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Red Panda *Ailurus fulgens* (Photo: Savita S. Rao)

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Small carnivorans from southern Benin: a preliminary assessment of diversity and hunting pressure

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Abstract

We conducted a preliminary study totalling nine-weeks between August 2007 and June 2008 in southern Benin to assess small carnivoran diversity and the hunting pressure to which they are subject through interviews, surveys of local markets and occasional direct observations. We provide an 'Index of Rarity' (IR), expressed as the number of times a species is identified as 'rare' by interviewees / the number of times it is mentioned. Nine species or taxa (*Genetta* spp.) were identified through 86 interviewed hunters, representing a total 333 mentions. Genets, Cusimanse *Crossarchus obscurus* and Ichneumon Mongoose *Herpestes ichneumon* were by far the most sighted, the prevalence of such ecologically versatile species confirming that southern Benin constitutes an environmentally disturbed region. Other species were Spotted-necked Otter *Hydrictis maculicollis,* Marsh Mongoose *Atilax paludinosus*, White-tailed Mongoose *Ichneumia albicauda,* African Civet *Civettictis civetta*, Gambian Mongoose *Mungos gambianus* and African Palm-civet *Nandinia binotata*. Direct observations allowed us to confirm the presence of *G. pardina / G. maculata*, *C. obscurus*, *H. ichneumon*, and *H. maculicollis*. Through market surveys and subsequent molecular identifications, we clearly distinguished among *G. genetta, G. pardina / G. maculata* and *G. thierryi*, raising to 11 the number of small carnivoran species present (or probably present) in southern Benin. During our interviews, Slender Mongoose *Galerella sanguinea* and African Small-clawed Otter *Aonyx capensis* were never positively identified. The ubiquitous *C. civetta* was considered the rarest species (IR = 0.89), followed by *H. maculicollis* (0.72) and *I. albicauda* (0.69), whereas *C. obscurus* (0.01) was the commonest small carnivoran. Hunting techniques were mostly traditional guns, accompanied by dogs, and jaw traps. Despite the absence of selective hunting, small carnivorans are likely to represent a fair source of income for hunters, body parts being sold to fetish markets in 47% of the cases. Mean incomes range between US$ 2.5 and 5.4 per animal, with the notable exception of *C. civetta* (US$ = 14.6) and heads of *H. maculicollis,* reaching US$ 33.7. The fair proportion of small carnivorans observed on fetish market displays showed that hunting for animist practices might sustain a continuous hunting pressure in Benin. Our preliminary survey raises a number of questions as to the distribution of small carnivorans in southern Benin, the impact of heavily disturbed habitats on their survival and the level of sustainability of the hunting pressure they are subject to. Additional field surveys will be necessary for more precise characterisation of their status.

Keywords: bushmeat trade, distribution, ethnozoological survey, Herpestidae, Mustelidae, Nandiniidae, Viverridae

Les petits Carnivores du Sud Bénin: une évaluation préliminaire de leur diversité et de la pression de chasse

Résumé

Nous avons mené une mission de terrain étalée sur neuf semaines entre Août 2007 et Juin 2008 au sud Bénin, dans le but d'estimer la diversité des petits Carnivores et la pression de chasse à laquelle ils sont soumis à travers des entretiens, des enquêtes sur les marchés et des observations directes occasionnelles. Nous proposons un « Indice de Rareté » (IR), équivalent au nombre de fois qu'une espèce est identifiée comme « rare » par les interviewés rapporté au nombre de fois que celle-ci est mentionnée. Neuf espèces ou taxons (*Genetta* spp.) ont pu être identifiés sur la base de 86 chasseurs interviewés, représentant un total de 333 mentions. Les genettes, *Crossarchus obscurus* et *Herpestes ichneumon* sont les plus cités, la prévalence d'espèces aussi versatiles d'un point de vue écologique confirmant que le sud Bénin représente un « écosystème » perturbé. Les autres espèces sont *Hydrictis maculicollis, Atilax paludinosus*, *Ichneumia albicauda, Civettictis civetta*, *Mungos gambianus* et *Nandinia binotata*. Nos observations directes nous ont permis de confirmer la présence de *G. pardina/maculata*, *C. obscurus*, *H. ichneumon* et *H. maculicollis*. Grâce aux enquêtes de marché et à des identifications moléculaires, nous avons clairement établi la distinction entre *G. genetta, G. pardina/maculata* and *G. thierryi*, établissant à 11 le nombre d'espèces de petits Carnivores présentes (ou probablement présentes) au sud Bénin. Au cours de nos entretiens, *Galerella sanguinea* et *Aonyx capensis* n'ont jamais été mentionné. L'espèce ubiquiste *C. civetta* est considérée comme le petit Carnivore le plus rare (IR = 0,89), suivie de *H. maculicollis* (0,72) et *I. albicauda* (0,69), alors que *C. obscurus* (0,01) est l'espèce la plus commune. Les méthodes de chasse sont principalement la chasse aux fusils traditionnels accompagnée par des chiens, et les pièges à mâchoires. Malgré l'absence d'une chasse sélective, les petits Carnivores représentent probablement une source non négligeable de revenus pour les chasseurs, différentes parties de leur corps étant vendues sur les marchés des fétiches dans 47% des cas. Les revenus moyens oscillent entre 2,5 et 5,4 US$ par animal, à l'exception de *C. civetta* (14,6 US$) et des têtes de *H. maculicollis,* pouvant atteindre 33,7 US$. La proportion importante de petits Carnivores observés sur les marchés des fétiches montre que la chasse destinée à alimenter les pratiques animistes implique très probablement une pression de chasse continue au Bénin. Notre étude préliminaire soulève un nombre de questions relatives à la répartition des petits Carnivores dans le sud Bénin, à l'impact des habitats fortement perturbés sur leur survivance et à la durabilité de la pression de chasse à laquelle ils sont soumis, qui nécessiteront de nouvelles études de terrain afin de tendre vers une caractérisation plus précise du statut de ces mammifères peu connus.

Mots-clés: commerce de viande de brousse, enquête ethnozoologique, Herpestidae, Mustelidae, Nandiniidae, répartition, Viverridae

Introduction

Small carnivorans from western Africa have been little studied to date. Despite their taxonomic diversity (Kingdon 1997, Wozencraft 2005), their variety of ecological functions — such as pest controllers, seed dispersers, pollinators and an ambivalent prey/predator condition — and their role as indicators of ecosystem conditions (Kingdon 1977, Lack 1977, Charles-Dominique 1978, Maddock & Perrin 1993, Duckworth 1995, Kingdon 1997, Engel 1998, Angelici *et al.* 1999a, Admasu *et al.* 2004a, De Luca & Mpunga 2005, Martinoli *et al.* 2006, Dunham 2008), knowledge on their natural history remains poor. As an example of the paucity of the data available, distribution ranges for Viverridae, Herpestidae, Nandiniidae and Mustelidae have remained speculative for most of the subregion (Kingdon 1997). This is notably because the available checklists (e.g. Rode 1937, Rahm 1961, Aeschlimann 1965, Kuhn 1965, Roche 1971, Happold 1987) are now outdated and museum records are rare (Taylor 1989, Colyn *et al.* 1998, Grubb *et al.* 1998, Gaubert *et al.* 2002, Gaubert 2003). Several publications dealing with the natural history of western African small carnivorans have been made available more recently, but their contribution remains anecdotal or episodic (Barnett *et al.* 1996, Sillero-Zubiri & Bassignani 2001, Ziegler *et al.* 2002). A recent study addressing the issue of low numbers of records to reconstruct habitat suitability in some western African small carnivorans showed that viverrids (such as *Poiana leightoni* and several species of forest genets) were likely to be under threat because of a high level of forest fragmentation in the subregion (Papeş & Gaubert 2007). This sum of established facts thus suggests an urgent reassessment of the conservation status of small carnivorans from the subregion.

The status of small carnivorans in Benin is almost unknown. Historical surveys are lacking and the museum record is virtually empty (P.G. pers. obs.). Existing literature has focused on larger mammals, including big carnivorans, and their conservation in the faunistically rich biosphere reserves from the northern part of the country (Sayer & Green 1984, Verschuren 1988, Boulet *et al.* 2004, Di Silvestre *et al.* 2004, Imorou *et al.* 2004, Assogbadjo *et al.* 2005, Claro *et al.* 2006). One exception is the checklist of Heymans (1984), where small carnivorans from northern Benin were inventoried. Unfortunately, this is barely accessible grey literature and, more significantly, there is no indication about how species identification was made and how distribution data were collected.

Although some recent ecological and ethnozoological surveys have allowed the preliminary reassessment of the status of a few small carnivorans (otters and mongooses) in southern Benin, much of what is known remains anecdotal. Contrary to otters (*Hydrictis maculicollis, Aonyx capensis*), which have become increasingly rare in the area due to direct destruction and river disturbance (Akpona 2004), some species of mongooses (*Herpestes ichneumon, Atilax paludinosus, Ichneumia albicauda, Crossarchus obscurus*) seem to persist despite heavy anthropogenic pressures (Djagoun *et al.* 2009).

In southern Benin, rainforest habitats are very patchily distributed into small forested islands and have been continuously logged for agricultural development (Sayer & Green 1984). Since small mammals from this region have been poorly surveyed, it is not known whether the surveillance measures developed in protected areas for larger mammals had a beneficial effect on the whole mammalian community. Despite a genuine will to promote the farming of animals such as the Marsh Cane Rat *Thryonomys swinderianus* as an alternative source of protein in Benin (Baptist & Mensah 1980), factors such as demographic expansion and widespread poverty, characterised by unemployment, few local economic opportunities, and dependency on limited natural resources contribute to the unstopped overexploitation of natural ecosystems, including over-hunting of wildlife (Fa *et al.* 2003, Ehui & Pender 2005, Bennett *et al.* 2006). In southern Benin, several protected forested areas exist (such as 'forêts classées' and 'forêts sacrées') but do not benefit from concrete conservation actions (Soury 2007). Small mammals are tempting targets for hunters, especially with the current monitoring of large game poaching which will inevitably increase the pressure on less visible game (Anadu *et al.* 1988, Codjia & Assogbadjo 2004). It is thus likely that hunting activities have remained sustained, especially given that small game in southern Benin represents most of the bushmeat intake, to be used either for food consumption (Codjia & Assogbadjo 2004, Assogbadjo *et al.* 2005) or as pharmacopoeia (Tchibozo & Motte-Florac 2004) and fetish items.

Given that small carnivorans are usual constituents of the small game trade in western Africa (Angelici *et al.* 1999b, Colyn *et al.* 2004) and notably, as we are interested here, in Benin (Assogbadjo *et al.* 2005), our study intends to assess their diversity and the hunting pressure to which they are subject in southern Benin through interviews, surveys of local markets and occasional field observations. By doing so, we wish to provide a preliminary update in the region from which better-informed management decisions may be possible. Last, but not least, our survey should help characterising the small carnivoran fauna of the southern Dahomey Gap area, a largely understudied stretch of forest–savannah mosaic that separates the Upper and Lower Guinean rainforest blocks.

Methods

Study area

This study was conducted in the southern part of the Republic of Benin, encompassing a zone within 6°20′–7°40′N, 1°30′–2°50′E (Fig. 1). The mean temperatures are constantly high (c. 25°C) with daily amplitude below 5°C, and there is a great irregularity of annual rainfall (mean = 1,200 mm; L'Hôte & Mahé 1996). Southern Benin is located in the Dahomey Gap and has a subequatorial climate subdivided into four seasons of unequal length: two rainy seasons (from April to July and September to October) and two dry seasons (from November to March and end of July to August). The vegetation is characterised by a great variety of fragmented phytocenoses resulting from a combination of climatic, topographic and edaphic factors and human agency. The southern part of Benin covers three ecological zones (Natta 2003): (1) a plateau with Guineo–Congolian affinities representing semi-deciduous forest, (2) the Lama depression, which is limited to the North by the Zagnanado and Ketou plateaux and to the South by the Allada and Sakete plateaux (this area is flooded during the rainy season), and (3) gallery and swamp forests, patchily distributed along rivers. Dominant native trees in these zones are *Ceiba pentandra, Celtis mildbraedii* and *Dialium guineensis,* whereas exotic species mainly consist of *Tectona grandis* and *Gmelina arborea*. Several emblematic species of mammals inhabit the forests of southern Benin, including Mona Monkey *Cercopithecus mona*, Vervet Monkey *Cercopithecus aethiops*, an endemic subspecies of

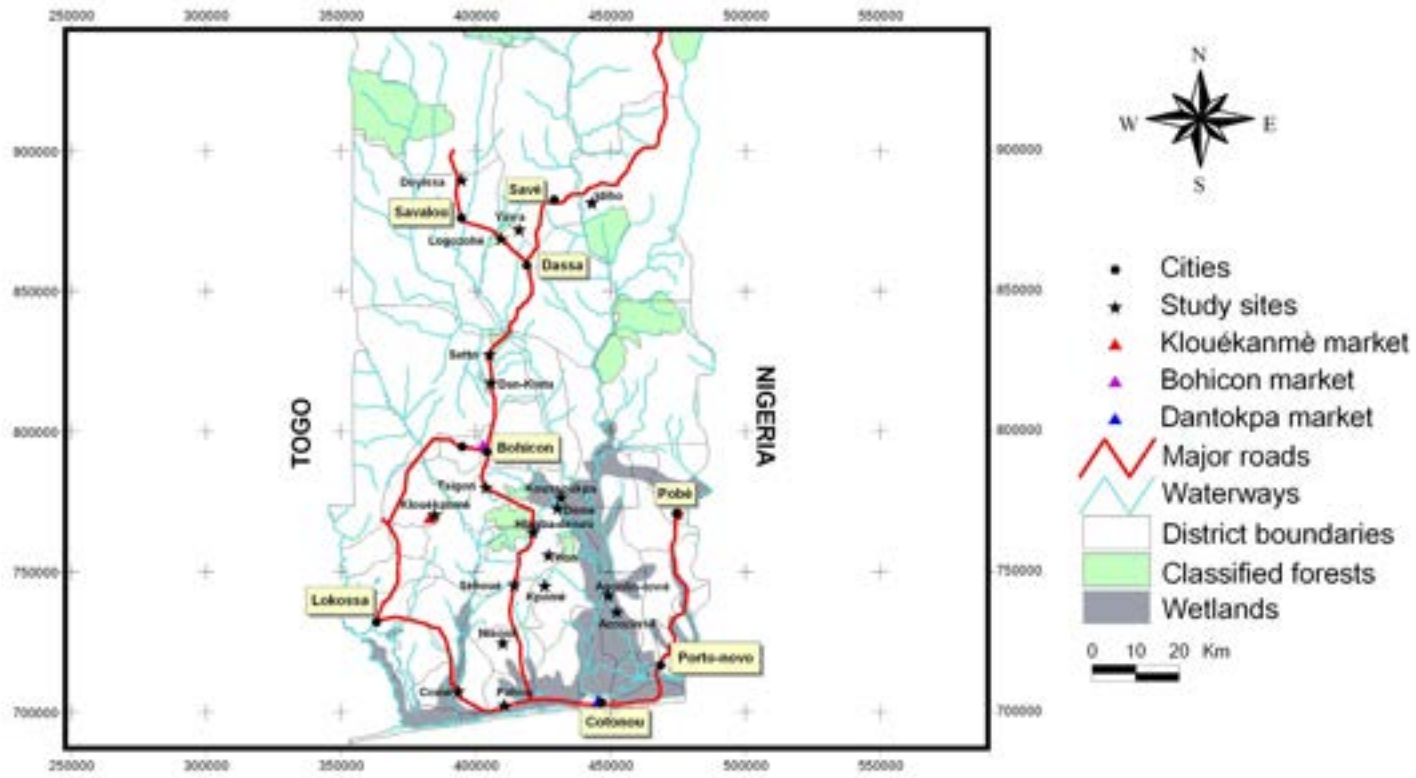

Fig. 1. Map of southern Benin, showing the study sites.

Red-bellied Monkey *Cercopithecus erythrogaster erythrogaster*, and threatened ungulates such as Sitatunga *Tragelaphus spekii*, Royal Antelope *Neotragus pygmaeus*, Black Duiker *Cephalophus niger* and Yellow-backed Duiker *C. silvicultor* (Sinsin & Assogbadjo 2002).

Surveys among hunters

An ethnozoological survey was conducted to gather information on small carnivorans, representing a nine-week period spread between August 2007 and June 2008. Open interviews were conducted among 86 active hunters of 18 villages distributed in southern Benin, representing about 2,500 km of road trip between Cotonou (coast) and Dassa surroundings (206 km inland; Fig. 1). All the people interviewed were men (hunting is not usual for women) from seven ethnic groups (Fon, Ouémé, Idatcha, Mina, Adja, Aïzo, Goun); their ages ranged between 23 and 67 years. Hunting was a secondary activity, whereas agriculture was most generally a primary occupation. A series of questions accompanied by illustrated identification sheets for each target species (defined following Heymans 1984, Kingdon 1997, Wozencraft 2005) were asked with the help of two local interpreters to collect information on (i) the different hunted species of small carnivorans, (ii) among them, which were considered rare, (iii) hunting techniques, and (iv) the use made of the hunted animals (personal consumption, trade, and related prices). As concerns point (ii), we calculated a straightforward 'Index of Rarity' (IR) for each species, expressed as the number of times a species is identified as 'rare' by interviewed people / the number of time it is mentioned (because the number of times a species can be identified as 'rare' depends on the number of times it has been mentioned as present by hunters). In summary, IR varies from 0 to 1, with higher values meaning a higher level of rarity as expressed by hunters. Whenever possible, the carcass, skin or other remains of the animals saved by hunters were observed or collected to confirm taxonomic identification.

To minimise possible misidentifications, species identity was cross-checked during interviews with questions related to diagnostic morphological, behavioural and dietary traits (Table 1). Despite that precaution, we realised that the three genets for which we surveyed (*Genetta genetta, G. pardina / G. maculata* [see Gaubert 2003] and *G. thierryi*) were subject to potential confusion, the different species being difficult to distinguish from our illustrated sheets, but also for hunters in general (see Angelici *et al.* 1999a). We thus treated all the mentions of genets under '*Genetta* spp.'.

Occasional survey of markets and road sellers

During August–July 2007, we twice had the opportunity to visit fetish markets in Dantokpa (Cotonou) and Bohicon. Markets in southern Benin seem not to be equivalent in size and purpose to large bushmeat markets found in forested Africa (see Barnes 2002, Colyn *et al.* 2004, Edderai & Dame 2006, Fa *et al.* 2006, Laurance *et al.* 2006, Albrechtsen *et al.* 2007, Bennett *et al.* 2007, Willcox & Nambu 2007). Instead, bushmeat consumption and trade, at least for small game (i.e. the most important wild source of protein; Codjia & Assogbadjo 2004, Assogbadjo *et al.* 2005), seems to be limited to local scales. The markets that we visited in Dantokpa and Bohicon were selling animals as fetishes for traditional medicine and animist rites. The animals found on those markets were mostly dried specimens (specimens may be left rotten and drying at the feet of market displays), smoked heads, skins or skulls and bones, which are conservable as such for months or even years. Most displays spend the night unmoved, covered with a piece of rough tissue. The rate of item renewal on market displays appeared extremely low (at least for small carnivorans). In Dantokpa, we noticed the presence of a wide variety of species that suggested remote geographic origins of part of the sold animals, including northern Benin but also neighbouring countries (e.g. Leopard *Panthera pardus*, African Buffalo *Syncerus caffer* and Hartebeest *Alcelaphus buselaphus*). Bohicon appeared to

Table 1. Morphological, behavioural and dietary information on small carnivorans used to check species identification during interviews.

