 (± 0.9)	26	2.2 (± 0.7)
Introduced carnivores			21	1.6 (± 0.7)	11	1.1 (± 0.5)
	Small Indian Civet	*Viverricula indica*	2	0.1 (± 0.1)	0	0.0 (± 0.0)
	Domestic dog	*Canis familiaris*	19	1.4 (± 0.7)	8	0.9 (± 0.5)
	Cat (domestic, feral or wild progenitor)	*Felis silvestris* and/or *F. catus*	0	0.0 (± 0.0)	3	0.2 (± 0.1)
Bush Pig		*Potamochoerus larvatus*	1	0.1 (± 0.1)	2	0.1 (± 0.1)
Humans (Malagasy villagers)		*Homo sapiens*	28	2.1 (± 1.2)	22	1.5 (± 0.6)

[a] # Captures = the number of captures. A 'capture' comprises all photographic events of a given species, at a particular camera-station, that are separated by less than 30 minutes from the next photographic event at that station of that species.
[b] TS = trap success: the number of captures / the number of trap-nights × 100, with standard error (± SE). Total trap-nights for Anjanaharibe in 2008 (from 20 camera-stations) was 1,315 and for Anjanaharibe in 2010 was 1,230 (from 25 camera-stations).

Fig. 4. Brown-tailed Vontsira *Salanoia concolor* just outside the Makira Natural Park, near the village of Sahavary. (Left) a duo in highly degraded forest, 17 January 2011; (right) a single in highly degraded forest on 19 January 2011.

negative relationship with *G. elegans* occupancy (Gerber *et al*. 2010, 2011, 2012a, 2012b). Additional camera-trapping surveys in Makira also showed higher introduced carnivore and human capture rates in fragmented and degraded forests, and negative correlations between endemic carnivore and human capture rates, as well as between endemic carnivore and introduced carnivore capture rates (Farris & Kelly 2011). The records near Sahavary and Andongana indicate, however, that *S. concolor* can sometimes occupy human-altered forest habitat. The apparent negative relationships between *S. concolor* and dogs, cats and humans give serious concerns about long-term protection and management of this species within a human-altered landscape in which human–wildlife conflicts are mounting. Managers should consider the implementation of a trapping and removal programme for cats and dogs throughout these forest sites.

At the Anjanaharibe study site, *S. concolor* was captured at eight stations during the 2008 survey but only four during the 2010 survey. Additionally, trap success decreased by 0.13 from 2008 to 2010. These negative changes highlight the need for additional research that investigates how human encroachment and introduced carnivores impact *S. concolor* populations. In the later survey human captures were more widespread across the study site, and illegal mammal traps (noose traps) had been erected within the grid. Poaching occurs at this site (Golden 2009; C. Golden verbally 2012), although its rate is unknown. In addition, during this period introduced cat and Bush Pig *Potamochoerus larvatus* captures increased (see Table 1). These differences (including more widespread distributions across the grid) may represent sustained increases in human, cat and Bush Pig numbers that might impact wildlife trap success across this study site. We are conducting additional surveys at the Anjanaharibe study site and throughout the Makira Natural Park to investigate *S. concolor* and co-occurring carnivores and to determine the impacts of these invasive pressures on *S. concolor* distribution and trapping rates. Understanding

how human encroachment, poaching and forest degradation affect *S. concolor* is also vital for this species's long-term protection. Its apparent reliance on lowland rainforest makes it particularly vulnerable to on-going fragmentation across its restricted range (see Sussman *et al*. 1994).

