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Ratel *Mellivora capensis* (Artist: Jeff Cain)

Small carnivores of the Maliau Basin, Sabah, Borneo, including a new locality for Hose's Civet *Diplogale hosei*

Jedediah BRODIE[1] and Anthony GIORDANO[2]

Abstract

The first camera-trapping study in the Maliau Basin Conservation Area of Malaysian Borneo, an area containing some of the last intact rainforest in Southeast Asia, detected 13 small mammalian carnivore species over 2,915 camera-trap-nights, including three newly recorded for the area: Banded Linsang *Prionodon linsang*, Masked Palm Civet *Paguma larvata* and Hose's Civet *Diplogale hosei*. Hose's Civet, endemic to Borneo, is one of the least known carnivore species in Southeast Asia and possibly the world. Maliau is only the fifth site where the species has been confirmed in Sabah. Camera-traps—deployed in three habitats: primary (unlogged) dipterocarp forest, logged dipterocarp forest and tropical heath (kerangas) forest—detected more small carnivore species in primary dipterocarp forest than in logged forest, despite similar sampling effort; data were too few to allow the estimation of meaningful habitat-specific detection probabilities. The Malay Civet *Viverra tangalunga* was the small carnivore species detected most often overall, followed by Leopard Cat *Prionailurus bengalensis* and Banded Palm Civet *Hemigalus derbyanus*. We did not detect Malay Civet or Leopard Cat in logged forest, yet other studies suggest that they are common in disturbed areas. The paucity of records (only one) of the generally abundant Common Palm Civet *Paradoxurus hermaphroditus* is unusual. Ongoing monitoring at this and other sites across Borneo should help elucidate patterns of small carnivore distribution and richness with respect to natural and anthropogenic variation in forest characteristics.

Keywords: activity patterns, camera-trapping, dipterocarp forests, logging, tropical heath forest

Karnivor kecil di Lembangan Maliau, Sabah, Borneo, serta kawasan baru bagi Hose's Civet *Diplogale hosei*

Abstrak

Kami telah menjalankan kajian perangkap kamera yang pertama di Kawasan Konservasi Lembangan Maliau di Borneo, Malaysia, salah satu hutan hujan tropika yang belum terjejas di Asia Tenggara. Kami dapat mengesan 13 spesies karnivor mamalia kecil dalam 2,915 malam-perangkap kamera, termasuklah tiga rekod yang baru di kawasan ini, iaitu Banded Linsang *Prionodon linsang*, Masked Palm Civet *Paguma larvata* dan Hose's Civet *Diplogale hosei*. Hose's Civet ialah viverrida yang endemic di Borneo, ia merupakan satu karnivor yang paling kurang dikenali di Asia Tenggara biar pun di seluruh dunia. Lembangan Maliau merupakan lokasi yang ke-5 di mana spesies ini dijumpai/ disahkan di Sabah. Perangkap kamera telah diletakkan di tiga jenis habitat iaitu hutan dipterokarpa primer (tanpa pembalakan), hutan dipterokarpa sekunder dan hutan kerangas. Didapati lebih banyak spesies karnivora kecil dikesan di hutan dipterokarpa primer berbanding dengan hutan dipterokarpa sekunder dengan menggunakan kaedah persampelan yang sama. Data adalah tidak mencukupi untuk membuat angkaran kebarangkalian bagi pengesanan habitat khas. Pada keseluruhannya, Malay Civet *Viverra tangalunga* ialah karnivora kecil yang paling kerap dikesan, diikuti oleh Leopard Cat *Prionailurus bengalensis* dan Banded Civet *Hemigalus derbyanus*. Kami tidak dapat kesan Malay Civet atau Leopard Cat di hutan sekunder, walaupun kajian lain mengatakan kedua-dua spesies ini adalah biasa dijumpai di kawasan terganggu. Jumlah rekod yang begitu jarang (hanya satu) bagi Common Palm Civet *Paradoxurus hermaphroditus* adalah luar biasa. Pemerhatian yang berterusan di kawasan ini dan lokasi yang lain di Borneo akan dapat menjelaskan corak taburan dan kekayaan bagi karnivora kecil di pelbagai jenis hutan sama ada semula jadi ataupun buatan manusia.