Species	Morphology	Behaviour	Diet
Genetta genetta	spotted; tail long and annulated to the tip; large ears	nocturnal; solitary; tree-climber	carnivorous
Genetta pardina / G. maculata	spotted; long annulated tail; dark distal part of the tail; large ears	nocturnal; solitary; tree-climber	carnivorous
Genetta thierryi	smaller genet; spotted; long annulated tail; dark distal part of the tail shorter than above; large ears	nocturnal; solitary; tree-climber	carnivorous
Civettictis civetta	large size; spotted; shorter annulated tail than genets; dorsal crest	usually nocturnal; solitary; not tree-climber	omnivorous
Crossarchus obscurus	uniform; short tail; small ears; long nose	diurnal; gregarious; not tree-climber	insectivorous
Atilax paludinosus	large mongoose; uniform; short tail; small ears	Mostly nocturnal; solitary; not tree-climber; lives near rivers	piscivorous; malacophagous
Herpestes ichneumon	uniform; long tail with tip tapered in a dark tassel; snake-like head	diurnal; solitary or in small families; not tree climber; trotting with head down	carnivorous (including reptiles)
Ichneumia albicauda	large mongoose; body usually grey-silver with dark feet; long tail usually white	nocturnal; usually solitary; not tree-climber	insectivorous
Mungos gambianus	body grey with a white chest; short tail; small ears	diurnal; gregarious; not tree-climber	insectivorous
Galerella sanguinea	small mongoose; uniform; long tail with tip usually dark; eyes reddish	diurnal; solitary; may climb trees	carnivorous; insectivorous
Nandinia binotata	dark and spotted; a pair of bright spots on shoulders; long tail; feet with large pads	nocturnal; solitary; tree-climber	frugivorous
Hydrictis maculicollis	slender otter; throat with dark and bright blotching; webbed toes	diurnal; usually solitary; not tree-climber; lives in clear waters	piscivorous; malacophagous
Aonyx capensis	large otter with broad head; chest, chin and cheeks whitish; unwebbed toes	diurnal; solitary; not tree-climber; lives in a variety of water-related habitats	mostly crabs (also piscivorous and malacophagous)

house a more 'local' market, showing a less diversified taxonomic assemblage, although species possibly from northernmost areas were also represented.

In order to confirm species-level identifications, we used nucleotide sequencing (about 400 bp of cytochrome *b*) of what we thought to be nine heads of genets (see Results) from the Bohicon market, following protocols and primers used in previous studies (Gaubert *et al.* 2004, Gaubert & Begg 2007).

Along the main road that borders the Lama classified forest (RNIE 2), we occasionally encountered points of 'road sellers' where fresh bushmeat was available. Such points were briefly visited on four occasions during the same time period as our market surveys.

Occasional sightings of small carnivorans made by one of us (C.A.M.S.D.) during recent field studies in the northern part of the country were also reported.

Results

Interviews among hunters

Nine species or taxa (*Genetta* spp.) of small carnivorans were identified through 86 interviewed hunters, representing a total 333 mentions (Fig. 2). Genets *Genetta* spp., the Cusimanse *Crossarchus obscurus* and the Ichneumon Mongoose *Herpestes ichneumon* were clearly the most sighted species in southern Benin (about 99%, 95% and 87% of the interviewees, respectively). The Spotted-necked Otter *Hydrictis maculicollis* and the Marsh Mongoose *Atilax paludinosus* were mentioned by 34% and 27% of the

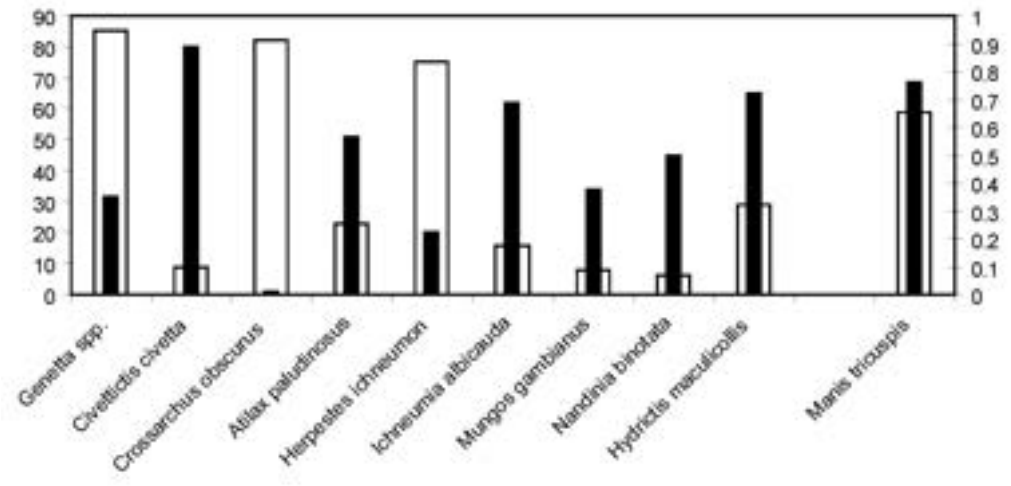

Fig. 2. Small carnivoran taxa identified by hunters during interviews. White bars correspond to the number of times the taxa were mentioned (left scale), and black bars represent 'Index of Rarity' values (right scale, IR; see Methods). Because the Three-cusped Pangolin Manis tricuspis *was also surveyed during interviews, we here used it as a reference value (see Results).*

hunters, respectively, whereas the White-tailed Mongoose *Ichneumia albicauda* represented 19%. Other, less mentioned, species included the African Civet *Civettictis civetta* (10%), the Gambian Mongoose *Mungos gambianus* (9%) and the African Palm-civet *Nandinia binotata* (7%). During our interviews, the Slender Mongoose *Galerella sanguinea* and the African Small-clawed Otter *Aonyx capensis* were never positively identified.

Civettictis civetta was considered the rarest species (IR = 0.89), followed by *H. maculicollis* (0.72) and *I. albicauda* (0.69) (Fig. 2). To a lesser extent, *A. paludinosus* (0.57) and *N. binotata* (0.5) were also identified as rare. Conversely, *C. obscurus* (0.01) was considered the commonest species among the interviewed people.

Comparing those results with a representative of another mammalian family (Manidae) of similar body size, the Three-cusped Pangolin *Manis tricuspis* was frequently mentioned by hunters (69%), but was most of the time considered rare (IR = 0.76).

Hunting techniques were mostly traditional guns (52%), accompanied by dogs, and jaw traps (45%) (Fig. 3), which were used in combination by 48% of the hunters. Hunting with packs of dogs was a minor technique for small carnivorans (3%).

All interviewed people acknowledged that small carnivoran meat was, partly or completely, used for personal consumption.

Fig. 3. Local trap for small carnivorans, baited with palm nuts. The jaw trap is buried at the entrance of a fence made of short sticks. Leaves are put at the top of the trap to figure a small tree.

Nevertheless, in about 47% of the cases, body parts, such as skins, heads and testes, were sold to fetish markets (Klouékanmè, Bohicon), either directly or via resellers (Pahou, Cotonou, Taigon).

We managed to gather information on prices concerning seven taxa sold to markets or resellers (Fig. 4). *Civettictis civetta* and *H. maculicollis* were the most expensive species (mean = about 6,500 and 5,900 Francs de la Communauté Financière d'Afrique [FCFA; US$ 14.6 and 13.3, as of August 2008], respectively). The wide variation in the price value of *H. maculicollis* was due to the fact that the species can be sold as body parts, including head (3,000 to 15,000 FCFA [US$ 6.7 to 33.7]), skin (5,000 FCFA [US$ 11.2]) or foot (1,000 to 2,000 FCFA [US$ 2.2 to 4.5]). Other taxa, including genets, *A. paludinosus*, *H. ichneumon* and *N. binotata*, were between 1,000 and 1,500 FCFA (US$ 2.2 and 3.4), whereas *C. obscurus* represented a slightly greater source of income (mean = 2,650 FCFA [US$ 6.0]). As a comparison, *M. tricuspis* was sold at a mean of 2,250 FCFA (US$ 5.1).

Direct observations of animal remains allowed us to confirm the presence of four species in areas neighbouring some interviewed villages, including *G. pardina / G. maculata* (skins and stuffed specimens, Fig. 5; Hon and Taigon), *C. obscurus* (anal region; Dèmè), *H. ichneumon* (stuffed specimen; Taigon), and *H. maculicollis* (anal region and dried head; Kpomè).

Occasional surveys: fetish markets, road sellers and incidental sightings

The fetish market in Dantokpa housed numerous dried heads of three species of genets (*G. genetta, G. pardina / G. maculata, G. thierryi*) and *H. ichneumon,* a few dried heads of *H. maculicollis*, a few skulls and skins of *C. civetta*, and a few skulls of *N. binotata*. It was remarkable to notice an unhidden, complete head of Hippopotamus *Hippopotamus amphibius* together with some rotting meat quarters. In Bohicon (Fig. 6), several dried heads and skins of three species of genets (*G. genetta, G. pardina / G. maculata, G. thierryi*) were present. Nucleotide sequencing of samples taken from five heads confirmed the identification of *G. pardina / G. maculata* and *G. thierryi* (data not shown). We also observed numerous dried heads of *H. ichneumon*, very few dried heads of *H. maculicollis*, and a couple of skulls of *N. binotata*. We also noticed the presence of dried heads of what appeared to be domestic dogs *Canis lupus familiaris*, and several skulls of unidentified jackals *Canis* sp. After nucleotide sequencing, four dried heads of what we thought to be, together with the main seller of the market, *G. genetta*, actually belonged to a small canid not available in da-

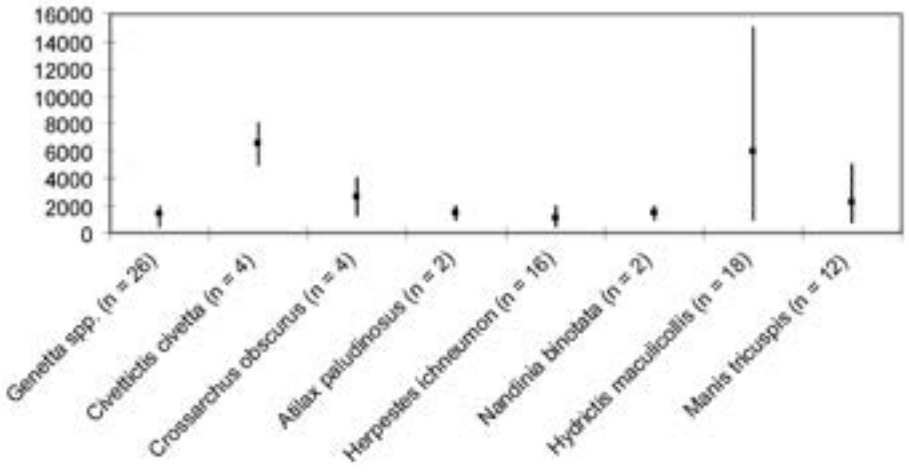

Fig. 4. Mean prices (in FCFA) of seven small carnivoran taxa sold to markets or resellers. Vertical bars indicate minimum and maximum values. Again, the Three-cusped Pangolin is used as a reference value (see Fig. 2).

Fig. 5. Remains of a freshly killed G. pardina/maculata *found in Hon (26°59'N, 02°18'E). The skin (a) is maintained a few days under ashes, subject to a soft smoking technique. Parts of the body are separated for supposedly different uses, including the tail (b) and the head (not shown).*

tabases such as GenBank (http://www.ncbi.nlm.nih.gov/Genbank/index.html; data not shown). After comparison of the prepared skulls with photographic material (see Acknowledgements), we conclude that those canids represent the Sand Fox *Vulpes pallida*.

Our sporadic surveys of road-side sellers bordering the Lama forest failed to detect any species of small carnivorans. During the field period, we only happened to observe sporadic selling of Marsh Cane Rats, Giant Pouched Rats *Cricetomys gambianus*, Maxwell's Duikers *Cephalophus maxwelli*, and one Bushbuck *Tragelaphus scriptus*.

Incidental sightings made by one of us (C.A.M.S.D.) during field investigations in northern Benin in 2007 included a skin of Zorilla *Ictonyx striatus* (Pendjari Biosphere Reserve: 10°30′–11°30′N, 0°50′–2°00′E) and a tail belonging to *C. civetta* (Bétérou: 9°11–47′N, 1°58′–2°28′E). According to the local perception of the populations living in neighbouring villages of the Pendjari, the Wild Cat *Felis silvestris*, the Ratel *Mellivora capensis*, the Sand Fox and *N. binotata* have been observed by hunters (C.A.M.S.D., pers. obs.).

Fig. 6. One of the displays of the Bohicon fetish market. Small carnivorans, including genets and mongooses, are on the front left.

Discussion

Diversity of small carnivorans in southern Benin

Our study does not intend to provide a definitive check-list of small carnivorans from southern Benin. Rather, by combining various sources of evidence from interviews, direct observation, nucleotide sequencing identification, and incidental observations, we aim at a refreshed, preliminary, assessment of their diversity in this understudied region. Such a reassessment will have to be further consolidated by field studies and a more exhaustive coverage of sites, which would be beneficial to extend to the northern part of the country.

Nevertheless, some interesting results on the diversity of small carnivorans from southern Benin were found (Table 2). A total of 11 species, representing four families, Viverridae (four species), Herpestidae (five), Nandiniidae (one) and Mustelidae (one), were identified by hunters and our molecular identifications (genets). Remains of four of them were directly observed in villages during our interviews (*G. pardina / G. maculata, C. obscurus*, *H. ichneumon*, and *H. maculicollis*), those corresponding to the most mentioned taxa by hunters (Fig. 2). Other species, including *G. genetta, G. thierryi,* and *N. binotata*, were sighted in the 'local' fetish market of Bohicon (but see below). The species *C. civetta* was only observed in the larger fetish market of Dantokpa (Cotonou), but recent, direct observations of skins made by one of us (C.A.M.S.D. pers. obs.) confirmed the natural occurrence of the species in southern Benin. The presence of *A. paludinosus*, although not directly observed here, was recently confirmed in the Lama and Niaouli forests (Djagoun *et al.* 2009), as was also the case for *C. obscurus* and *H. ichneumon*.

Two species of mongooses, *I. albicauda* and *M. gambianus*, were never observed directly. Interestingly, Djagoun *et al*. (2009) reported the presence of *I. albicauda* in southern Benin from a low number of hunters' mentions, but could not make any direct observations of the species.

The commonest small carnivoran taxa appeared to be, according to hunters, genets *Genetta* spp., *C. obscurus* and *H. ichneumon* (Fig. 2). The apparently high occurrence of the two species of mongooses may be due to their ability (i) to occupy a wide spectrum of habitats (Kingdon 1997, Palomares in press), as was

Table 2. Synthetic table of small carnivoran species diversity in Benin, compiling literature and inputs from the present study.

Species	Heymans (1984)	Kingdon (1997)	Wozencraft (2005)	This study[3]
Genetta genetta	N Benin	Benin	Benin	S Benin[4]
Genetta pardina / G. maculata	N Benin	Benin	[taxonomic confusion[1]]	S Benin
Genetta thierryi		Benin	Benin	S Benin[4]
Civettictis civetta	N Benin	Benin	Benin	S Benin
Crossarchus obscurus		S Benin	Benin [under *platycephalus*]	S Benin
Atilax paludinosus	N Benin	Benin		S Benin
Herpestes ichneumon	N Benin	Benin		S Benin
Ichneumia albicauda	N Benin	Benin		S Benin
Mungos gambianus		Benin		S Benin
Galerella sanguinea	N Benin	Benin	Benin	N Benin
Nandinia binotata	N Benin	Benin	Benin	S Benin[4]
Hydrictis maculicollis	N Benin	Benin	Benin	S Benin
Aonyx capensis	N Benin	Benin	Benin	N Benin
Ictonyx striatus	N Benin	N Benin	Benin	N Benin
Mellivora capensis	N Benin	Benin	[erroneous range[2]]	N Benin

[1] See *Genetta pardina* and *genettoides* (p. 556)

[2] Wozencraft only mentioned "South Africa" as for the African distribution of the species (p. 612)

[3] Our study includes two categories of species, namely those for which the occurrence in southern Benin (S Benin) could be ascertained (whether or not they are present in northern Benin), and those that could not be found in southern Benin but that are present in northern Benin (N Benin)

[4] But see Discussion

observed for *C. obscurus*, and (ii) to live around crop fields and to feed on poultry, as for *H. ichneumon* (Djagoun *et al.* 2009, and comments of hunters from this study). In the case of genets, a combination of both factors (genets were reported to kill poultry frequently) may be the reason for their high occurrence (Admasu *et al.* 2004a, Gaubert *et al.* 2008, Delibes & Gaubert in press). The prevalence of such versatile species indicates that our survey zone represents an environmentally disturbed area, where only small, ubiquitous or prone-to-commensality species would be able to maintain their populations.

Other small carnivorans, including *C. civetta*, *H. maculicollis*, *I. albicauda*, *A. paludinosus* and *N. binotata,* were considered rare by hunters. This may reflect habitat specialisation affecting survival in the context of intensive crops and teak plantation, as found in southern Benin (Ganglo & de Foucault 2005, Barthès *et al.* 2006), for species such as *N. binotata* (dependent on rainforest canopy; Charles-Dominique 1978, Angelici *et al.* 1999a), and *H. maculicollis* and *A. paludinosus* (dependent on forest galleries and water; Kingdon 1997, Ray 1997). Although known to be a ubiquitous species (Ray 1995, Kingdon 1997), *C. civetta* was considered as the rarest small carnivoran, which may reflect the intense depletion of large- to mid-size game that has occurred in the region. The high IR of the ecologically versatile *I. albicauda* (Rosevear 1974, Kingdon 1997, Admasu *et al.* 2004b), together with the absence of direct evidence for its presence, remains unexplained. A possible restriction to a specific habitat such as lowland forest in the particular case of southern Benin was previously evoked by hunters (Djagoun *et al*. 2009). The scarcity of mentions of *M. gambianus*, which may be locally common (IR = 0.38), also remains unexplained. Confusion by hunters with *C. obscurus* may have occurred (see Rosevear 1974), but ecological factors may be a better, yet unknown, source of explanation if the species is genuinely uncommon in the region.

One species of mongoose, *G. sanguinea,* presumed to occur in southern Benin (Kingdon 1997), was not cited by the interviewees. Although Voglozin (2003) listed the species for the Lama forest reserve, it has never been directly observed there (C.A.M.S.D. pers. obs.). Despite the fact that *G. sanguinea* may occupy a wide range of habitats, including forest swamps (Kingdon 1997), it seems to avoid forested areas in southern Benin but to occupy northern savannahs, where it causes conflicts with people by preying on poultry (Djagoun & Sinsin 2007). Similarly, *A. capensis*, considered by Kingdon (1997) as occurring in southern Benin, was not reported by interviewed people. On the other hand, *A. capensis* may still be present in northern Benin, where it was sighted near the Pendjari river (1978), and recently around the Bali pool in the Pendjari Biosphere Reserve (2002–2003; Di Silvestre *et al.* 2004).

Hunting pressure and trade

Traditional guns and jaw traps were predominantly used by hunters from southern Benin to catch small carnivorans. The use of jaw traps and the lack of mentions of wire snares is a remarkable feature here, since the majority of published studies on small- to mid-game hunting in Africa showed the co-dominance of guns and wire snares as the most usual techniques (Noss 1998, Willcox & Nambu 2007). Snares may be suitable for more densely forested regions than southern Benin, and the use of jaw traps may be a more efficient technique in open habitats such as degraded forests, savannah–forest mosaics and croplands.