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Book Review

Les Carnivora de Madagascar by S. M. Goodman. Association Vahatra, Antananarivo, Madagascar, 2012. 158 pages and 73 figures, mostly in colour. Available from associatvahatra@moov.mg. Price: Euro 38 or USD 55

This neat, A5-sized, 158 page book brings together much of what is known about the remarkable endemic family of Malagasy carnivores, the Eupleridae. The ten species in this endemic family form one of the most fascinating radiations of mammals to be found anywhere in the world. The book is the fourth in the series 'Guides sur la diversité biologique de Madagascar' [Guides to the biological diversity of Madagascar] to be produced by Association Vahatra, in Madagascar. Intended for a Malagasy audience, it is entirely in French, and while that may limit its usefulness for some readers, there is a great deal of new material and photos that make it a very good buy even if you do not read French.

The book starts with introductory sections on the Carnivora in general, then focuses on the species found in Madagascar, native and introduced. A general section on the geological history of Madagascar explains how this remarkable island came to acquire such a prodigious wealth of endemic life (22 endemic animal and plant families, and counting). Much of the following chapter on the history of carnivores in Madagascar is new, and fascinating, and is completed by short chapters on the diversification and taxonomy of the family, as well as discussion about how the ancestor of the Eupleridae arrived in Madagascar about 20 million years ago. This section reveals the remarkable variation in the body form and lifestyle of the members of the family, a characteristic that led to the Malagasy carnivores being classed in three different families before DNA analysis pulled them together. Short chapters on habitat use, structure, food, reproduction, shelter and movements are followed by a section on the three introduced species of carnivores. An introductory section to members of the Eupleridae notes that there are two taxa that probably merit treatment as separate species, *Galidia* (*elegans*) *occidentalis* and *Mungotictis* (*decemlineata*) *lineata*. This section also gives an interesting account of the Eupleridae in Malagasy culture, including much new and interesting material, and is followed by others on status and conservation and the physical characteristics of the family.

The rest of the book, starting on page 80, is composed of species accounts for the ten members of the Eupleridae. The species accounts are written in an easy and concise manner, and cover everything published and a good deal of unpublished information about each species. The composite photos produced by Velizar Simeonovski are very realistic and give a good indication of the character of each species. An excellent glossary and reference list round out the book.

I could not find any significant omissions of reference material, but some statements (for instance the separation of *Galidictis fasciata* into two subspecies) are not referenced. A very few errors have crept in: for instance, in the table showing biometrics of the subfamily Galidinae (p. 104), the given head-and-body length of *G. fasciata* is actually the total length including the tail, as reported in Goodman & Pidgeon (1999). The true head-and-body length should be 310–339 mm. However, these are very minor complaints that should not diminish a sense of admiration for this complete and very valuable book.

It would be very exciting for a global audience to have this remarkable little book available in English. I hope that the publishers find a way to do this, as currently accessibility is limited.

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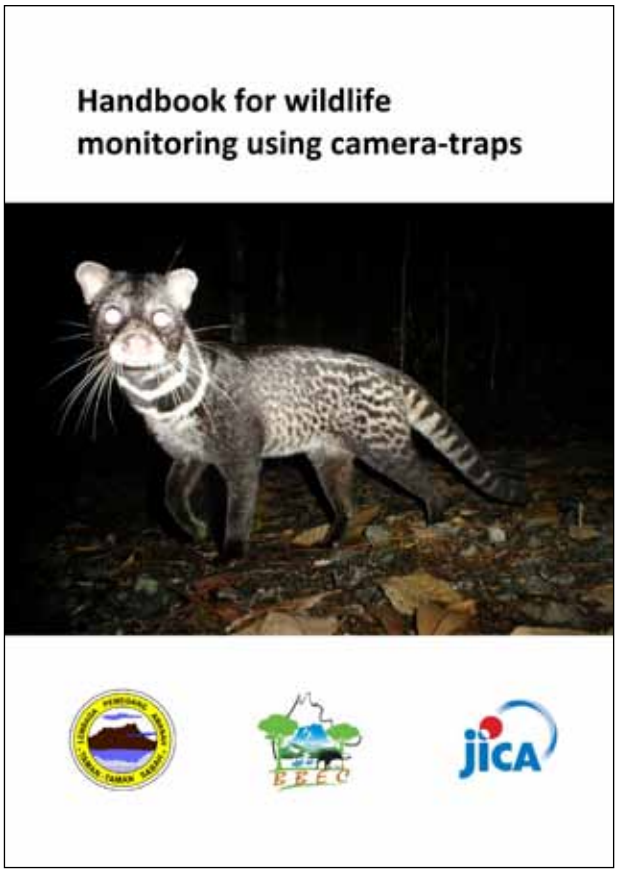
A. F. A. HAWKINS