Kata kunci: Corak aktiviti (pergerakan), perangkap kamera, kadar pengesanan, pembalakan, kerangas

Introduction

Borneo has some of the last remaining large contiguous tracts of rainforest in Southeast Asia (Sanderson *et al.* 2002, Bradshaw *et al.* 2009). The largest island in the Sunda archipelago, Borneo was historically covered predominantly by tropical rainforest (Ashton 2010) and supported high biodiversity (e.g. Corbet & Hill 1992, Ashton 2010), with many species endemic to the island. The remaining forest cover, however, remains under continued threat; with approximately 1.7% of its forests converted annually, Borneo has one of the highest deforestation rates in the world (Koh 2007, Langer *et al.* 2007), most of which is driven by international logging interests and the commercial harvesting of exotic tree products such as palm oil (Laurance 2007). Those forests not converted outright may be seriously degraded by other activities such as selective logging (Poffenberger 2009). Although approximately 9% of Borneo is afforded some level of protected status (IUCN categories I–IV, as defined in IUCN 1994), these protected areas are becoming increasingly isolated from each other as the forests in between are lost or degraded (Curran *et al*. 2004). Furthermore, wildlife in protected areas is still susceptible to internal threats such as mining (Hazebroek *et al.* 2004), illegal logging (Curran *et al.* 2004) and hunting (Milner-Gulland *et al.* 2003).

Borneo contains high carnivore species richness (Corbet & Hill 1992) and endemism (Schreiber *et al.* 1989). Despite this, little is known about how carnivore populations and communities

vary spatially across the island, particularly with respect to forest type and habitat characteristics. Systematic and opportunistic camera-trapping surveys have provided important information on small carnivores at a few sites such as the Sabangau peat forest in Central Kalimantan (Cheyne *et al.* 2010), Mount Kinabalu (Wells *et al.* 2005) and Deramakot Forest Reserve (Wilting *et al*. 2010a) in Sabah, and the upper Baram watershed of Sarawak (Mathai *et al.* 2010) and there remains a pressing need for similar profiles at other localities. In some instances, these photographic surveys represent the only known information on the occurrence of particular mammal species in a given area.

However, there is little published information on small carnivore communities in the few remaining forests of Borneo that have not been logged historically and that have lost no known native Holocene vertebrates. This lack of baseline data from undisturbed sites makes it difficult to assess the impact of human activities such as logging (Wells *et al.* 2005) and hunting (Milner-Gulland *et al.* 2003) on rainforest vertebrates such as carnivores. Without knowing how habitat differences naturally influence mammal community composition, it is difficult to discern the impact of human-induced landscape changes on these communities.

Moreover, nearly nothing is known of the ecology or natural history of several small carnivore species on Borneo. Among these is the Hose's Civet *Diplogale hosei*, a 'Vulnerable' viverrid (Schipper *et al*. 2008) endemic to the island. First collected on Mount Dulit in northern Sarawak in 1891, as of 2004 the animal had been collected or observed at only seven sites in Sarawak, four in Sabah and two in Brunei, with only 17 known museum specimens, all collected before 1983 (Van Rompaey & Azlan 2004). Hose's Civet has been observed from 450 to 1,700 m in elevation and is thought to be a mainly ground-dwelling species of lower montane regions in northeast Borneo (Payne *et al.* 1985, Van Rompaey & Azlan 2004). Although it is perhaps not abundant anywhere (Van Rompaey & Azlan 2004), Hose's Civet may be comparatively locally common in the Kelabit Highlands (Davis 1958) and the nearby upper Baram watershed (Mathai *et al.* 2010). Although they listed its ecology and habitat as "unknown", Payne *et al.* (1985: 286) speculated that Hose's Civet could be specialised for foraging among mossy streams and boulders, based on the presence of hair between its footpads and long whiskers on its face. Davis (1958) speculated that it primarily consumes arthropods.

Here we report on the first camera-trapping study of the Maliau Basin in Sabah, with special reference to small carnivore richness, detection rates, and activity patterns. We sampled three habitats: primary mixed dipterocarp forest, logged mixed dipterocarp forest, and primary tropical heath forest (known locally by the Iban name of 'kerangas'). Kerangas forests occur on sandy, nutrient-poor soil and are drained by dark, tannin-rich streams; average canopy height is lower and average tree trunk diameter is smaller than in other forest types. Because of their reduced productivity, kerangas forests are thought to be depauperate in many vertebrate taxa (Janzen 1974, Struebig *et al*. 2006), but little is known about which small carnivore species use these habitats. The study's primary goals are to assess the distribution, richness, habitat usage and response to anthropogenic impacts of mammals. The data presented here are from the first five months of camera-trapping in the Maliau Basin, and should be viewed as a preliminary assessment of the small carnivore community in the area.