Nearly all the species of small carnivorans present in southern Benin were hunted. However, from the hunters' comments, and despite the fact that there was no selective hunting, small carnivorans were not a priority because of their small size and low income values compared with large herbivores and rodents (Codjia & Assogbadjo 2004, Assogbadjo *et al.* 2005). Several bushmeat surveys in the African rainforest showed that small carnivorans generally constitute a small but regular proportion of the bushmeat intake (Anadu *et al.* 1988, Wilkie *et al.* 1992, Colyn *et al.* 2004, Fa *et al.* 2006; but see Angelici *et al.* 1999b). In southern Benin, this trend also seems to apply (Codjia & Assogbadjo 2004). In our case, the majority of hunters

(94%) declared that their preferred meat was the Marsh Cane Rat (similarly in Nigeria; Anadu *et al.* 1988), and mongooses were sometimes reported by interviewees to be little valued because of the strong, musky, smell from their anal glands. Nevertheless, sale of small carnivorans is likely to represent a non-negligible income for hunters. Indeed, whereas Marsh Cane Rats and Giant Poached Rats were sold at US$ 8–10 and US$ 2–4, respectively, around the Lama forest (Assogbadjo *et al.* 2005), mean incomes from small carnivorans in southern Benin ranged between US$ 2.5 and 5.4 per animal for most of the species. Two exceptionally valued animals were *H. maculicollis* (US$ 13.3, with maximum price (head) reaching US$ 33.7), and *C. civetta* (US$ 14.6). Thus, we suspect that hunting pressure, although not specifically targeted on this group, will remain continuous.

Despite the fact that small carnivorans were not especially prized as game, we could notice clear differences in the use/value of some species, differences that could impact the level of hunting pressure to which they are subject. The most remarkable case is that of *H. maculicollis*, which appeared to be the most prized small carnivoran because of the significant income related to its resale, mostly as body parts, to the fetish market. Some hunters considered that *H. maculicollis* destroyed fishing nets and pots, and that the prices that could be obtained from its sale compensated the damage to fishing material. Similarly, the relatively high resale price of *C. civetta* could increase hunting pressure on that species, which may be vulnerable in southern Benin given its large size and its level of rarity as estimated by hunters.

Mongooses have an ambivalent status in hunters' perceptions, since (i) their strong smell seems to make them a less valued game and, as insect- and snake-eaters (*C. obscurus, H. ichneumon*), they may represent 'positive' animals, but on the other hand, (ii) their reputation as poultry killers (*H. ichneumon*) and their use in specific animist rituals (*A. paludinosus*) may promote their active hunting (also see Djagoun *et al.* 2009).

According to hunters, fetish markets were the main way in which small carnivorans were sold. Although we do not pretend to draw definitive conclusions from our episodic surveys, the low representation of mongoose diversity on displays (only *H. ichneumon* was sighted), compared with all the species of Nandiniidae, Viverridae and Lutrinae reported by hunters, may suggest a higher level of personal consumption (i.e. mongooses are little sold) that would have gone undetected during our interviews, or simply a lower rate of mongoose intake during the hunt (for reasons mentioned above).

The markets of Dantokpa and Bohicon exhibited a similar set of small carnivoran remains, with the exception of *C. civetta*, which was only found in Dantokpa. Given the broader geographic origins suspected for the animals exhibited in the latter, a proportion of *C. civetta* items may originate from northernmost regions and/or neighbouring countries. In Bohicon, which was supposed to be a local market, the presence of *Vulpes pallida* also suggests that at least a part of the remains displayed come from animals taken from northernmost areas (see Kingdon 1997). Thus, remains of *G. genetta, G. thierryi* and *N. binotata* sold in Bohicon (see above) are not 100% reliable evidences that those species inhabit southern Benin.

The presence of a fair proportion of small carnivorans on fetish market displays showed that hunting for animist practices constituted a regular pressure on populations (for a similar situation in Nigeria, see Angelici *et al.* 1999b). It remains, however, unknown whether the hunting, either for personal consumption or resale, is sustainable. Remarkably, the rate of item renewal on market displays appeared extremely low (but our survey period was short).

Conclusions

Because of great agricultural pressure and deforestation, natural habitat destruction is almost complete in southern Benin (Siebert & Elwert 2004). Very reduced patches of almost unprotected forests are now scattered across the area, and the impact of the predominance of disturbed / cropland habitats on the survival of small carnivorans is totally unknown. In conjunction with this, hunting pressure, although opportunistic, on those taxa seems sustained and may thus be a serious threat to the survival of some species already affected by habitat destruction, especially since national protection does not exist for small carnivorans.

Despite the fair diversity of West African small carnivorans in southern Benin found on this preliminary survey, questions remain open relative to (i) the absence of direct observations of two species of mongooses (*I. albicauda* and *M. gambianus*), and (ii) the ecological status of all species in the region. Unlike the more conspicuous large carnivorans, populations of small carnivorans can decrease with little notice (Buskirk & Zielinski 2003). Thus, there is an urgent need for additional field surveys in Benin in order to test the hypotheses of distribution and status built from the interviews of hunters. In return, a better characterisation of small carnivoran diversity, population history and ecology should enlighten our understanding of the Dahomey Gap as a key factor in the structuring of the West African fauna.

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First confirmed records of Large-toothed Ferret Badger *Melogale personata* in Cambodia, with notes on country records of *Melogale*

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Abstract

A Large-toothed Ferret Badger *Melogale personata* skull was found just outside Botum Sakor National Park in Koh Kong province, Cambodia, on 3 November 2008. A road-killed individual was found in the Seima Biodiversity Conservation Area in Mondulkiri province, Cambodia, on 11 April 2007. Confirmation of both these records was based on the diagnostic large size of the upper fourth premolar and the relative size of the upper first and second premolars to one another. The known geographic range of this species includes parts of India, Bangladesh, Nepal, Burma (Myanmar), Thailand, Laos and Vietnam. This account represents the first two documented records of Large-toothed Ferret Badger in Cambodia of which we are aware. True geographic distribution and conservation status remain poorly known.

Keywords: conservation priorities, distribution, geographic range, Koh Kong province, Mondulkiri province, Mustelidae

Introduction

Due to the difficulties in differentiating, based on external characters, between Large-toothed (or Burmese) Ferret Badger *Melogale personata* and Small-toothed (or Chinese) Ferret Badger *M. moschata*, there remains confusion over the range boundaries of both species in mainland Asia. The Large-toothed Ferret Badger has been recorded from northeast India, Bangladesh, Nepal, Burma (Myanmar), Thailand, Laos and Vietnam (Pocock 1941, Corbet and Hill 1992, Duckworth *et al*. 1999, Islam *et al*. 2008). Previous references to records from southern China and peninsular Malaysia (e.g. Hussain 1999, Wozencraft 2005, 2008) lack citation to reliable primary sources. Here, we report on the first confirmed *M. personata* records from Cambodia, with additional notes on *Melogale* records from the country.

Observations

On 3 November 2008, C.S. found a skull on the northeastern outskirts of Botum Sakor National Park (Fig. 1). The collection locality (11°10′N, 103°28′E, altitude about 15 m) was in the southeast corner of a 0.25 ha watermelon field adjacent to the house of a local family, around 1 km southwest of the village of Andoung Tuek, Koh Kong province, Cambodia. The habitat was an agricultural matrix, including various plantation types, with mixed low secondary growth (to not much more than 3 m stature). The

Fig. 1. Large-toothed Ferret Badger skull from the outskirts of Botum Sakor National Park, Koh Kong province, Cambodia, 2008 (Photograph by J. Holden, GWC).

Fig. 2. Body of road-killed Large-toothed Ferret Badger, Seima Biodiversity Conservation Area, Mondulkiri province, Cambodia, 2007 (Photograph by E. Pollard, WCS Cambodia Program).

skull was discovered lying on top of a mound of what appeared to be organic agricultural waste. No other bones or animal material were found nearby. We presume that it had been killed by a person and discarded on the mound, although no trauma was indicated on the skull.

Analysis of skull morphology shows the specimen belongs to the genus *Melogale*, and the diagnostic large size of the upper fourth premolar and the relative size of the upper first and second premolars to one another confirm it as a Large-toothed Ferret Badger (A. V. Abramov, J. W. Duckworth, K. Helgen *in litt*. 2008; Fig. 1). The skull was deposited at the Centre of Biodiversity Conservation Museum at the Royal University of Phnom Penh, where it is currently awaiting catalogue.

In addition, on 11 April 2007, E.H.B.P. found a dead ferret badger on a road in the Seima Biodiversity Conservation Area, around 6 km east of Keo Seima in Mondulkiri province, Cambodia. The location (12°08′N, 106°55′E, altitude about 160 m) was within a disturbed semi-evergreen and bamboo forest. The head and body length was 43 cm (17 inches) and the tail length was 20 cm (8 inches). This specimen was eaten by one of the field station dogs and no other measurements were taken. However, it was photographed beforehand, including clear images of its dentition, allowing subsequent confirmation as *M. personata* (A. Abramov *in litt*. 2009; Figs 2, 3).

Fig. 3. Dentition of road-killed Large-toothed Ferret Badger with diagnostic large size of upper fourth premolars and the relative large upper second premolar relative to upper first premolar, Seima Biodiversity Conservation Area, Mondulkiri province, Cambodia, 2007 (Photograph by E. Pollard, WCS Cambodia Program).

Most Cambodian *Melogale* records are from camera-trap photographs and therefore cannot be identified to species based on current knowledge (e.g. Walston 2008). Currently, there are camera-trap records of *Melogale* from at least Seima Biodiversity Conservation Area, Mondulkiri province (Fig. 4) and Preah Vihear Protected Forest, Preah Vihear province (WCS unpublished data 2009); Phnom Prich Wildlife Sanctuary, Kratie and Mondulkiri provinces (WWF unpublished data per Huy Keavuth verbally 2005); and Phnom Tumpor, Phnom Samkos Wildlife Sanctuary, Pursat province (approximately 1 km from a camp at 12°22′N, 103°03′E; see photo on back cover; Holden & Neang Thy 2009). Additionally there are at least a few records of *Melogale* sp(p). based on captive or dead animals in recent years, including an animal captured and released on 14 January 2003 during a survey of the southern Cardamom Mountains, found in seasonal semi-dry marshland near Trapeang Peang in the Sre Ambel River valley (11°25′N, 103°44′E) (Daltry & Traeholt 2003), and a dead animal seen in the eastern plains of Cambodia (WWF unpublished data per Huy Keavuth verbally 2005). There is at least one known direct observation of a live wild ferret badger in Cambodia: on 2

Fig. 4. Camera-trap photo of an unidentified Melogale *from the Seima Biodiversity Conservation Area (Photograph by E. Pollard, WCS Cambodia Program).*

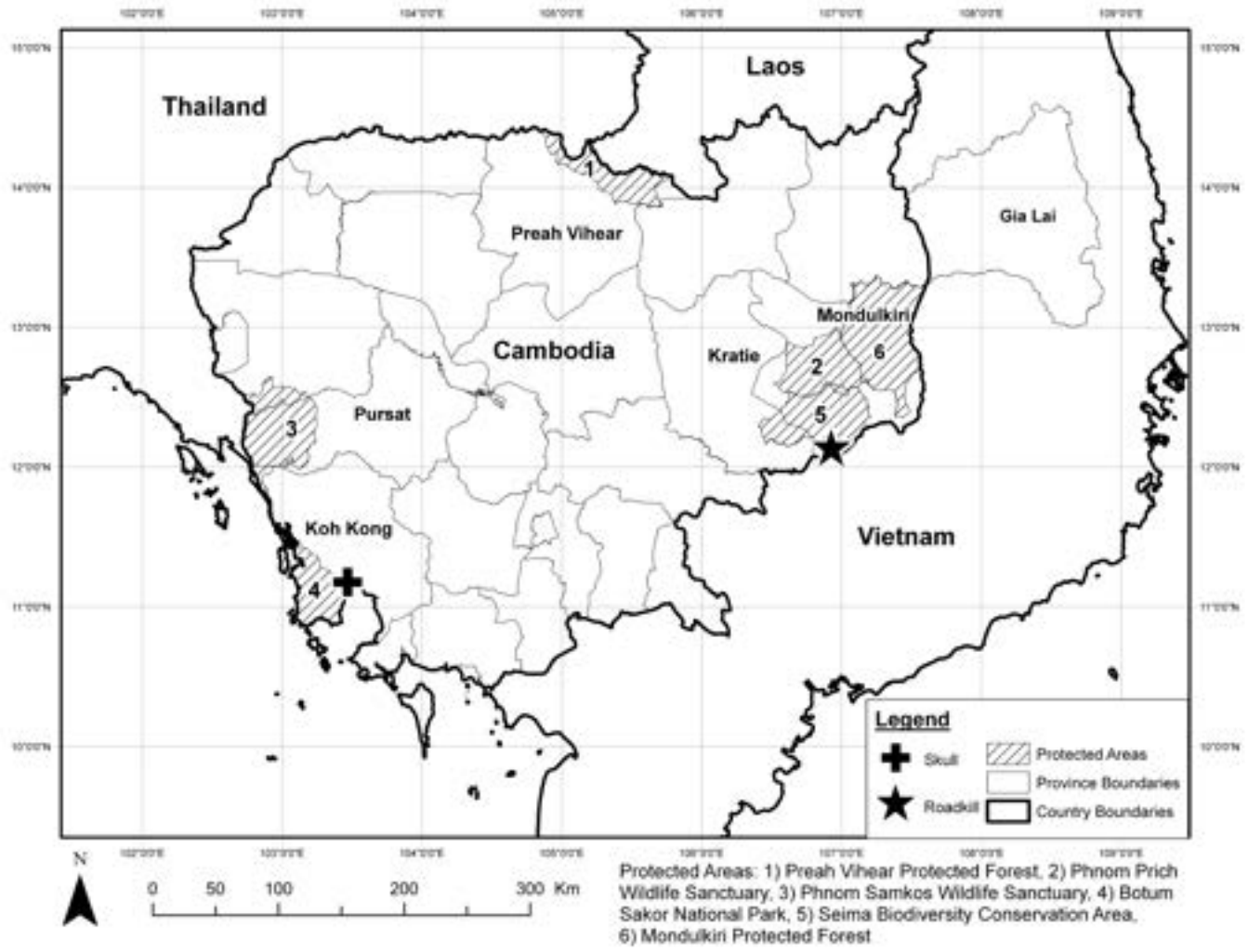

Fig. 5. Map of the two known confirmed Large-toothed Ferret Badger records from Cambodia, along with records of unidentified Melogale *by protected area.*

May 2006 in the Seima Biodiversity Conservation Area (12°09′N, 106°56′E, altitude about 165 m), one was observed at 22h00 by spotlight from a vehicle. It was in a roadside ditch on the edge of bamboo forest in a matrix of semi-evergreen forest, and was eating a frog (E.H.B.P.). Fig. 5 shows the locations of these records and Table 1 provides their details. The mapped records are not intended to depict the likely range of ferret badgers in Cambodia, because suitable surveys have been conducted in only a few areas of the country.

In Cambodia, the habitat types from which *Melogale* has been recorded include bamboo forest in a matrix of semi-evergreen forest, deciduous dipterocarp forest, semi-evergreen forest, and seasonally semi-dry marshland. Records range from altitudes close to sea level in Botum Sakor National Park, to approximately 1,000 m above sea level in Phnom Samkos Wildlife Sanctuary. The skull discussed here was found in an agricultural matrix of farmland and fruit trees and secondary growth, although its exact provenance is unknown, given the likelihood that humans deposited it there.

Discussion

Melogale personata has not previously been documented from Cambodia, although it is known to occur in adjacent regions of Vietnam (Van Peenen *et al*. 1969, Dang Huy Huynh *et al*. 1994, Roberton 2007, C. Groves unpublished manuscript) and is mapped for all of Thailand by Lekagul & McNeely (1977). It is possible that *M. moschata* might also be found to occur in Cambodia, particularly given the relative paucity of ferret badger records confirmed to species from both Vietnam and Laos, as well as numerous recently documented range extensions for many bird and mammal species in the region (e.g. Duckworth *et al*. 1999, Walston 2001, Roberton 2007). *Melogale moschata* is currently known to occur as far south as Gia Lai Province in Vietnam (Roberton 2007), but this should not be seen as indicating its real southern extent. Therefore, it would be remiss at this stage to suggest that all or even many of the *Melogale* records in Cambodia should be assumed to refer to *M. personata*.

Although in some manner it is surprising that it has taken so long to document the genus for Cambodia, Cambodia was not as well studied historically as were neighbouring countries (e.g. Walston 2001). Most of these recent *Melogale* records have come from camera-trapping projects, members of the genus apparently otherwise rarely being encountered. In addition, most conservationists and biologists working in-country do not fully realise the importance of identifying *Melogale* records to species, or how to do so, when the opportunity arises, as appears to be the case in other range states (e.g. Roberton 2007: 89).

Table 1. List of known localities of Large-toothed Ferret Badger and unidentified Melogale in Cambodia.

Description	Species	Province	Protected Area	Latitude	Longitude	Date	Source
Skull	*M. personata*	Koh Kong	(outside) Botum Sakor National Park	11°10′	103°28′	3 Nov 2008	C. Schank pers. obs.
Roadkill	*M. personata*	Mondulkiri	Seima Biodiversity Conservation Area	12°8′	106°55′	11 Apr 2007	E. Pollard pers. obs.
Observation	unidentified	Mondulkiri	Seima Biodiversity Conservation Area	12°9′	106°56′	2 May 2006	E. Pollard pers. obs.
Trapped[1]	unidentified	Koh Kong	n/a	11°25′	103°44′	14 Jan 2003	Daltry & Traeholt 2003
Camera trap	unidentified	Phnom Prich	Phnom Prich Wildlife Sanctuary	12°28′	106°52′	14 Mar 2002	WWF unpublished data 2005
Camera trap	unidentified	Preah Vihear	Preah Vihear Protected Forest	13°51′	105°22′	22 Apr 2005	WCS unpublished data 2009
Camera trap	unidentified	Preah Vihear	Preah Vihear Protected Forest	14°3′	105°31′	19, 20, 21 Mar 2005	WCS unpublished data 2009
Camera trap	unidentified	Mondulkiri	Seima Biodiversity Conservation Area	12°18′	106°55′	3 Apr 2005	WCS unpublished data 2009
Camera trap	unidentified	Mondulkiri	Seima Biodiversity Conservation Area	12°17′	106°56′	10, 18, 21 Feb 2005	WCS unpublished data 2009
Camera trap	unidentified	Mondulkiri	Seima Biodiversity Conservation Area	12°17′	106°56′	29 Nov, 20 Dec 2006; 2 Jan, 17, 18 Feb 2007	WCS unpublished data 2009
Camera trap	unidentified	Mondulkiri	Mondulkiri Protected Forest[2]	12°17′	106°56′	12 Dec 2006	WWF unpublished data 2009
Camera trap	unidentified	Mondulkiri	Mondulkiri Protected Forest[2]	12°48′	107°28′	16 May 1996	WWF unpublished data 2009
Camera trap	unidentified	Pursat	Phnom Samkos Wildlife Sanctuary	12°22′	103°3′	May 2006	Holden & Neang Thy 2009
Carcass[1]	unidentified	(Eastern Plains)	n/a	n/a	n/a	2005	WWF unpublished data 2005

[1]These two localities are not represented on the map (Fig. 5).
[2]Also known, informally, as the Srepok Wilderness Area.