Manual Review

Handbook for wildlife monitoring using camera-traps **by Marc Ancrenaz, Andrew J. Hearn, Joanna Ross, Rahel Sollmann and Andreas Wilting. BBEC II Secretariat, c/o Natural Resources Office, Chief Minister's Department, Kota Kinabalu, Sabah, Malaysia, 2012. ISBN: 978-983-3108-21-3. x + 71 pages and many colour photographs. Available free from <http://www.bbec.sabah.gov.my/phase2/downloads/2012/april/camera_trap_manual_for_printing_final.pdf>**

The NGO Hutan convened a team of experienced operators of camera-traps in Sabah, Malaysia, to produce this manual about surveying forest animals with camera-traps. Across the world, many new insights about small carnivore conservation status have come recently from camera-trapping, although usually not from programmes targeting these animals. Such surveys vary widely in their quality of execution, and this guide has something to offer almost anyone contemplating such a survey. The manual is about much more than the popular understanding of 'monitoring' (measuring change over time), but it is strongly focussed on assessing status: it mentions only briefly the uses of camera-traps in understanding behaviour. The manual has three multi-chapter parts: Part 1, Theories and concepts of camera-trapping (Generalities about wildlife monitoring; Brief review of camera-trapping for wildlife studies: advantages, disadvantages; Project planning; Personnel and equipment); Part 2, Practical aspects of camera-trapping (Project design; Camera set up; Study duration and checking camera-traps; Data processing; Additional surveys); Part 3: Involvement of local communities in camera-trap activities (Advantages of camera-traps in a participatory monitoring program; Goals of community-based camera-trapping studies). These are complemented by three appendices (Examples of data sheets and spreadsheets; Trouble shooting guide – FAQ; Photographs for identification). Numerous text boxes cover topics from 'Baiting camera-traps' to 'Involving communities in a state-wide species distribution monitoring programme'.



This is a trove of information for those undertaking the field side, with many highly practical points (e.g. living with high humidity), and for those conceptualising a programme. Some commonly-used approaches with no foundation in natural history are given short shrift, notably, the fallacious 'Relative Abundance Index'. In fact, more cautions could have been given; for example species discovery curves (section 3.2.2) are misleading where detection probability varies widely between species: it invariably does among large to medium-size mammals in a tropical forest.

Only two aspects seriously troubled me. Box 1 states that when paired camera-traps are used, the survey effort of a pair is equivalent to that of a single. But especially where the two cameras are not wired to a single sensor, the vagaries of sensor function and camera position mean that pairs fall somewhere between the survey effort of a single camera and of two singles. Each survey can, and should where precise effort measurement is essential, assess empirically the degree of overlap in photos from the two cameras of each pair. And, completely ignored is the issue of ensuring correct identification; this is by no means the given that people often assume. Colleagues and I have been privileged to inspect many camera-trap surveys' images in Southeast Asia, and while many have very few mistakes, major misidentification is not uncommon. Results from such programmes are useless, yet appear in every style of publication, including 'high-impact' refereed journals.

Although the text clearly envisages a Sabah audience, the content is highly relevant across the world. And it's free! Written in a very accessible style, this is the perfect primer for the thinking camera-trapper, who may later move on to more heavyweight technical publications, including the many cited in the manual. If this manual has a wide global readership, better-quality camera-trapping, and therefore more useful information for conserving the world's small carnivores, will result.

J. W. DUCKWORTH

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