Methods

Study site

The Maliau Basin Conservation Area (centred on 4°49′N, 116°54′E; 588 km²; Fig. 1) contains some of the last floristically and faunally intact forest in all Southeast Asia. The protected area spans the basin itself and a surrounding buffer zone; it was nominated as a World Heritage Site in 2003. It is possible that the interior of the Maliau Basin itself (about 400 km²) was never occupied by humanity: there are few records of people in the area before the 1980s (Hazebroek *et al.* 2004). The basin consists of lowland and hill rainforest surrounded by a circle of sedimentary mountains up to 1,700 m altitude. Estimated annual precipitation in the region is approximately 3,800 mm (Mykura 1989). The area is drained by many streams that converge into the Maliau river. The rim and interior of the basin contain a mixture of primary dipterocarp forest and kerangas forest. The surrounding mountains contain highland kerangas and casuarina forests. The 'southern plateau', a topographically undulating area on the southern rim of the basin, contains mid-elevation (about 1,000–1,200 m) kerangas forest with thick moss and abundant carnivorous pitcher plants *Nepenthes*. Outside the basin itself, but still within the Conservation Area, are large tracts of dipterocarp forest selectively logged in the early–mid 1990s (H. Tangki verbally 2011). The logged forests seen during the present survey have much reduced forest canopy cover, a thick understorey of grasses, forbs and ferns, and abundant herbaceous vines covering many of the trees.

Initial observational surveys of fauna within the basin recorded a high richness of vertebrate species (Hazebroek *et al.* 2004). These surveys were conducted by zoologists and ecologists affiliated with the Universiti Malaysia Sabah (UMS) in Kota Kinabalu. However, the methods for species identification on these surveys have not been clearly specified, so their species lists

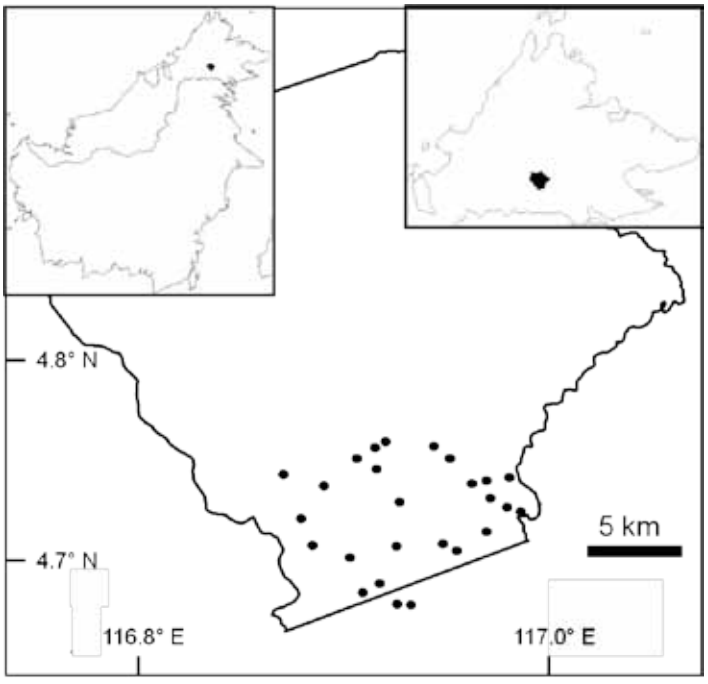

Fig. 1. The Maliau Basin Conservation Area study area, showing camera station locations (dots), location of the area within Sabah (upper right insert), and location of the area within Borneo (upper left insert).

must be viewed as preliminary. Maliau Basin is one of the last three places in Malaysian Borneo (the others being Danum Valley Conservation Area and Tabin Wildlife Reserve; A. Hearn and J. Ross *in litt*. 2011) that still have Asian Elephant *Elephas maximus*, Banteng *Bos javanicus*, Bornean Orang-utan *Pongo pygmaeus*, and recent (< 10 year old) records of Sumatran Rhinoceros *Dicerorhinus sumatrensis*.