Large-toothed Ferret Badger is listed as Data Deficient on the IUCN Red List of Threatened Species (Duckworth *et al.* 2008), due to a combination of a dearth of current information on the species, largely as a result of identification difficulties, and a paucity of ferret badger records in parts of the species's range, notably in Indochina. The small number of *Melogale* records relative to survey effort and to records of presumably similar species, especially of other small carnivores, might suggest relative rarity and perhaps the presence of significant threats. On the other hand, there is some anecdotal evidence that general camera-trapping surveys may in fact be a poor method for detection of the genus and/or the local abundance patterns of ferret badgers may be uneven, for still unknown natural reasons. Camera-trapping in Laos and Vietnam has shown a disparity of records amongst sites which is difficult to attribute to any obvious cause (R. Timmins pers. obs., J. W. Duckworth *in litt*. 2009). In Cambodia, there have been numerous surveys, in particular camera-trapping efforts, and similar-sized species have been well detected in general. For instance, widespread camera-trapping by WWF in northern and eastern Cambodia had only, up until 2005, detected ferret badgers at a single camera-trap locality, by comparison with ten localities for Large-spotted Civet *Viverra megaspila* and 15 for Small Indian Civet *Viverricula indica* (WWF unpublished data per Huy Keavuth verbally 2005). Annual camera-trap surveys by WCS of varying intensity were carried out between 2000 and 2007 within Seima Biodiversity Conservation Area and detected ferret badgers at only four localities (WCS unpublished data 2009). During this same period, Common Palm Civet *Paradoxurus hermaphroditus* and Large Indian Civet *Viverra zibetha* were photographed relatively frequently (in 47 and 26 localities respectively), followed by Large-spotted Civet, Small Indian Civet, and Yellow-throated Marten *Martes flavigula* (in nine, 10, and 11 localities, respectively). Species such as Crab-eating Mongoose *Herpestes urva*, Masked Palm Civet *Paguma larvata*, and Small Asian Mongoose *H. javanicus* were, like ferret badgers, seldom detected (in four, one and three localities, respectively) at this site. In Preah Vihear Protected Forest, similar camera-trap surveys between 2000 and 2005 detected ferret badgers in only two localities (WCS unpublished data 2009). Large-spotted Civet was recorded at 40 camera-trap locations and Common Palm Civet, Large Indian Civet, and Small Indian Civet were captured at 11, 12 and 17 localities, respectively, at this site. Crab-eating Mongoose and Small Asian Mongoose were detected at four and six localities and Yellow-throated Marten at two.

The priorities for ferret badger conservation include a thorough review of ferret badger records in mainland Asia (i.e. range-wide, excluding *Melogale moschata* populations in Taiwan and the two separate species of *Melogale* in the Greater Sundas), with the conclusions taking into account ecology (so far as is known), predominant survey methods, and comparisons with data on other species, especially small carnivores (e.g. similar to recent compilations for Stripe-backed Weasel *Mustela strigidorsa*, Abramov *et al*. 2008; Jungle Cat *Felis chaus*, Duckworth *et al*. 2005; Northern Smooth-tailed Treeshrew *Dendrogale murina*, Timmins *et al*. 2003). This would allow direct comparison with other species for which status is better understood, and would begin to clarify

the global status of both *Melogale* species. Such a review should also include an examination, based on specimens of unequivocal identity and provenance, of pelage characters potentially useful in specific identification, which might then enable some interpretation of species-level patterns amongst camera-trap data. However, without more confirmed records of both species, and thus a more thorough knowledge of range and especially habitat preferences, it will be difficult to determine conservation status of either species. Gathering such confirmed records will not be easy, but begins with disseminating knowledge of the importance of accurate ferret badger identification when the opportunity arises – as well as information that the only reliable means of diagnosis so far known is through characters of the upper first, second, and particularly the fourth premolar. Additionally, individual field workers and organisations should be encouraged to document thoroughly all records of ferret badgers, including any evidence of ecology and life history, and make such information readily available for scientific analysis, including for conservation status assessment, e.g. by providing data to the Small Carnivore Specialist Group. Informed Large-toothed Ferret Badger conservation, similar to that of many small carnivore species, is reliant on an increase in both the frequency and efficiency of fieldwork in Southeast Asia.

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Small carnivore records from the Cardamom Mountains, southwestern Cambodia

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Abstract

Few specific data are available on the occurrence of small carnivores in Cambodia either historically or recently. Presented here are the results from camera-trapping (targeted at other species) at several sites in the Cardamom Mountains, including wetlands and hill forest. These are supplemented by records from other methods. Excepting the arboreal Small-toothed Palm Civet *Arctogalidia trivirgata* and uncertainty over how many species of otter are present, all the small carnivores that could reasonably be expected to inhabit this part of Cambodia were recorded by at least one method during the surveys, which spanned 2000 to 2009. This included the second record of Spotted Linsang *Prionodon pardicolor* from Cambodia. Significant numbers of otters (Lutrinae) and Large-spotted Civets *Viverra megaspila* remain, although these have declined widely across South-east Asia. Small carnivores in this area are harvested through generalised hunting and as by-catch for quarry species of large carnivores and herbivores, but no evidence was found that any species was itself a highly-sought quarry.

Keywords: *Arctictis binturong*, *Arctonyx collaris*, conservation status, distribution, otters, *Prionodon pardicolor*, *Viverra megaspila*

សេចក្តីសង្ខេប

ទិន្នន័យសំខាន់ៗមួយចំនួន ស្តីពីវត្តមាននៃមំសាសីសត្វតូចៗនៅក្នុងប្រទេសក្ពុជា បានធ្វើកំណត់ត្រាតាំងពីអតីតកាល ក៏ថ្លែចជា ក្នុងពេលថ្មីៗនេះ។ នេះ គឺជាការបង្ហាញលទ្ធផលដែលបានមកពីការដាក់ម៉ាស៊ីនថតស្វ័យប្រវត្តិ (ដែលមានគោលដៅទៅលើប្រភេទ ផ្សេងៗ) ពីកន្លែងមួយចំនួននៅក្នុងតំបន់ភ្នំក្រវាញ រាប់បញ្ចូលទាំងតំបន់ពីសើម និងព្រៃភ្នំថងដែរ។ លទ្ធផលទាំងនេះ ត្រូវបានបំពេញ បន្ថែមដោយកំណត់ត្រាផ្សេងៗ ដែលបានមកពីមធ្យោបាយដ៏ទៃទៀត។ ក្រៅពីសំពោចអ៊ុកខ្លួង *Arctogalidia trivirgata* និងភាព មិនទាន់ច្បាស់លាស់នៅឡើយអំពីថា តើមានសត្វភេប៊ុំឆ្មានប្រភេទ ដែលមានវត្តមាននោះ មំសាសីសត្វតូចៗទាំងអស់ដែលគេជឿជាក់ ថា បានរស់នៅក្នុងតំបន់នេះនៃប្រទេសកម្ពុជា ត្រូវបានធ្វើកំណត់ត្រា យ៉ាងហោចណាស់ក៏តាមវិធីសាស្ត្រមួយ ក្នុងអំឡុងពេលនៃការ ស្រាវជ្រាវចាប់ពីឆ្នាំ ២០០០ ដល់ ២០០៩។ កំណត់ត្រាបើកទីពីរនៃកំពីងពួងអ៊ុក *Prionodon pardicolor* ពីប្រទេសកម្ពុជា ក៏ត្រូវ បានរាប់បញ្ចូលផងដែរ។ ចំនួនភេ Lutrinae និងសំពោចធំ *Viverra megaspila* នៅមានវត្តមានច្រើនគួរអោយកត់សំគាល់ នៅឡើយ បើទោះជាចំនួននេះត្រូវបានថយចុះក្រាប់ទឹកន្លែងនៅទូទាំងតំបន់អាស៊ីអាគ្នេយ៍ក៏ដោយ។ មំសាសីសត្វតូចៗនៅក្នុងតំបន់ ទាំងនេះ ត្រូវបានធ្វើអាជីវកម្មតាមរយៈនៃការប្រមាញ់ និងការចាប់បានដោយចៃដន្យ នៅពេលដែលអ្នកប្រមាញ់បានសំដៅទៅរក មំសាសីសត្វ និងតិណសីធំៗ។ ក្រៅពីនេះ វាមិនមានភស្តុតាងដែលបញ្ជាក់ថា មំសាសីតូចៗជាប្រភេទដែលជាគោលដៅសំរាប់ការ ប្រមាញ់ខ្លោះទេ។

ពាក្យគន្លឹះ *Arctictis binturong, Arctonyx collaris,* ស្ថានភាពអភិរក្ស រចាយ ភេ *Prionodon pardicolor, Viverra megaspila*

Introduction

The Cardamom Mountains region of southwestern Cambodia spans more than 20,000 km², following the northern margin of the Gulf of Thailand (Daltry & Momberg 2000). The range begins in the Khao Soi Dao Mountains of Thailand and extends 225 km southeast to the Elephant Mountains of Bokor National Park, east of Kampot. This wild and remote region is composed of forest-covered peaks and foothills separated by low-lying basins and valleys. Phnom Aural at 1,771 m is both Cambodia's tallest peak and the highest point in Cardamom range. In the west, Phnom Samkos and Phnom Tumpor reach 1,717 m and 1,551 m., respectively; while peaks in the Central Cardamoms reach elevations of 1,400 m. These mountains in Cambodia include five protected areas: the Phnom Samkos Wildlife Sanctuary; the Phnom Aural Wildlife Sanctuary; the Central Cardamoms Protected Forest; and Kirirom and Bokor National Parks. All these protected areas have only recently been established and are progressing at varying speeds towards significant on-ground protection of habitat and wildlife.

Eleven categories of habitat and vegetation type have been recognised from the Cardamoms region: dry deciduous forest (now more generally known as deciduous dipterocarp forest); mixed deciduous forest; dry evergreen forest; lowland evergreen forest; hill evergreen forest; gallery forest; bamboo thicket; pine forest; marshland; grassland; and fernland (Ashwell 1997). Rainfall is relatively heavy, averaging around 3,000 mm annually. The southwest monsoon falls in the region during May–October; while December–April sees a prolonged dry period with infrequent rain. Temperatures show little seasonal change, averaging 25–30°C (Ashwell 1997).

Until the last decade of the 20th century, the Cardamom Mountains remained very poorly surveyed, especially for cryptic species such as small carnivores. The first recent mammal survey of the Phnom Samkos Wildlife Sanctuary, in 2000, recorded 10 species of small carnivores (excluding cats [Felidae]; Daltry & Momberg 2000). A record for *Lutra lutra* resulting from this survey was based on tracks and, following discussion in Poole (2003), it is disregarded here.

In this report we bring together small carnivore records gathered during our surveys for Fauna & Flora International in the western Cardamoms, spread across nine years. This is by no means an exhaustive review of the records available from this area, not even by FFI, let alone by the various other conservation organisations active in the area.

Survey Sites

Fieldwork was carried out in two protected areas: the Phnom Samkos Wildlife Sanctuary and the Central Cardamoms Protected Forest.

The Phnom Samkos Wildlife Sanctuary, near the northwestern end of the Cardamom Mountains, is centred at approximately 12°16′N, 103°07′E with an area of 332,566 ha (Ministry of Environment 2006). The sanctuary covers parts of three provinces,

Battambang, Pursat and Koh Kong. Between February and July 2006 a six-month camera-trapping programme was conducted on and around the two highest peaks in the sanctuary: Phnom Samkos itself, and the adjacent massif of Phnom Tumpor.

The sandstone massif of Phnom Samkos is the second highest peak in the Cardamom range. Logging operations in the 1990s cut a series of roads through the surrounding foothills and lower slopes, removing most of the commercially valuable trees. At elevations above 500 m the terrain becomes very steep and is relatively undisturbed evergreen forest for the most part. During the 2000 surveys an excursion was made to the summit, but no camera-traps were placed.

During the 2006 surveys, cameras were placed in the secondary logged forest accessed from the village of Chheu Teal Chrum (12°12′15″N, 103°07′08″E), at altitudes below 500 m. These were concentrated around or close to saltlicks used by large mammals such as Asian Elephants *Elephas maximus* and Gaur *Bos frontalis*. A second and more extensive set of cameras were placed on the Phnom Tumpor complex, a series of ryolitic peaks clustered in a coronet-shaped massif. The approaching slopes of Phnom Tumpor are extremely steep and covered in dense bamboo thicket, while the higher areas comprise hill evergreen forest and open basaltic clearings. The base camp for these surveys was at about 1,100 m beside the permanent Ou Kran stream (12°22′06″N 103°03′26″E), one of the few areas of the peak that has water all year round.

Veal Veng Marsh (12°02–03′N, 103°15–18′E) consists of approximately 1,000 ha of riparian marshland with small areas of swamp forest at 560 m (Daltry 2002). It is situated in Pursat province and forms part of the Central Cardamoms Protected Forest.

Methods

The small carnivore records given in this report were collected between 2000 and 2009 during biodiversity surveys for other purposes. Records came in various ways, including sight records, hunters' trophies, and signs. Most, however, came through a series of camera-trapping programmes, operated between 2006 and 2008. Although these camera-trapping programmes targeted larger-bodied species, cameras were placed in a way that ensured smaller mammals, such as small carnivores, were recorded as well. Night surveys were frequently made in search of reptiles and amphibians, and civets were occasionally encountered; but no systematic spotlighting for nocturnal mammals was undertaken.

TrailMaster™ 1550 and 1500 Infrared Trail Monitors were used for all camera-trapping. These were fitted with Canon Sureshot, Olympus Infinity, and Yashica T4 film cameras. Cameras were fixed to their posts with UniLoc™ tripod heads and protected with metal covers made locally in Phnom Penh. Film stock used was Fuji Superia 200 ASA. Green duct tape was used to protect any exposed cables from rodent or termite attacks. No baits or lures were used. Cameras were set to record both day and night.

Cameras were placed to target many different species, from Asian Elephants to Siamese Crocodiles *Crocodylus siamensis*. Without exception, the infrared beam was positioned to pass within 8–20 cm above the ground, low enough to record most small carnivores.

During a six-month period between January and July 2006 a total of 25 camera placements was made on Phnom Samkos and Phnom Tumpor. This programme produced a total of 2,097 trap-days: 517 trap-days on Samkos and 1,580 trap-days on Tumpor.

Camera-traps targeting crocodiles were set in Veal Veng marsh over the two dry seasons (late December of the previous calendar year to late March) of 2007 and 2008. The 12 cameras set during the 2007 programme, in addition to targeting crocodiles, were also placed in adjacent forested areas to assess general mammal presence. This programme totalled 1,194 trapping days. The five traps set during the 2008 programme operated for approximately 370 trapping days, and were concentrated solely on crocodiles. In spite of this targeting, three species of small carnivore were recorded.

Species Accounts

Table 1 lists all species recorded during the surveys and summarises their distribution as documented. The pictures on the back cover are those of small-carnivores camera-trapped in Cambodia.

Yellow-throated Marten *Martes flavigula*
This mustelid was only camera-trapped during daylight hours, often in pairs, on both Phnom Samkos and Phnom Tumpor. A single animal was also observed at midday in secondary logged forest below Phnom Samkos. The Cambodian animals have a strikingly pale body colour compared with Sundaic specimens, which are overall dark brown with a yellow throat. Martens camera-trapped in the Cardamoms showed a pale buff body colour with dark hind quarters, front legs and tail. The face was also dark with a black bar from behind the ear shading the yellow throat.

Hog Badger *Arctonyx collaris*
On Phnom Tumpor this species regularly appeared on camera-traps set along forested ridge paths at 1,000–1,200 m. A single animal was also camera-trapped at night on the foothills of Phnom Samkos in very disturbed habitat at 300 m. Of the 15 camera-trap records, seven were made at night, with an equal number for daylight hours. A single crepuscular image was made at 06h18. The Tumpor area is difficult of access and suffers minimal human disturbance, so these data probably reflect the natural behaviour patterns of this species. Animals were generally consistent in pelage tone and pattern with each other, and showed a paler, yellower, colour than J.H. is used to from Sumatra (see Holden 2006); this is consistent with pelage differences noted by Helgen *et al*. (2008), who separated the Sumatran population as a separate species Sumatran Hog Badger *A. hoevenii*. As in Indonesia and Vietnam (own data), locals refer to this animal as a species of pig: the commonly used Khmer name is *Chruk Poun*, *chruk* being pig.

Ferret badger *Melogale* sp(p).
Ferret badgers were recorded twice on different camera-traps set on Phnom Tumpor. Both images were taken at night on cameras placed beside animal wallows, which during the dry season were also used as drinking holes by various other species. Due to the difficulties of distinguishing between Large-toothed Ferret Badger *M. personata* and Small-toothed Ferret Badger *M. moschata* (both of which might occur in Cambodia) these records must remain indeterminate. Evidence from the lowlands south of the Cardamoms and from eastern Cambodia has recently confirmed that at least *M. personata* is present in Cambodia (Schank *et al*. 2009).

Hairy-nosed Otter *Lutra sumatrana*
Hairy-nosed Otter is known in Cambodia from the vicinity of the

Table 1. Small carnivores recorded in the Cardamom mountains.

Species	Scientific name	Location	Altitudes	Habitat Type	CTR	Method
Yellow-throated Marten	*Martes flavigula*	PT, PS	300–1,200	SEF, PEF	5	O, C
Hog Badger	*Arctonyx collaris*	PT, PS	300–1,200	PEF	15	C
Ferret badger	*Melogale* spp.	PT	1,000–1,200	PEF	2	C
Hairy-nosed Otter	*Lutra sumatrana*	VV?, PS	500–560?	PEF, SF?	5?	C?, H
Smooth-coated Otter	*Lutrogale perspicillata*	SB	300?	PEF	0?	H
Oriental Small-clawed Otter*	*Aonyx cinereus*				0	
Large Indian Civet	*Viverra zibetha*	PT	800–1,300	PEF	18	O,C
Large-spotted Civet	*Viverra megaspila*	VV	250?; 560	M, DD?	13	C
Small Indian Civet	*Viverricula indica*	SB, VV	250?; 560	M, DD?	22	C
Spotted Linsang	*Prionodon pardicolor*	PT	1,200	PEF	1	C
Common Palm Civet	*Paradoxurus hermaphroditus*	PS, PT,VV	300–1,000	SEF, PEF	24	C
Masked Palm Civet	*Paguma larvata*	PT	1,000–1,200	PEF	3	C
Binturong	*Arctictis binturong*	PT	250?	?	0	H
Small Asian Mongoose	*Herpestes javanicus*	SB	100	V	0	O
Crab-eating Mongoose	*Herpestes urva*	PT, PS	1,000–1,200	SEF, PEF	28	O, C

Codings refer to records from the authors' surveys; records from other sources are given in the species accounts.
Location: PS, Phnom Samkos; PT, Phnom Tumpor; SB, Samkos Basin; VV, Veal Veng.
Habitat: SEF, Secondary evergreen forest; PEF, Primary evergreen forest; SF, Swamp forest; M, Marshland; DD, Dry Dipterocarp; V, Village.
CTR: Camera-trap record, with the number referring to independent events, not number of images.
Method: O, Observed in the wild; C, Camera-trapped; H, Captive or dead animal (where objective validation of identification was possible and import from another area seemed unlikely).
*This species was not recorded on the present surveys.

flooded forest of Tonle Sap (Poole 2003). Its presence in the Cardamom Mountains was finally confirmed after examination of a skin in Chhe Teal Chrum village, Pursat province, reportedly hunted in 2006 from the Ang Krang River at the foot of Phnom Samkos. The Ang Krang is a small stream flowing through hilly primary and secondary logged forest at about 400 m altitude. Despite having been reportedly stored in a village house for the past three years, the skin was still in good condition, retaining the pads and claws, and clearly showing the hair-covered rhinarium, the chief diagnostic feature of this species (Lekagul & McNeely 1977). The ground colour was chocolate brown, shading into a darker tone on the head and along the dorsum and tail. The whitish coloration of the throat was not extensive, extending no further than the length of the head. It showed a slight yellowish tint that may have been caused by exposure to wood smoke. The white coloration on the upper lip was irregular in thickness, ranging from a few millimeters to almost 1 cm in places. Measurement from snout to tail tip was recorded at 125 cm. After skinning the otter, the hunter had eaten it, reporting that the flesh was not very palatable. None of the skeleton remained. The skin was left in the possession of the hunter.

Between January 2007 and March 2008, on three camera-traps set for crocodiles, a series of six photographs showing a large, dark-coloured, otter, felt most likely to be Hairy-nosed Otter, were made in Veal Veng marsh. The cameras were set close to an area of permanently flooded forest, constituent tree species not determined (12°02′5.3″N, 103°15′51.5″E), at 560 m. All six photographs were taken during daylight hours. When questioned about otter presence, hunters usually described three types: two large types, one of which they referred to as 'black' and one as 'brown'. The 'black' type they described as usually solitary; while the 'brown' species lives in 'groups' and has a flatter tail, which probably relates to *Lutrogale*. The third type appears to be *Aonyx*, reported as 'grey', much smaller, and known from rivers, where it occurs in 'groups'.

Smooth-coated Otter *Lutrogale perspicillata*

Two fresh skins identified as Smooth-coated Otters were seen in the possession of wildlife traders travelling along the Anglong Reap road during the 2000 survey of Phnom Samkos; they reportedly came from the Tum Yong River (Daltry & Momberg 2000). Local hunters described otters apparently of this species (see Hairy-nosed Otter).

Oriental Short-clawed Otter *Aonyx cinereus*

Short-clawed Otter was reported as 'observed' in lowland evergreen forest of the Central Cardamoms during the 2000 survey (Daltry & Momberg 2000), but no further details are given. Spraints around Phnom Tumpor in 2007 possibly belonged to this species. This suggestion was made because the spraints were found mid-stream along forest rivers on small rocks. Local hunters described otters apparently of this species (see Hairy-nosed Otter), but at present no verifiable records from the Cardamoms seem to be available.

Large Indian Civet *Viverra zibetha*

In Phnom Tumpor this was a very common civet, recorded regularly on the camera-traps. All records were made at night in forest

at altitudes of 800–1,300 m. One bold animal was observed at night foraging around our forest camp at about 800 m.

Large-spotted Civet *Viverra megaspila*

Viverra megaspila and *V. zibetha* did not appear to be syntopic in the Cardamoms. While *V. zibetha* was common in the hill forests of Phnom Tumpor, *V. megaspila* was only recorded in the open marshland and fragment forests of Veal Veng, where it was camera-trapped 13 times. Large-spotted Civet is believed to occur at lower altitudes than does Large Indian (Lynam *et al*. 2005) and this appears to be the case in the Cardamoms. However, the Veal Veng marsh, at 560 m, is higher than areas from which *V. megaspila* records with precise altitudes have typically come (Khounboline 2005). Lower altitudes than this (250–300 m) in the heavily logged evergreen forest around Phnom Samkos did not produce any records of this species, perhaps suggesting it prefers more open habitat. It seems unlikely that this species was absent from Samkos through over-hunting: human presence in the area was low and no traps targeting civets or small mammals were seen. It is possible that viverrid tracks seen in the deciduous forests of the Samkos basin (where no camera-traps were set) belonged to this species, as it occurs in the landscape dominated by deciduous dipterocarp forests of Mondulkiri province, northeastern Cambodia (T. Gray, WWF Greater Mekong Programme, *in litt*. 2008), although R. J. Timmins (*in litt*. 2009) knows of few, if any, records from such forest itself within Cambodia. In Veal Veng this civet was camera-trapped in the centre of the marsh, some distance from any tree cover, and was frequently recorded moving close to the water's edge. Footprints, presumably from this species, were occasionally seen skirting pools and drainage channels. This civet's habit of foraging close to water, plus its cat-like footprints, seem likely to have lead to frequent erroneous reports, from both field biologists and local hunters, of Fishing Cat *Prionailurus viverrinus*. Local people often use the term *kla trey* ('fish cat') for both species, even when shown photographs. Unlike *Viverricula indica*, no individuals were photographed with obviously wet fur, suggesting they are not entering the water at all frequently, if at all.

Although Large-spotted Civet was not recorded in Cambodia until recently (by Walston *et al*. 2001), a variety of surveys (the results remaining, to date, largely unpublished; e.g. J. L. Walston *in litt*. to Lynam *et al*. 2005) suggest that Cambodia is among the countries retaining the largest populations of this generally much-decreased civet (Lynam *et al*. 2005).

Small Indian Civet *Viverricula indica*

Records of this small civet were restricted to Veal Veng and village roads through the deciduous dipterocarp forests of the Samkos basin. In Veal Veng this species appeared on camera-traps every week, both in open marshland, and in the small forest areas that followed the water courses flowing through the marsh. It was often recorded close to water, and on occasion photographs showed individuals with wet fur, as if they had just been in the water. An alternative possibility is that they had been drenched by foraging in dewy grass, but this seems less likely because Large-spotted Civet, also abroad in such habitat, was never photographed with wet fur. The only records from the Samkos basin were from foot prints, apparently belonging to this species, along roads and beside drying-out pools near the village of Chheu Teal Chrum at about 250 m.

Spotted Linsang *Prionodon pardicolor*

A single photograph was taken of a Spotted Linsang in May 2006 on a camera-trap set at about 10 cm from the ground, in primary evergreen forest on Phnom Tumpor. The photograph was made at night along a forest trail and represents the first record of a linsang in the wild from Cambodia. Spotted Linsang is known from all countries neighbouring Cambodia, Laos (e.g. Evans *et al*. 1994), Vietnam (e.g. Long & Minh Hoang 2006) and Thailand, where it was reported as 'very rare and localized'(Van Rompaey 1995). Thus, its occurrence in Cambodia is not unexpected. The only previous country record was of a dead animal collected from a hunter, which presumably originated from the nearby Kirirom National Park (Kong Kim Sreng & Tan Setha 2002), an outlying branch of the Cardamom Mountains.

Linsangs are often thought to be mainly arboreal, but various records have been made with camera-traps, showing animals on the ground. This is perhaps because they forage through the lower shrub layer (Kuznetsov & Baranauskas 1993, Van Rompaey 1995). One method successfully employed to camera-trap these small animals is to place cameras focused on fallen trees, logs or low buttresses. Camera placements like this have repeatedly secured photographs of Banded Linsang *P. linsang* in Sumatra (Holden 2006) and of Spotted Linsang twice in Vietnam (Long & Minh Hoang 2006).

Common Palm Civet *Paradoxurus hermaphroditus*

This civet was recorded on camera-traps set around Phnom Samkos at 300 m (three records) and in the forested areas around Veal Veng marsh (20 records). All camera-trap records were made at night. On Phnom Tumpor a single image was made at about 1,000 m in primary forest. As with *Viverricula indica*, individuals around Veal Veng were camera-trapped with wet fur.

Masked Palm Civet *Paguma larvata*

Duckworth (1997) suggested that this is a hill and montane species in adjacent Laos (although this is clearly not so throughout its range: it occurs as low as 100 m in Sumatra; Holden 2006) because all records there were from over 500 m. Findings in the Cardamoms were consonant with this: records were obtained only above 1,000 m, and only on Phnom Tumpor. All three records were made at night.

As with Yellow-throated Marten, this species showed markedly different pelage coloration from animals in Indonesia. Cambodian individuals show a pale, buff, ground colour, with dark feet and terminal portion to the tail (which lacks the white tip seen in Sumatran animals). The face and head are black with a white central stripe running from above the snout, across the top of the head, through to between the shoulders.

Binturong *Arctictis binturong*

The single Binturong record was of a trapped animal confiscated in the village of Tumpor (12°22′40″N, 103°06′18″E) and released by park rangers. As this is a remote village with poor road access, it is safe to conclude that the animal was caught locally.

Small Asian Mongoose *Herpestes javanicus*

Small Asian Mongoose never appeared on camera-traps, either because it was small enough to pass undetected, or more likely, because no camera-traps were set in the kind of disturbed habitat it uses (e.g. Than Zaw *et al*. 2008, and references therein). During

the period of fieldwork, one individual was seen crossing the main Pramouy–Pursat road (at 12°18′31.7″N 103°31′53.3″E) at about 100 m close to a village, at around midday. Daltry (2002) recorded this species around Veal Veng marsh.

Crab-eating Mongoose *Herpestes urva*

Crab-eating Mongoose was regularly photographed on Phnom Tumpor but was found only occasionally on Phnom Samkos. It was also observed once at 12h00 on Phnom Tumpor foraging in forest at about 1,000 m. It was not recorded in the more open habitat of Veal Veng marsh and adjacent forests. Although commonly camera-trapped near water, it also frequented ridge trails through drier areas of forest. Despite reports that it is infrequent at higher elevations (Van Rompaey 2001) in the Cardamoms it was especially common above 1,000 m. As in Laos, Myanmar and elsewhere (Duckworth 1997, Than Zaw *et al*. 2008), it appears to be strictly diurnal in the Cardamom Mountains: all camera-trap records were during full daylight, usually in the morning.

Discussion

These opportunistic records documented nearly all species of small carnivores known from Cambodia, or likely to occur. The most obvious exception is Small-toothed Palm Civet *Arctogalidia trivirgata*, which was recorded in eastern Cambodia by Walston & Duckworth (2003) and, given its known range in Thailand adjacent to the Cardamoms (e.g. Khao Yai National Park; Duckworth & Nettelbeck 2008), it is likely that it occurs in the survey area. It is, however, a difficult species to camera-trap, because of its arboreal habits (Duckworth & Nettelbeck 2008). The status of Eurasian Otter *Lutra lutra* in Cambodia, if it occurs at all, is opaque (Poole 2003). The possibility that weasels *Mustela* might occur in Cambodia remains; these seem not to be well recorded by camera-trapping, at least in South-east Asia (e.g. Abramov *et al*. 2008). Owston's Civet *Chrotogale owstoni* occurs close to Cambodia, but if it enters the latter country at all it is likely to be only in the evergreen forests of the east, of limited extent, which are climatically similar to and contiguous with the species's main range in Vietnam (R. J. Timmins verbally 2006). The recently described Taynguyen Civet *Viverra tainguensis* from Vietnam is taken, following Walston & Veron (2001), to be a synonym of Large Indian Civet. In addition, Wozencraft (2005) listed Cambodia within the range of Malay Civet *Viverra tangalunga*, despite there being no records known to anyone who has surveyed mammals in the country. The 30 images of *Viverra* civets from this project do not show any Malay Civets. It is likely that Wozencraft's (2005) statement was an error, and pending a record with primary detail the species should not be considered to inhabit Cambodia. Similarly, Papeş & Gaubert (2007) seem to imply that Otter Civet *Cynogale bennettii* might be expected to occur quite widely in Cambodia, specifically in the Cardamoms, but (as they themselves indicate) there has never been any record from the country or from adjacent areas of neighbouring countries.

The main focus of the Cardamom Mountain surveys undertaken in the past three years was to determine the status of large and seriously threatened species, such as Tiger *Panthera tigris*, Leopard *P. pardus*, Asian Elephant, bears *Ursus*, and the wild cattle Gaur and Banteng *Bos javanicus*. Elephant and Gaur were regularly recorded and an Asian Black Bear *Ursus thibetanus* was recorded once, while both Tiger and Leopard remained unrecorded, despite careful placement of camera-traps targeting these species. This seems to suggest that they have been largely exterminated from the more accessible areas of the Cardamom Mountains. This conclusion was supported by local reports of rampant hunting in the early years of the millennium. The small carnivores, at least for the moment, seem not to be the subject of targeted hunting. At present, hunting effort seems to be concentrated on the remoter peaks where snares are set to target Southern Serow *Naemorhedus sumatraensis* and bears. Dogs are used to hunt tortoises and turtles (Chelonia) and pangolins *Manis*. Small carnivores appear to be mostly victims of by-catch and of general hunting: civets and small cats caught in snares, either in those set in remoter areas for Southern Serow, or for pigs *Sus* in forest adjacent to agricultural areas. They also feature as an opportunistic catch where dogs are used, such as the case of the Hairy-nosed Otter from the Ang Krang.

The type of systematic hunting with snares as frequently found in Vietnam, where viverrids are often the main target (Long & Minh Hoang 2006), was observed only once during the survey periods, in forest adjacent to Veal Veng Marsh. These snares were reportedly set for porcupines *Hystrix* but were robust enough to catch small carnivores.

Although civets are at least occasionally eaten in Cambodia (pers. obs.), they are not the valued delicacy there that they are in Vietnam (Roberton 2007), but rather seem to be an opportunistic meal for protein-starved rural dwellers. However, an influx of Chinese construction labourers into Veal Veng and the administrative centre of Pramouy, working on a series of dam projects, may well change this situation, especially as civet numbers dwindle in Vietnam.

These same dam projects may well also seriously threaten the area's otters. There remain few data of which otter species use which habitats within the Cardamoms, and even how many species occur, and how well they could adapt to the habitat changes precipitated by dam-building. Otters are also occasionally caught as by-catch in fishing nets used in the marsh, but no evidence was found of specific otter hunting.

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Evaluation of three indirect methods for surveying the distribution of the Least Weasel *Mustela nivalis* in a Mediterranean area

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Abstract

The Least Weasel *Mustela nivalis* occurs in a large circumboreal range and seems to be declining in some localities. However, methods used for surveying the species vary highly between studies and data are scarce about the effectiveness of different techniques. Three indirect methods frequently used for carnivore inventories (hair-traps, track census and faeces sampling) were tested for surveying the distribution of this species in a Mediterranean area, central Spain. Hair-traps recorded the highest proportion of sites occupied (30.8%), whereas the other methods provided values <10%, with differences statistically significant among these techniques. The probability of detection also shows that hair-trapping works significantly better than sign surveys (0.56 with hair-trap opposed to 0.20 and 0.28 with signs). The hair-trap method can be a powerful and useful technique for surveying the Least Weasel but further research is needed to improve the method and increase probability of detection.

Keywords: central Spain, faeces sampling, hair-trap, Mustelidae, track survey

Evaluación de tres métodos indirectos para el muestreo de la distribución de la Comadreja *Mustela nivalis* en un área Mediterránea

Resumen

La Comadreja *Mustela nivalis* está presente en un área circunboreal extensa y parece que está declinando en algunas localidades. Sin embargo, los métodos empleados para muestrear a la especie son muy variables entre los estudios y los datos sobre la efectividad de las diferentes técnicas son escasos. Tres métodos indirectos usados frecuentemente en los inventarios de carnívoros (trampas de pelo, censos de huellas y muestreos de excrementos) fueron testados para muestrear la distribución de la especie en un área Mediterránea de España central. Las trampas de pelo registraron la mayor proporción de sitios ocupados (30.8%), mientras que los otros métodos proporcionaron valores <10%, con diferencias estadísticamente significativas entre estas técnicas. La probabilidad de detección también mostró que las trampas de pelo funcionaban significativamente mejor que las prospecciones de indicios (0.56 para las trampas de pelo en contraposición a un 0.20 y 0.28 de los indicios). El método de las trampas de pelo puede ser una técnica adecuada para muestrear a la Comadreja, pero es necesario investigar para mejorar el método e incrementar las probabilidades de detección.

Palabras clave: España central, muestreo de huellas, Mustelidae, prospección de excrementos, trampa de pelo

Introduction

The Least Weasel *Mustela nivalis* is broadly distributed throughout the northern hemisphere (Sheffield & King 1994). Particularly in Europe, it seems one of the commonest carnivores (Mitchell-Jones *et al*. 1999), but some recent evidence (McDonald & Harris 1999, Battersby 2005, Palomo *et al*. 2007) suggests population declines.

For this species, specific sampling protocols have not been developed and typical methods used for surveying carnivores, such as faeces sampling, camera-trapping and direct observations, do not work well (Millán *et al*. 2001, Torre *et al*. 2003, González-Esteban *et al*. 2004, Virgós & Travaini 2005, Gompper *et al*. 2006, Barea-Azcón *et al*. 2007, Reid 2007, Mangas *et al*. 2008). Further, monitoring programmes are usually based on track surveys (Korpimäki *et al*. 1991, Aunapuu & Oksanen 2003 Gehring & Swihart 2003, Gompper *et al*. 2006, Hellsted *et al*. 2006, Oksanen *et al*. 2006, Reid 2007), indirect data derived from trapping (McDonald & Harris 1999, 2002, McDonald 2000, de Marinis & Masseti 2003, Lischka *et al*. 2006, Reid 2007), enquiries (McDonald & Harris 1999, de Marinis & Masseti 2003, Richter & Schauber 2006, Reid 2007) or actual field-based observations (de Marinis & Masseti 2003, Reid 2007). Thus, estimations of occurrence, range shifts or habitat preferences are rarely robust enough for statistical analysis.

Dirks *et al*. (1996) designed a funnel trap for Stoats *Mustela erminea* that could also be potentially powerful method for surveys of the Least Weasel. However, González-Esteban & Villate (2005) using such hair-traps in northern Spain achieved poor results on Least Weasel distribution, but considered this a reflection of low abundance of the species in their study site. Our objective was to compare the effectiveness of hair-traps, track census and faeces sampling for detection of Least Weasel.

Materials and methods

Study area

The study was carried out in a suburban area of central Spain, around Salamanca and near villages (Coordinates of a central point: 40°57′24″N, 5°39′27″W; general altitude 800 m for the study area). Sampling was focused on the riparian habitats adjacent to the river Tormes, because during the last decade all observations and data obtained in the study area about the species came from this zone.

Climax vegetation of the riparian strip consists of a gallery forest dominated by willows (e.g. *Salix fragilis* and *S. alba*) but

including European Alder *Alnus glutinosa* and various poplars *Populus sp(p)*. The shrub stratum is represented by the rose family: brambles *Rubus* sp(p)., roses *Rosa* sp(p)., and Common Hawthorn *Crataegus monogyna*. Some grassland are present around this forest. Helophytic vegetation (*Typha latifolia*, *T. domingensis*, *Phragmites australis*, *Sparganium erectum*, *Juncus* sp(p). and *Scirpus* sp(p).) is well developed, covering sometimes >10% of the water's surface in dense aggregations.

Given the close proximity to the city, some of the riverine habitat is currently used intensively for recreation, thereby modifying forest structure and dynamics.

Some other carnivore species such as the Red Fox *Vulpes vulpes*, the Common Genet *Genetta genetta* and the American Mink *Neovison vison* were also detected in Salamanca during the study.

Sampling design

The design of the survey is based on the minimum home range of a single Least Weasel (Wilson *et al.* 1996, Zielinski & Stauffer 1996), ensuring at least one trap and survey per potential territory. Home range data of adult Least Weasel is scarce, but published data indicates a minimum home range of about 0.25 km² (King 1975, Sheffield & King 1994, Erlinge 1995, Jedrzejewski *et al*. 1995, Brandt & Lambin 2007).

Given the human pressure described, the natural vegetation around the study area extends 200–500 meters from the banks. Thus, the entire river and closely related stream length (13 kilometers) was divided into one-kilometer stretches, creating plots of about 0.25 km², with both banks considered independent from the plot on the opposite side of the main river. For defining this surface area, in some sites it was necessary to enlarge or reduce by some meters (never more than 100) the length of the station surveyed. Tributaries were divided equally into one-kilometer length stations with 500 m width, but in this case we included both banks because of high connectivity (many bridges, and some stretches with the bed usually dry). This design gave 26 sampling stations (Fig. 1) in which the above protocols were used.

Fieldwork was conducted in April and May 2008 to avoid biases due to seasonal variations in population abundance (see King 1980, Sheffield & King 1994, Erlinge 1995, McDonald & Harris 2002).

Fig. 1. A: Geographical location of the study area (black rectangle). B: Results of the survey with each method (division in one-kilometer long stations superimposed). Black dots: station positive; open dots: station negative.

Faeces sampling

Faeces sampling is one of the most used techniques for surveying carnivores (Wilson *et al*. 1996, Birks *et al*. 2005, Gompper *et al*. 2006, Barea-Azcón *et al*. 2007). Least Weasel faeces are small (<3 cm long), thin and often rolled in appearance, and are differentiable from those of the few other species of carnivores (see above) in the study area (Sanz *et al*. 2004). Faeces were intensively sought (more than two hours per station per surveyor) in ways, trunks, rocks, among the vegetation, etc. with the help of a portable torch by walking the entire 0.25 km² area of each station.

Track sampling

Searches for footprints are much used in carnivore studies (Palomares *et al*. 1996, Wilson *et al*. 1996), but rely on a good substrate for imprinting the tracks. In each 0.25 km² station, tracks were searched by walking in all areas where their occurrence was potentially likely, as in mud or sand, abundant in the banks of the river after flooding. Sampling effort was as that during faeces surveys (more than two hours per observer). Least Weasel tracks are of typical mustelid form, but smaller in size than any congeners (less than 2 cm) and frequently in groups of four, representing all the limbs of an animal (Sanz *et al*. 2004). Taking into account the identities of the few other carnivore species in Salamanca, tracks with these attributes must belong to a Least Weasel, but such cannot be extrapolated throughout the species's range.

Hair-traps

Several different types of hair-traps, depending on the target species, have been designed to retain a sample of hairs to be identified to species through microscopic preparation (Belant 2003, Lynch *et al*. 2006). This study adopted the design of González-Esteban & Villate (2005), of two overlapped wire mesh pieces, one baited with fresh chicken wing and another provided with an adhesive tape. The trap was placed on shrubs or trees at 20–30 cm high (Fig. 2). One hair-trap was placed at the centre of each sampling station for seven consecutive nights (as with sampling for Pine

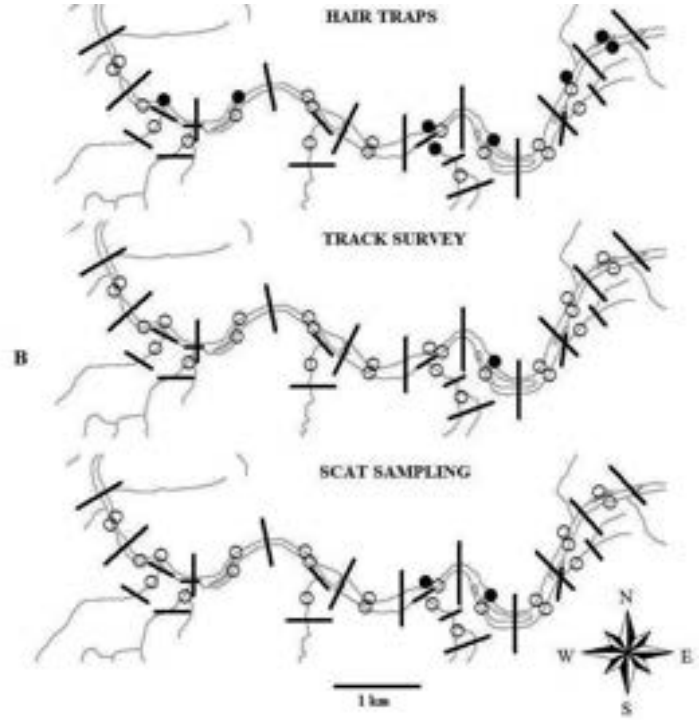

Fig. 2. Design of the hair-trap used in this study placed in a tree trunk. The adhesive tape was partially removed to allow observation of the structure; it usually covers the entire surface of the larger wire mesh piece.

Marten *Martes martes*; Lynch *et al*. 2006) trying to ensure that if a Least Weasel is present, it will come some times around the trap (King 1975, Sheffield & King 1994, Erlinge 1995, Jedrzejewski *et al*. 1995, Brandt & Lambin 2007). The hairs collected in the traps were processed following the procedures of Teerink (1991) and identified using Faliu *et al*. (1980), Teerink (1991) and Toth (2002).

In all three procedures, when hair, faeces, or track of Least Weasel was found, the point was considered positive, if not, or if signs were unclear the point was considered negative.

Effectiveness of the methods and statistical analysis

The results obtained from the 26 different sampling stations allowed a matrix of detection data gained with each method to be built. Occurrence determined with these methods was compared with a non-parametric paired McNemar test (Sprent 1989). The probability of detection is a basic feature in animal surveys (Borchers *et al*. 2002). Optimal detection probability is 1, but is rarely achieved (MacKenzie *et al*. 2002). Those methods that provide a better estimation of this parameter (closer to 1) appear, other factors being equal, to be more suitable for surveying a species.

With the same matrix used in the statistical analysis, the probability of detection of the Least Weasel using the three different methods was estimated following MacKenzie *et al*. (2002) and using program PRESENCE (at http://www.proteus.co.nz/home.html). Finally the probability of Least Weasel detection using each method was compared using a χ^2 test for proportions. Statistical measurements were carried out in S-PLUS 8.0.

Results and discussion

The Least Weasel was widely distributed in the study area (Fig. 1). Hair-traps had a higher overall rate of detection (30.8 % of stations), whereas faeces and track sampling provided positive results at <10 % of sampling points (7.8% and 3.9%, respectively). More sites were positive using hair-traps than with the other two methods (McNemar test faeces–hair-traps: 135.26, *d.f.* = 25, $P < 0.01$; McNemar test track survey–hair-traps: 124.32, *d.f.* = 25, $P < 0.01$), but comparison between these latter two methods did not reveal differences (McNemar test faeces sampling–track census: 1.00, *d.f.* = 25, $P = 0.32$). Besides this, in stations where faeces or tracks were found, hair samples were always collected (Fig. 1).

Probabilities of detection estimated with these methods also differed greatly ($\chi^2 = 32.16$, *d.f.* = 2, $P < 0.01$), confirming that hair-trapping offers a higher probability of detection (0.56) than do faeces or track surveys (0.28 and 0.20, respectively). Both proportion of occupied sites and probability of detection suggests that faeces and track surveys may underestimate occupation of the area by the Least Weasel by comparison with results from hair-traps.

Despite these results, a previous study using hair-traps in Atlantic areas of the Iberian peninsula (González-Esteban & Villate 2005) indicated rather low rates of Least Weasel detections (less than 20%) but this may have reflected poor habitat quality (i.e., genuinely low numbers) as opposed to inefficiencies in the technique. Night-time direct observations (Millán *et al*. 2001), photo-trapping (Guzmán *et al*. 2002, Torre *et al*. 2003, González-Esteban *et al*. 2004, González-Esteban & Villate 2005, Gompper *et al*. 2006, Barea-Azcón *et al*. 2007), sign surveys (Gil-Sánchez *et al*. 2001, Gehring & Swithart 2003, Virgós & Travaini 2005, Gompper *et al*. 2006, Mangas *et al*. 2008) or accidental trapping (McDonald & Harris 1999, 2002, McDonald 2000, Lischka *et al*. 2006) showed lower detection rates compared with hair-traps, ranging from 2% to 18%.

Previous data on detection probability for Least Weasels using these methods are unavailable; thus, no comparisons can be made. Although hair-traps provided the best results in the number of occupied stations and also in the probability of detection, the estimation of the last parameter suggests that the method could potentially be improved and that about 40% of the sites with Least Weasel remain not detected. However, the track and faeces methods had 70–80% underestimation.

Data from this study indicate that hair-trapping is a good method to assess distribution of the Least Weasel, at least in the Mediterranean basin, providing better results than the other methods tested herein; and it is less invasive than live-trapping. Hair and faeces samples are also suitable for various genetic studies (Wang *et al*. 2002, Fernandes *et al*. 2008). Monitoring schemes for the Least Weasel should therefore consider use of hair-traps, providing a tool for objective assessment of Least Weasel status rather than basing conservation strategies upon a range of opinions of people (as in Palomo *et al*. 2007). However, further investigations are needed to evaluate the efficacy of hair-trapping as an abundance indicator and the power to reveal the natural variations in the abundance of populations of the Least Weasel.

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An observation of Indonesian Mountain Weasel *Mustela lutreolina* at Gunung Kerinci, Sumatra, Indonesia

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Abstract

A single Indonesian Mountain Weasel *Mustela lutreolina* was seen and photographed at 2,250 m on Gunung Kerinci, in the Kerinci–Seblat National Park, Sumatra, on 9 June 2008. This seems to be only the second recorded field sighting of the species; the first came from the same mountain.

Keywords: field characters, habitat, Kerinci–Seblat National Park, locality record

Pengamatan Pulusan Gunung *Mustela lutreolina* di Gunung Kerinci, Sumatera, Indonesia

Abstrak

Seekor Pulusan Gunung *Mustela lutreolina* terlihat dan terekam kamera di ketinggian 2.250 m dpl di Gunung Kerinci, Taman Nasional Kerinci–Seblat pada tanggal 9 Juni 2008. Tampaknya ini merupakan catatan ke dua dari perjumpaan di alam dari jenis ini, dimana semuanya diperoleh dari wilayah gunung yang sama.

Kata kunci: catatan setempat, habitat, karakter, taman nasional Kerinci–Seblat

In the early afternoon of 9 June 2008, while guiding a group of four birdwatchers for Birdtour Asia along the summit trail of Gunung (= Mount) Kerinci, situated within the West Sumatra province part of Kerinci–Seblat National Park, a small, sleek, brown mammal ran through the lush vegetation to the side of the trail at 2,250 m asl, about 300 m past 'Camp Cochoa' at about 1°41′50″S, 101°17′40″E. This area of rugged terrain supports unlogged montane tropical forest, with mostly relatively small trees (but some to perhaps 30 m tall), lots of epiphytes, and dense undergrowth on rich, permanently damp soil. The slender, neat proportions and small size immediately reminded me of a weasel *Mustela* species. Realising at the time that I had not encountered any species of this genus on Sumatra before, I attempted to obtain better views. After summoning the group members and telling them of my sighting, one member, Andy Deighton (A.D.), started making squeaking noises to attract the mammal because this can interest other weasel species elsewhere (pers. obs.). Almost immediately the weasel reappeared and found the squeaking so enticing it actually ran to within a meter of A.D. on the narrow forest trail, leaned forward and stood on just its hind feet for several seconds as the squeaking continued, peering up at A.D. It then ran off the trail back into the undergrowth, not to be seen again. Although A.D. managed a single photograph to record the weasel (Fig. 1), despite intensive searching and squeaking, another member was just too late in action to obtain video footage of the event.

The animal appeared mostly similar in shape and proportions to Least Weasel *M. nivalis*, a species familiar from Britain to all five of us, although it appeared slightly larger. Its noticeably long tail was perhaps 40% of its total length (head, body and tail) and was noticeably thin, densely furred and pointed at the end. Its fur was a dull chocolate-brown colour all over, except for its contrasting whitish underparts that reached from throat backwards at least beyond the forelegs, and a slightly darker hind-neck and face.

Knowing that only two species of weasel occur on Sumatra, we identified the animal as an Indonesian Mountain Weasel *M. lutreolina*: the fur coloration, particularly of the head, and the thin tail rules out Malay Weasel *M. nudipes*. I have made numerous field sightings of other potential confusion species such as the larger, Short-tailed Mongoose *Herpestes brachyurus*, Small Asian Mongoose *H. javanicus* and Yellow-throated Marten *Martes flavigula*. The photograph (Fig. 1), while somewhat out of focus and excluding the head, supports the identification.

Fig. 1. Indonesian Mountain Weasel, Gunung Kerinci, 09 June 2008 (Photograph by Andy Deighton).

Van Bree & Boeadi (1978) drew attention to the paucity of records of this species, tracing only a handful of specimens. Since then, two further historical specimens have been unearthed, bringing the total known specimens to nine from Java, three from Sumatra and two of uncertain origin (Lunde & Musser 2003, Meiri *et al*. 2007). Otherwise the species is only recorded through two field records of faeces presumed to be from this weasel (Bartels 1937), a live captive animal (Schreiber *et al*. 1989), and a single sighting

Table 1. Comparative lengths of species of Mustela with which M. lutreolina has been compared.

Species	Head-and-body	Tail	Source
M. nivalis (in U.K.*)	175–220 mm	40–75 mm	King 1977
M. putorius	290–406 mm	125–140 mm	Macdonald & Barrett 1993
M. lutreola	300–400 mm	120–190 mm	Macdonald & Barrett 1993
M. lutreolina	297–321 mm	136-170 mm	van Bree & Boeadi 1978

Sizes are compiled from various sources to give a general guide as to how large *M. lutreolina* should seem in the field relative to these species.
*This species varies greatly in size across its wide geographic range. The observers of both sight-records on Gn Kerinci specifically were familiar with U.K. animals.

of four animals (Holden 2006). The latter record also came from Gunung Kerinci. This therefore seems to be only the second field sighting of Indonesian Mountain Weasel (and the second record with specific habitat information) and the first known photograph of a wild individual ever taken. The altitude of this record, 2,250 m, fits within the known range (1,400–3,000 m; Meiri *et al*. 2007). Three morphological features deserve comment compared with the morphology as portrayed by van Bree & Boeadi (1978). Firstly, the perceived size is small, adjudged as only a little bigger than a Least Weasel in the U.K., whereas van Bree and Boeadi (1978) considered the species to be the size of a European Polecat *M. putorius* or a European Mink *M. lutreola* (Table 1). J. Holden (*in litt*. 2009) also assessed his four animals (Holden 2006) as similar to a Least Weasel in size. Secondly, the extent of pale on the throat apparently exceeds that shown by any of the eight specimens examined by van Bree & Boeadi (1978), although their diagrams indicate that this feature is highly variable individually. Thirdly, van Bree & Boeadi (1978) described the pelage colour as glossy dark russet, whereas the present record, and those observed by Holden (2006) on Kerinci, were dull chocolate-brown and dark slate-grey respectively. J. Holden (*in litt*. 2009) states that the image of the present animal shows a distinctly browner pelt than on the animals he saw.

It is unclear whether the rarity of records of Indonesian Mountain Weasel reflects a genuine scarcity of the animal or simply a low survey effort within suitably high altitudes of Java and Sumatra. The species is therefore categorised on the IUCN Red List as Data Deficient (Duckworth *et al.* 2008). Kerinci–Seblat National Park covers an area of 13,750 km² in total, and supports a large area of montane forest, a presumed habitat of this species, between the two altitudes of sighting this weasel there (2,050–3,000 m). The park may plausibly, therefore, be found to hold a large population of the weasel. Gunung Kerinci itself rises further to around 3,805 m asl, and on current information it is impossible to predict truly how high the weasel occurs.

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Notes on the distribution of Marbled Polecat *Vormela peregusna* in Mongolia

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Abstract

We report three new locations of Marbled Polecat *Vormela peregusna* in Mongolia, comprising: 1) the Tuul river valley in Altanbulag soum, Tuv aimag; 2) the northern slope of the Mongol Altai mountain range in Tsetseg soum, Khovd aimag; and 3) the Ikh Nart Nature Reserve in Dalanjargalan soum, Dornogobi aimag. To our knowledge, the Marbled Polecat has not been previously recorded in these areas and our observations expand the known distribution of the species in the country. Currently, specimens of Marbled Polecat, represented as 11 pelts and nine skulls (two as stuffed animals), are housed in collections of five research institutions and museums of Mongolia.

Keywords: Altai Mountain Range, Ikh Nart Nature Reserve, range extension, specimen listing, Tuv aimag

Монгол орны эрээн хүрний (*Vormela peregusna* Guldenstaedt, 1770) тархцын судалгаанд нэмэрлэх олдворууд

С. Дуламцэрэн[1], Richard Reading[2], С. Шар[3], James D. Murdoch[4], Ж. Гантулга[5], Д. Өсөхжаргал[6], С. Буяндэлгэр[7]
[1]Шинжлэх Ухааны Академийн Биологийн Хүрээлэн; [2]Денверийн Зоологийн Сан; [3]Монгол Улсын Их Сургуулийн Амьтан Судлалын Тэнхим; [4]Оксфордын Их Сургууль; [5]Эко-Ази Дээд Сургууль; [6]Хустайн Байгалийн Цогцолборт Газрын Төв; [7]Их Нартын Байгалийн Нөөц Газар

Товч агуулга
Монголд эрээн хүрнэ нэлээд өргөн дэлгэр тархацтай ч хааяагүй элбэг биш, хүнд үзэгдэж харагдах нь ч цөөн, агнуурын үслэг арьсны бэлтгэлд ордоггүй учраас арьс үслэгийг нь шохоорхож хэрэглэдэггүй, хүмүүс сайн мэддэггүй, арьс гавлын яс гэх мэт хэрэглэхүүн нь судалгаа шинжилгээний байгууллагын цуглуулга, сан хөмрөг, музейн үзмэрт ч ховор байдаг. Бид Монголын баруун болон төв хэсэгт эрээн хүрний олдсон гурван шинэ цэг нутгийг (Ховд аймгийн Цэцэг сум, Төв аймгийн Алтан булаг сум мөн Дорноговь аймгийн Даланжаргалан сум) нэмэн тэмдэглэж, тус улсын эрдэм шинжилгээний байгууллага музейд хадгалагдаж байгаа судалгааны холбогдолтой эрээн хүрний хэрэглэхүүнийг тодруулж мэдээлэв.

Түлхүүр үг: Алтайн нуруу, Их Нартын Байгалийн Нөөц Газар, Төв аймаг, чихмэлийн жагсаалт

Introduction

Early accounts of Marbled Polecat *Vormela peregusna* in Mongolia reported that it ranged throughout the Gobi Desert, based on observations and specimens (pelts) collected by A. G. Bannikov (1954). Dulamtseren (1970) and Sokolov & Orlov (1980) published additional accounts of Marbled Polecat and mapped the species's distribution, which included the western and southern desert regions of Mongolia. The map was based on oral statements, pelt data, questionnaire surveys and museum collections. Subsequently, Marbled Polecats have been recorded in 10 locations (Avirmed 1972, Khotolkhuu 1985, Chotolchuu *et al*. 1989, Dulamtseren *et al*. 1999) from central, western, and northwestern parts of Mongolia, all within the range published by Dulamtseren (1970) and Sokolov & Orlov (1980). Thus, the Marbled Polecat's previously known distribution in Mongolia ranged along the high steppe of the Mongol Altai to southern Siberia and the desert of Ikh Nuuruudiin Khotgor. More recent locations outside Mongolia have been recorded along the southern border of the Tuva Republic of Russia, in the Tes river valley near the Mongolian border, and near Tsagaan Shiveet Mountain (Boyarkin 1997, Sidorov & Vakhrushev 1997, Rozhnov 2001, 2003, Putintsev *et al*. 2002).

Clark *et al*. (2006) published the most recent range map for Marbled Polecats in Mongolia. A panel of mammal experts from Mongolia reviewed the maps in Dulamtseren (1970) and Sokolov & Orlov (1980) and provided their rationale for any changes in the Mongolian Biodiversity Databank available from the Department of Zoology of the Mongolian National University (Clark *et al*. 2006).

Observations

In recent years, since 2002, we recorded Marbled Polecat in three regions outside the species's known range (Fig. 1). They are:

1. Tuul river valley. Two of us (J.G. & D.U.) collected a Marbled Polecat skull and pelt from a poacher who showed us the trap site in a shrubland steppe area of the Tuul River valley, Altanbulag soum, Tuv aimag (47°30′23″N, 105°59′02″E; 1,290 m elevation). The skull and pelt were deposited in a collection at Hustai National Park. This location lies approximately 250 km north of the border of the previously known Marbled Polecat's distribution.
2. Northern slope of the Mongol Altai Mountain Range. One of us (S.S.) received, in summer 2003, the skull of a Marbled Polecat from a herder named Sainbayar whose dog killed the animal in December 2002, in Bachaa, Tsetseg soum, Khovd aimag (46°30′49″N, 92°24′08″E; 1,800 m elevation). The skull has been deposited in the mammal collection of National University of Mongolia.
3. Ikh Nart Nature Reserve. One of us (J.D.M.) recorded an individual by spotlight and captured another (Fig. 2) in a live-trap set as part of study of carnivore behaviour and ecology

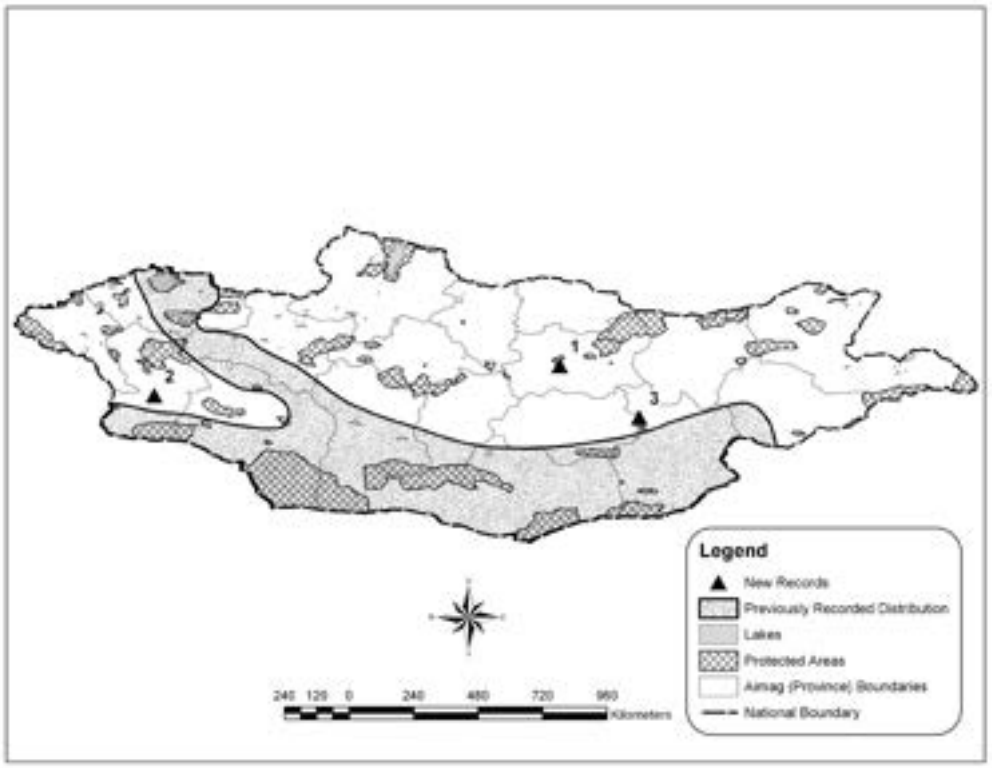

Fig. 1. Marbled Polecat Vormela peregusna *distribution in Mongolia. Numbers match numbers of new records discussed in text. Previous recorded range adapted from Clark et al. (2006) to allow inclusion in a geographic information system.*

Fig. 2. Marbled Polecat captured in Ikh Nart Nature Reserve, Dornogobi aimag (Photo: David Kenny).

in northern Ikh Nart Nature Reserve, Dalanjargalan soum, Dornogobi aimag, in 2006 (45°46′15″N, 108°38′57″E). We released the animal. Another one of us (R.P.R.) found the remains of a Marbled Polecat in a Cinereous Vulture *Aegypius monachus* nest in Ikh Nart the previous year (45°41′03″N, 108°35′29″E, 1,200 m elevation). We did not collect these remains.

Discussion

The Marbled Polecat is one of the most widely distributed small carnivores in Eurasia inhabiting mainly steppe, semi-desert, and desert environments. Its range countries include Serbia, Montenegro, Greece, Romania, Macedonia, Ukraine, Bulgaria, Turkey, Russia, Lebanon, Israel, Syria, Georgia, Iraq, Armenia, Iran, Azerbaijan, Kazakhstan, Turkmenistan, Uzbekistan, Afghanistan, Pakistan, China and Mongolia (Heptner *et al*. 1967, Wozencraft 2005, Clark *et al*. 2006). In many areas, however, populations have declined substantially in recent years. Some researchers also believe that the species has been extirpated from much of the eastern part of its range (Sadikov 1983, Shagdarsuren & Erdenejav 1988, Anonymous 1991, Shiirevdamba 1997, Rozhnov 2001, Putintsev *et al*. 2002, Clark *et al*. 2006). The Marbled Polecat is listed as threatened in Uzbekistan (Sadikov 1983), Kazakhstan (Anonymous 1991), Russia (Rozhnov 2001) and Mongolia (Shagdarsuren & Erdenejav 1988, Shiirevdamba 1997, Clark *et al*. 2006). It is listed as Vulnerable globally (IUCN 2008).

The Marbled Polecat is widely distributed but rarely observed, so few details of its biology, distribution, and population status are known. In Mongolia, little knowledge exists about the species, largely because it is rarely seen and its pelt has little economic value. Museum specimens of Marbled Polecat are also few (Dulamtseren *et al*. 1999). Those known comprise seven pelts and six skulls in the Institute of Biology, Mongolian Academy of Sciences; a pelt and a skull in a collection of the Department of Zoology, National University of Mongolia; a taxidermy specimen (pelt) on exhibit in the mammal collection of the Natural History Museum of Mongolia; another taxidermy specimen (pelt and skull) listed in a database of Uvs aimag Nature Reserve (Fig. 3); and a pelt and skull in the collection at Hustai National Park (Table 1).

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Table 1. Marbled Polecat Vormela peregusna *specimens in Mongolian collections.*

Specimen Location	Accession Number	Collection Date	Collection Location	Material	Collector
Institute of Biology, Mongolian Academy of Sciences					
	3643	1976	Tonkhil soum, Gobi-Altai aimag	Pelt	N. Khotolkhuu
	3644	1976	Bogd soum, Bayankhongor aimag	Pelt	N. Khotolkhuu
	4129	1986	South of Zuun Saikhan Mountain, Khurmen soum, Omnogobi aimag	Pelt & skull	G. Dashzeveg
	4130	1984	Galt Mountain, Saikhan Ovoo soum, Dundgobi aimag	Pelt & skull	G. Dashzeveg
	4249	1988	Khuvkhuljin Well, Mandakh Brigade, Khankhongor soum, Omnogobi aimag	Skull	G. Dashzeveg
	4250	1988	Khuvkhuljin Well, Mandakh Brigade, Khankhongor soum, Omnogobi aimag	Skull	G. Dashzeveg
	None	12 October 1999	Zagt Gobi, 20 km south of Khuvsgul soum, Dornogobi aimag	Skull	Z. Namshir
	None	18 October 2003	Tsagaan Buraa, Tes soum, Uvs aimag	Pelt & skull	D. Togtokhbayar
	Unknown	Unknown	Unknown	2 pelts	Unknown
Mongolian Natural History Museum					
	None	1950	Unknown	Pelt	Eregdendagva
Museum of Uvs Strictly Protected Area					
	None	19 March 2003	First Brigade, Tes soum, Uvs aimag	Pelt & skull	D. Togtokhbayar
Museum of Khustai Nuruu National Park					
	None	Not indicated	Tuul River valley, Altanbulag soum, Tuv aimag	Pelt & skull	D. Usukhjargal
Department of Zoology, Mongolian National University					
	None	2 December 2002	Bachaa, Tsetseg, soum, Khovd aimag	Pelt & skull	S. Shar & D. Jambalsuren

Fig. 3. Marbled Polecat specimen housed in the collection of Uvs aimag Strictly Protected Area museum (Photo: S. Dulamtseren).

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Distribution and observations of Red Pandas *Ailurus fulgens fulgens* in Dhorpatan Hunting Reserve, Nepal

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Abstract

We documented the presence of Red Pandas *Ailurus fulgens fulgens* during March–May 2007 in three hunting blocks (Surtibang, Barse and Fagune) of Dhorpatan Hunting Reserve, Nepal. Based on faecal pellet groups, Red Pandas occurred from 3,000 to 3,600 m elevation, with abundance of pellets increasing to 3,500 m and declining sharply at higher elevations. No evidence of Red Pandas was observed or reported at elevations >3,730 m. Four Red Pandas were observed in the study area at elevations ranging from 3,220 to 3,610 m. Observed elevational distribution of Red Pandas in Dhorpatan Hunting Reserve was similar to elevational distributions reported in the literature. Vegetation in areas of highest Red Panda activity were dominated by *Abies spectabilis, Rhododendron campanulatum, Betula utilis, Juniperus indicus* and *Arundinaria* sp(p)., which have been documented previously as important food and cover species.

Keywords: conservation, elevation use, habitat use, transect sampling

Introduction

The two subspecies of Red Panda, *Ailurus fulgens fulgens* and *A. f. styani*, are geographically separated by the Nujiang River: the nominate subspecies inhabits the bamboo-dominated temperate forests of Nepal, India, Bhutan, Myanmar and parts of China, while the latter occurs in southwestern China in Sichuan and Yunnan provinces (Roberts & Gittleman 1984, Glatston 1994). In Nepal, Red Pandas have been confirmed in eight protected areas: Khangchenjunga Conservation Area, Manaslu Conservation Area, Makalu Barun National Park, Sagarmatha National Park, Langtang National Park, Annapurna Conservation Area, Dhorpatan Hunting Reserve and Rara National Park (Yonzon 1989, Jackson 1990, Yonzon *et al.* 1991, Yonzon & Hunter 1991a, 1991b, Karki 1999, Karki & Jendrzejewski 2000, Shrestha & Ale 2001, Mahato 2003, 2004, Sharma & Kandel 2007, Sharma 2008). The Red Panda has also been reported from community-managed and national forest land in the villages of Jamuna and Mabu of Ilam in eastern Nepal (Williams 2004).

The Red Panda is categorised as Vulnerable, with a declining population (IUCN 2008). It is protected by the Government of Nepal's National Parks and Wildlife Protection Act of 1973. Any person who kills or tries to kill a Red Panda could be fined up to NRs. 40,000, jailed for 1–10 years, or both. The Himalayan National Park Regulation 2037 allows local people their traditional right to use forest products such as collecting dead and dying twigs (as firewood), grazing cattle, and use of timber with special permits.

Previous studies (e.g. Johnson *et al*. 1988, Yonzon & Hunter 1991a, Pradhan 1999) demonstrated that Red Pandas use temperate and sub-alpine forests at elevations ranging from 2,500 to 4,000 m. However, information on elevation distribution of Red Pandas at Dhorpatan Hunting Reserve (DHR) is lacking. Our objective was to describe the elevational distribution of Red Pandas in DHR, Nepal. We also report on observations of Red Pandas recorded during this study.

Study area

Dhorpatan Hunting Reserve (DHR) is a 1,325 km² protected area in western Nepal (28°27′30″–28°50′N, 82°50′–83°15′E) with elevations ranging from 2,850 to 7,000 m. Villages bound DHR on all sides except the northern border which is delineated by high mountain peaks including Gurja, Putha and Churen. The southern border extends to the Surtibang and Uttarganga rivers (Wilson 1981). Dhorkhani, Jhalke and Lamakyang mountain ranges border the eastern part of DHR and Kharibanh khola, Pelma khola, Kulta, Bhanjyang and Jangla comprise the western border. The DHR adjoins Rukum, Myagdi and Baglung districts of the Dhaulagiri mountain range.

Dhorpatan Hunting Reserve is the only hunting reserve in Nepal where Blue Sheep *Pseudois nayaur,* Eurasian Wild Pig *Sus scrofa* and Red Muntjac *Muntiacus muntjak* are legally hunted. Although trophy hunting of Blue Sheep has occurred in DHR since the early 1970s (Austegard & Haugland 1993), it was gazetted (i.e., officially declared a hunting reserve) in 1987. Sport hunting for Blue Sheep is managed by allocating harvest among seven subdivisions (blocks): Sundaha (145 km²), Seng (138 km²), Dogadi (199 km²), Ghustung (201 km²), Fagune (327 km²), Barse (167 km²) and Surtibang (148 km²).

Methods

A reconnaissance survey in DHR was conducted during March 2007 to assess presence of Red Pandas. After confirmation of Red Panda presence, three blocks of DHR were selected and line-transects were established to estimate distribution of faecal pellet groups (hereafter pellet groups) at elevations ranging from 3,000 to 4,000 m. Eighteen 1–km transects (horizontal distance) were delineated, seven in Barse, five in Fagune and six in Surtibang blocks. The transects in Surtibang block ranged to 4,000 m elevation, while transects in Barse and Fagune reached 3,845 m and 3,720 m, respectively. All transects were of approximately similar slope. The number, elevation and location of pellet groups within 5 m to both sides of each transect were counted and recorded, as were observations of Red Pandas. Natural demarcations including springs, ridges and valleys were used as reference in orienting along transect lines. At each pellet group or Red Panda observation, information including altitude, latitude, longitude, aspect and slope were recorded. Woody plant species including stumps, dead standing trees and fallen logs were identified using Polunin & Stainton (1986).

Results and Discussion

Overall, Red Panda pellet groups were observed from 3,000 to 3,600 m (Fig. 1). Frequency of pellet groups increased markedly from 3,000 to 3,500 m then declined sharply at higher elevations. No pellet groups were observed at elevations greater than 3,600 m. Although elevations >3,720 m were surveyed less intensively than lower elevations, elevations from 3,500 to 3,720 were not, suggesting the decline in pellet groups observed at elevations >3,500 was not an artefact of sampling effort. Distribution of pellet groups appeared positively associated with the abundance of bamboos *Arundinaria* sp(p). and available water resources. Bamboos are the dominant forage species of Red Pandas throughout their geographic range (Reid *et al.*1991, Yonzon & Hunter 1991a, Pradhan *et al*. 2001). Because Red Pandas generally defecate at feeding sites (Wei *et al.* 2000), we presumed they were foraging primarily on *Arundinaria* sp(p). in DHR.

During March–May 2007, four Red Pandas were sighted. Two were observed in Barse block; one at 3,220 m elevation on 30 April (28°29′12″N, 83°9′45″E) and another at 3,300 m elevation on 10 May (28°30′59″N, 83°06′5″E). The first was observed on a northeast facing slope on Ratmata Hill. The Panda was excavating when first observed at a distance of 200 m. It immediately climbed up to the crown of a fir *Abies*. It was alert to the presence of observers but its movement was relatively slow. It climbed approximately 2 meters in 10 minutes from one branch to another. During this movement the Red Panda looked toward the observers on five occasions and frequently licked its upper lip. When the Panda reached the higher branch it ceased climbing but did turn frequently toward the observers and blinked its eyes often. This Red Panda was observed for about 90 minutes (15h30–17h00). The second observation (Fig. 2) occurred at Phedi, which lies above the Chhantung, at a point was dominated by *Abies spectabilis* with understorey bamboo, and 50 m distant from any water source. This Red Panda was observed briefly on a south-facing slope.

In September 2004 two Red Pandas were encountered at Ratmata (Barse block) by herders at about 18h00. They thought that they were Red Foxes *Vulpes vulpes* (which are locally believed to kill livestock) and pelted stones at them after which the Red Pandas left. A hunter (Chak Bahadur Malla) had also seen Red Pandas at Ratmata and Simpani of Barse block. According to park staff, one Red Panda was found dead in a foot-hold trap at Dharkharka (28°30′50″N, 83°11′05″E; 3,730 m elevation; he took us to this location and we measured the elevation) in 2004 (Jung B. Adai verbally, 15 May 2007). Trapping is illegal in DHR, and we did not observe evidence of Red Pandas in this location during our survey.

In Surtibang block a Red Panda was observed at an elevation of 3,400 m on 15 May 2007 (28°28′19″N, 83°01′29″E). This Panda was observed at a range of about 250 m for 30 minutes (17h25–17h55) before departing. The panda rolled over a branch of *Betula utilis* and escaped toward a large fir *Abies* sp. The tail was almost straight during this movement. The Panda climbed onto a large branch of the fir, where it opened its mouth for some time. It may have vocalised but we could not be certain because of the distance.

Similarly, another Red Panda was observed climbing a fir at the Garpa in Fagune block at an elevation of 3,610 m on 19 May 2007 (28°31′11″N, 83°03′49″E). The Panda turned toward

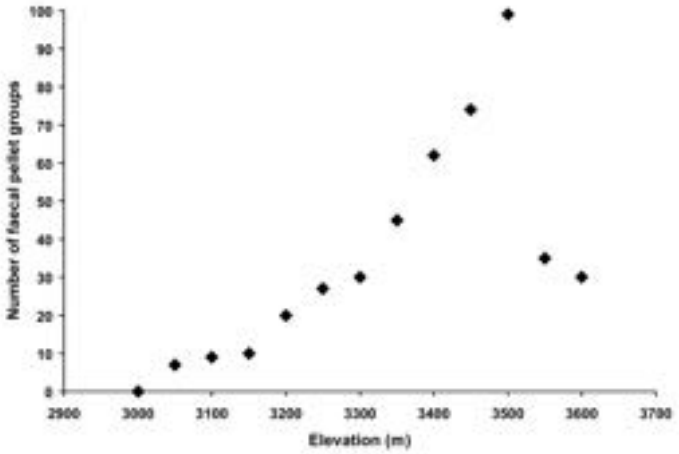

Fig. 1. Elevational distribution of Red Panda faecal pellet groups, Dhorpatan Hunting Reserve, Nepal, March–May 2007.

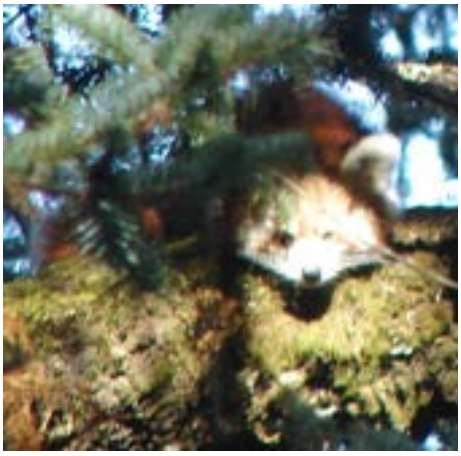

Fig. 2. Red Panda in fir Abies *sp., Phedi of Barse block, Dhorpatan Hunting Reserve, Nepal, 10 May 2007.*

the observers, fixing fore and hind limbs on the bark of the tree. The bark of the tree seemed to rupture and the Panda appeared to begin falling but adjusted its body and climbed slowly up the tree. We later observed it eating bamboo leaves, using fallen trees as feeding platforms. Pradhan *et al.* (2001) indicated the importance bamboo leaves for panda diet. Additionally, fresh pellets were located 100 m from this site.

Recorded elevations of Red Pandas and their pellet groups in DHR were similar to elevational records reported in other studies (Johnson *et al*. 1988, Yonzon & Hunter 1991a, Pradhan 1999), and appears linked to the distribution of bamboo. Similar to observations reported by Pradhan (1999), Red Pandas did not generally attempt to flee when initially encountered by observers, but rather maintained alert behaviour towards observer presence and stayed in their initial location or moved off slowly.

Acknowledgements

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Observations of small carnivores in the southern Western Ghats, India

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Abstract

Despite a diverse assemblage of small carnivores in the forests of the southern Western Ghats in India, there is a paucity of information on their ecology, distribution, behaviour and current conservation status. Chance observations generated during surveys for other purposes are therefore useful. Sightings and signs of small carnivores were recorded opportunistically during a study to assess the distributions of larger mammals in the southern Western Ghats. The study yielded sightings of seven species of viverrids, herpestids and mustelids. The Common Palm Civet *Paradoxurus hermaphroditus* and Small Indian Civet *Viverricula indica* were sighted most frequently. The restricted-range Brown Palm Civet *Paradoxurus jerdoni* was sighted once.

Keywords: endemic species, herpestid, mustelid, night drive, opportunistic sighting, viverrid

Introduction

The southern Western Ghats, lying between 8° and 11°N, is an important ecological subunit of the Western Ghats global biodiversity hotspot in India (Myers *et al*. 2000). The region is dominated by moist forests and harbours higher levels of biodiversity and endemism than the rest of the Western Ghats (Nair & Daniel 1986, Daniels 1992, Ishwar *et al*. 2001, Vasudevan *et al*. 2001, Kumar *et al*. 2004). The Western Ghats is considered a global core area for small carnivore conservation, holding a number of endemic species, comprising the Nilgiri Marten *Martes gwatkinsii*, Brown Palm Civet *Paradoxurus jerdoni* and the Critically Endangered Malabar Civet *Viverra civettina*. The Brown Mongoose *Herpestes fuscus* and Stripe-necked Mongoose *H. vitticollis* are endemic to the Western Ghats and Sri Lanka (Schreiber *et al*. 1989). Species widespread outside the Western Ghats and Sri Lanka also occur. There is little current information on the ecology, status, distribution and behaviour of small carnivores in this region.

This paper details the opportunistic sightings of seven species of small carnivores in the southern Western Ghats (Fig. 1) during a large mammal survey carried out from April to June 2008 (Johnsingh *et al*. 2008).

Study Area

The southern Western Ghats is biologically and topographically more diverse than the rest of the Western Ghats. The wide variation in rainfall together with the region's complex geography produces a diversity of vegetation types. Tropical dry thorn and dry deciduous forests occur in the low-lying rain shadow tracts on the eastern flanks. Moist forests including tropical moist deciduous and wet evergreen forests dominate up to about 1,500 m on the windward side (Champion & Seth 1968). These forests include some of the best representatives of non-equatorial tropical evergreen forests in the world. High elevation montane or shola forests and rolling grasslands above 1,500 m add to the diversity of habitats. Around 137 species of mammals have been recorded from the Western Ghats with 17 endemic species (CEPF 2007).

The region, straddling the states of Kerala and Tamil Nadu, is inhabited by several indigenous tribes including the Kadar, Mannan, Malayar/Malasar, Malai Malasar, Muthuvar, Malai Aryan, Kani, Ulladan, Urali, Hill Pulayar and Paliyar that are primarily dependent on the forest. However, the massive influx of settlers over the last century has had a far greater impact on wildlife than the tribal population, effectively wiping out populations of many wildlife species widely outside protected areas. Hunting, habitat loss, degradation and fragmentation due to monoculture plantations, agriculture, dams, and development are the principal threats to biodiversity in the region (Nair 1991). A contiguous forested landscape until the beginning of the 20th century, the southern Western Ghats is now fragmented from north to south into the Anamalai, Periyar and Agasthyamalai landscape complexes (Nair 1991; Fig. 1).

Methods

Direct sightings and indirect evidence of viverrids, herpestids, and mustelids were recorded opportunistically during drives or walks through forest areas. The work was conducted from April to June 2008 over the course of an extensive field survey to assess distributions of larger mammals. Since this was not a study of small carnivores, no relevant study design or sampling protocol was followed.

Observations

A total of five sightings was recorded for both the Common Palm Civet *Paradoxurus hermaphroditus* and Small Indian Civet *Viverricula indica*, three for both the Stripe-necked Mongoose and the Ruddy Mongoose *Herpestes smithii*, and singles for the Grey Mongoose *H. edwardsii*, Brown Palm Civet and Smooth-coated Otter *Lutrogale perspicillata.* Only the Stripe-necked Mongoose and Smooth-coated Otter were observed during the day; the remaining five were recorded only at night. The term 'pair' indicates that two animals were seen together, but we were not able to confirm their gender. Details of each record can be found in Table 1.

Smooth-coated Otter *Lutrogale perspicillata*

A single sighting of a group of six Smooth-coated Otters took place on the Mullaperiyar reservoir in Periyar Tiger Reserve, Kerala. The sighting occurred at 09h45 when the animals were ashore. In addition, otter spraints were found on the banks of the Chimmony reservoir in Chimmony Wildlife Sanctuary, Kerala (10°26′N, 76°29′E) and tracks were observed in Malayattur Forest Division, Kerala (10°15′N, 76°50′E). However, the identity of the species that left the spraints and tracks is unknown.

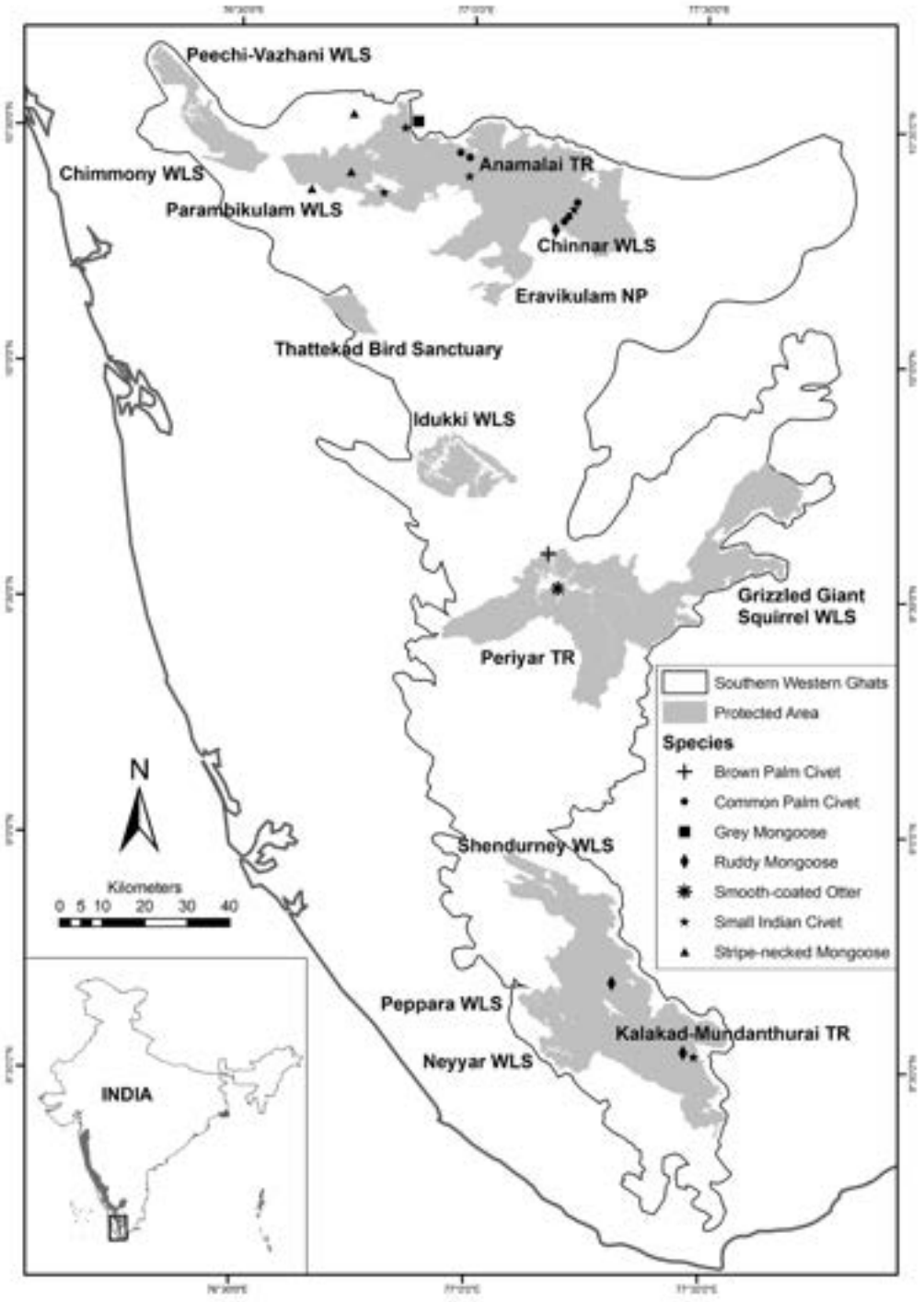

Fig. 1. The southern Western Ghats, showing locations of small carnivore sightings.

Small Indian Civet *Viverricula indica*

The Small Indian Civet was sighted five times during night drives, at Top Slip in Anamalai Tiger Reserve, Tamil Nadu; Parambikulam Wildlife Sanctuary, Kerala; Anamalai Tiger Reserve on the road from Anamalai town to Valparai; Chinnar Wildlife Sanctuary, Kerala; and in Papanasam Range of Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu. Except for the sighting in Parambikulam Wildlife Sanctuary that occurred in a moist deciduous habitat, the rest of the sightings were in dry deciduous forests. All the sightings were of solitary animals that disappeared as soon as they were illuminated by the headlights of the vehicle. Small Indian Civets have been reported to be the most common small carnivore in the drier forests of the southern Western Ghats and rare in the tropical wet evergreen forests of the region (Mudappa 2002).

Common Palm Civet *Paradoxurus hermaphroditus*

Sightings of two pairs of Common Palm Civets occurred in the Anamalai Tiger Reserve on the road from Anamalai town to Valparai. Three pairs of Common Palm Civets were sighted at different locations in Chinnar Wildlife Sanctuary, while driving along the road from Marayoor town to Chinnar. All the sightings occurred in dry deciduous habitats. One sighting in Chinnar Wildlife Sanctuary involved an unusual-pelaged animal. While driving to Chinnar from Marayoor town, two animals were observed in the headlights of the vehicle, foraging on the ground. Upon being lit by the headlights, they climbed the bushy embankment on the shoulder of the road and stood watching us for a few seconds, enabling close observation. One was instantly identified as a Common Palm Civet, yet the other, although similar in size, did not

Table 1. Locations of small carnivore sightings in the southern Western Ghats.

Species and Sighting Locations	State	Latitude (N)	Longitude (E)	Location type	Habitat type	No. of animals	Date
Smooth-coated Otter							
Periyar TR	Kerala	9°31′	77°11′	Reservoir	MDF	6	20 Jun 2008
Small Indian Civet							
Top Slip, Anamalai TR	Tamil Nadu	10°30′	76°51′	Dirt road	DDF	1	27 Apr 2008
Parambikulam WLS	Kerala	10°21′	76°48′	Dirt road	MDF	1	21 May 2008
Anamalai TR	Tamil Nadu	10°24′	76°59′	Tar road	DDF	1	22 May 2008
Chinnar WLS	Kerala	10°19′	77°12′	Dirt road	DDF	1	24 May 2008
Kalakad-Mundanthurai TR	Tamil Nadu	8°32′	77°28′	Tar road	DDF	1	14 Jun 2008
Common Palm Civet							
Anamalai TR	Tamil Nadu	10°26′	76°58′	Tar road	DDF	2	22 May 2008
Anamalai TR	Tamil Nadu	10°26′	76°59′	Tar road	DDF	2	22 May 2008
Chinnar WLS	Kerala	10°18′	77°11′	Tar road	DDF	2	24 May 2008
Chinnar WLS	Kerala	10°19′	77°12′	Tar road	DDF	2	24 May 2008
Chinnar WLS	Kerala	10°20′	77°13′	Tar road	DDF	2	24 May 2008
Brown Palm Civet							
Periyar TR	Kerala	9°35′	77°10′	Tar road	MDF	1	3 May 2008
Stripe-necked Mongoose							
Parambikulam WLS	Kerala	10°24′	76°44′	Dirt road	MDF	1	21 May 2008
Kollengode Range, Nemmara FD	Kerala	10°31′	76°44′	Dirt road	MDF	1	22 May 2008
Charpa Range, Vazhachal FD	Kerala	10°22′	76°39′	Dirt road	MDF	1	24 Jun 2008
Ruddy Mongoose							
Chinnar WLS	Kerala	10°18′	77°11′	Dirt road	DDF	1	24 May 2008
Kalakad-Mundanthurai TR	Tamil Nadu	8°32′	77°27′	Tar road	DDF	1	14 Jun 2008
Kalakad-Mundanthurai TR	Tamil Nadu	8°41′	77°18′	Tar road	DDF	1	15 Jun 2008
Grey Mongoose							
Sethumadai, Anamalai TR	Tamil Nadu	10°30′	76°52′	Dirt road	DDF	1	22 May 2008

DDF = Tropical Dry Deciduous Forest, MDF = Tropical Moist Deciduous Forest, TR = Tiger Reserve, WLS = Wildlife Sanctuary, FD = Forest Division

share the same pelage pattern. Its face and head had a few black markings while the entire anterior half of the body was white, the posterior half, including the tail, was black. Identification as a Common Palm Civet is based on its association with a confirmed Common Palm Civet, with the two animals being of similar size. The range officer of Chinnar Wildlife Sanctuary also described a civet-sized animal with a pelage that was half-white and half-black occurring in the area. The officer rejected a photograph in Menon (2003) of a Ratel (Honey Badger) *Mellivora capensis* as the unidentified animal, explaining clearly that the animal was not marked white–black dorso-ventrally as is the Ratel, but anterio-posteriorly. During the same drive, two more pairs of Common Palm Civets were observed further along the road, all with normal coat markings. From the fact that all the sightings of Common Palm Civets occurred of animals in pairs, it may be speculated that the mating season for this species may have been ongoing or that they could have been mother–pup groups.

Brown Palm Civet *Paradoxurus jerdoni*

The only Brown Palm Civet seen was a fresh road-kill near Kumily town at the outskirts of Periyar Tiger Reserve, amid moist deciduous forest. The road from Kumily to the Forest Department office is flanked by grassland and fragments of tropical moist deciduous and wet evergreen forest. At 20h30, while driving, a small, dark, elongated animal was found prone by the roadside. Its pelage was uniformly blackish brown with a slightly grizzled appearance, darker around the head, neck, shoulders, legs and tail fading to a lighter brownish yellow on the abdomen. The tail was as long as the body; uniformly black and rounded but lacked a white tip. The Brown Palm Civet is a highly arboreal and frugivorous species restricted to rainforests in the Western Ghats. Although it is not as rare as previously thought to be, fragmentation of its rainforest habitat is likely to have adverse effects on its distribution and abundance (Mudappa 2002). This individual was probably trying to cross from one forest fragment to another when it was struck by a vehicle. Although the distribution of the Brown Palm Civet in the southern Western Ghats extends from the Anamalai Hills to the Agasthyamalai Hills (Rajamani *et al*. 2002), reports from Periyar Tiger Reserve are surprisingly sparse with only one published record of a dead specimen hunted by local tribals (Gupta 1997). This sighting confirms Periyar Tiger Reserve as part of the range of this endemic viverrid.

Stripe-necked Mongoose *Herpestes vitticollis*
The Stripe-necked Mongoose, the largest Asian mongoose (Van Rompaey & Jayakumar 2003), was sighted in Parambikulam Wildlife Sanctuary, Kollengode Range of Nemmara Forest Division, Kerala and in Charpa Range of Vazhachal Forest Division, Kerala. All sightings were of solitary animals in tropical moist deciduous habitat during the daytime.

Ruddy Mongoose *Herpestes smithii*
The Ruddy Mongoose was sighted on three occasions during night drives in dry deciduous forests, as solitary individuals, in Chinnar Wildlife Sanctuary and in Papanasam and Mundanthurai Ranges of Kalakad–Mundanthurai Tiger Reserve. This species is large and resembles the Grey Mongoose but sports a reddish-brown, grizzled appearance and a black-tipped tail (Prater 1998). It was instantly identified by its habit of walking with the tip of its tail turned upwards, a distinctive behavioural trait (Menon 2003). When lit by the vehicle headlights, all three individuals remained unperturbed and continued walking at the same unhurried pace, making no attempt to run for cover.

Grey Mongoose *Herpestes edwardsii*
A single Grey Mongoose was sighted in a dry deciduous and thorn scrub habitat near Sethumadai, in the vicinity of Anamalai Tiger Reserve.

Discussion

All small carnivore sightings were in or adjacent to protected areas. While this may suggest that their status outside such places could be of concern, it may simply reflect unequal search effort, in that night drives were not conducted at the same rate outside protected areas.

Few comprehensive ecological studies exist on the small carnivores of India, notably on the Brown Palm Civet (Mudappa 2001) Asian Small-clawed Otter *Aonyx cinerea* (Perinchery 2008) and Smooth-coated Otter (Anoop & Hussain 2004, 2005, Perinchery 2008). Their roles as predators, prey and seed dispersers have been inadequately investigated even as severe loss and fragmentation of their habitat threatens their populations (Mudappa 2001, Mudappa *et al*. 2007). Most viverrids, herpestids and mustelids are cryptic species that among popular minds lack the panache of large carnivores such as the Tiger *Panthera tigris* to attract conservation and research funding. When information on their ecology and behaviour is not readily forthcoming, opportunistic observations such as these have to be exploited to further our knowledge about these fascinating creatures.

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This work was carried out during a survey on large mammal habitat connectivity and quality in the Western Ghats. The Ministry of Environment and Forests, Government of India granted the required permits and provided financial support. The State Forest Departments of Kerala and Tamil Nadu are thanked for permission, support and co-operation during the survey. Additional funding from the National Fish and Wildlife Foundation (Save the Tiger Fund), U.S.A. and WWF International is gratefully acknowledged. Sasindra Babu and Akbar Ali were present during all small carnivore sightings and assisted in their identification. R. Raghunath is thanked for helping prepare the map. Divya Mudappa and M. D. Madhusudan are acknowledged for providing the initial encouragement and for critical comments and suggestions on the manuscript. I wish to thank Scott Roberton, William Duckworth, and anonymous referees for their valuable inputs that helped improve the manuscript.

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CORRIGENDUM

"A road kill of the Ethiopian Genet *Genetta abyssinica* along the Addis Ababa–Dira Dewa Highway, Ethiopia" by Mundanthra BALAKRISHNAN and AFEWORK Bekele (2008, *Small Carnivore Conservation* 39: 37–38).

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In the previous issue of *Small Carnivore Conservation* (2009, vol. 39), Balakrishnan & Afework (2008) illustrated a road-killed specimen identified as an Ethiopian Genet *Genetta abyssinica* Rüppell, 1836 (Fig. 1, p. 37) and kept at the Zoological Natural History Museum, Addis Ababa University, Ethiopia (specimen accession number: ZNHM – AAU M2008 – 108). Although some diagnostic, coat pattern traits corresponding to the species were given (p. 38), the skin illustrated in Figure 1 undoubtedly corresponds to a specimen of Common Small-spotted Genet *Genetta genetta* (Linnaeus, 1758). Here follows a series of diagnostic traits that can be observed from the figure and that characterise the latter species. These contradict the description of the skin made by Balakrishnan & Afework (2008): (i) the tip of the tail, which is slightly cut, appears bright, (ii) the first two longitudinal rows of dorsal spots show important (first row) to weak (second row) coalescence, never forming continuous stripes, (iii) the coat of legs exhibits dark areas, (iv) a well-visible "dirty" stripe longitudinally crosses the rings of the upper part of the tail, and (v) hairs on tail are long, resulting in a confused "black and white" annealing pattern on the upper part of the tail. As a consequence of this re-identification, ZNHM should be considered as not holding any specimens of *Genetta abyssinica* in its collections.

Recently, an interactive identification key for Genettinae was developed and made available to assist a wide spectrum of biodiversity actors in the sometimes difficult identification of genets (Gaubert et al. 2008; accessible at: http://lis.snv.jussieu.fr/apps/xper/data/genettes/web/index.html.en). We encourage field survey reports to base their species identification on this updated taxonomic tool, which among other things provides a series of illustrated material and descriptive lists of character traits for each species. Any feedbacks on the practical aspects of this identification key are welcome to improve the utility of this tool.

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Camera-trap pictures from Cambodia (see page 16 of this issue).
Clockwise from top left: Ferret Badger, Crab-eating Mongoose, Small Indian Civet, Large-spotted Civet, and Spotted Linsang (Photos: FFI-Cambodian Crocodile Conservation Programme, 2008)

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