The previous UMS surveys in Maliau Basin reported the following small carnivores: Yellow-throated Marten *Martes flavigula*, Malay Weasel *Mustela nudipes*, Sunda Stink-badger *Mydaus javanicus*, Smooth-coated Otter *Lutrogale perspicillata*, Oriental Small-clawed Otter *Aonyx cinereus*, Malay Civet *Viverra tangalunga*, Binturong *Arctictis binturong*, Small-toothed Palm Civet *Arctogalidia trivirgata*, Common Palm Civet *Paradoxurus hermaphroditus*, Banded Palm Civet *Hemigalus derbyanus*, Collared Mongoose *Herpestes semitorquatus*, Short-tailed Mongoose *H. brachyurus*, Marbled Cat *Pardofelis marmorata*, Flat-headed Cat *Prionailurus planiceps* and Leopard Cat *P. bengalensis* (Hazebroek *et al.* 2004). As noted, these records should be viewed as preliminary. In addition, the expeditions reported an "unconfirmed" record of Bay Cat *Pardofelis badia* (Hazebroek *et al*. 2004: 191). Following Mathai *et al.* (2010), term 'small carnivores' includes all Bornean Carnivora except the Sunda Clouded Leopard *Neofelis diardi* and Sun Bear *Helarctos malayanus.*

Field methods and data analysis

We established 26 camera-trap stations in the Maliau Basin Conservation Area in January 2010. These stations included areas in logged forest outside the basin (but still inside or immediately adjacent to the Conservation Area; 11 sites), in adjacent primary dipterocarp forest on the south-facing flank of the southern rim of the basin (i.e. outside the basin itself), inside the basin and near the rim (12 primary dipterocarp sites total), and in kerangas forest on the southern plateau (three sites; Fig. 1). Stations were generally positioned 1–2 km apart and were set up over potential travel routes for carnivores such as wildlife trails (particularly along ridge tops), human footpaths, abandoned logging roads and streambeds. Stations spanned a recorded elevational gradient of 901 m across all habitat types (Table 1).

Each station had two Reconyx™ RM45 digital camera-traps facing each other on opposite sides of the trail, path, or streambed, attached to tree trunks an average of ~80 cm above the ground, but angled slightly downward. Cameras were powered by six 3000mAh NiMH C-cell batteries. Camera trigger sensitivity was set to 'high' and each unit was set to take three photographs in rapid-fire succession upon being triggered. Cameras were set to trigger through the 24-hour cycle; no baits or lures were used. All units held 1–2 GB memory cards capable of storing 7,000–15,000 images per card. All memory cards were retrieved from camera units in May 2010.

Separate detections of a given species at a particular site were photographs that occurred >1 hour apart; the 1 hour threshold is arbitrary. We present two crude indicators of species occurrence: (1) species- and habitat-specific detection rates as the number of detections per 100 trap-nights, and (2) the number of camera-trap stations at which each species was recorded. Camera-trap-nights are defined as the product of the total number of camera-trap stations operating over a given area, and the total number of nights over which they were operating. The preliminary analyses here do not attempt to estimate or correct for detection probability.

Table 1. Characteristics of the camera-trap stations, Maliau Basin, Sabah, Malaysia.

Station	Forest type (elevation in m)	Number of trap-nights
01	Primary dipterocarp (340)	126
02	Logged dipterocarp (290)	128
03	Logged dipterocarp (300)	95
04	Logged dipterocarp (230)	98
05	Primary dipterocarp (210)	(destroyed by flood)
06	Primary dipterocarp (540)	126
07	Primary dipterocarp (400)	126
08	Logged dipterocarp (590)	89
09	Logged dipterocarp (610)	124
10	Logged dipterocarp (420)	119
11	Logged dipterocarp (350)	126
12	Logged dipterocarp (240)	81
13	Primary dipterocarp (590)	126
14	Kerangas (1030)	126
15	Kerangas (1080)	125
16	Kerangas (1060)	125
17	Primary dipterocarp* (1120)	125
18	Logged dipterocarp (280)	107
19	Logged dipterocarp (360)	101
20	Primary dipterocarp (620)	124
21	Primary dipterocarp (900)	124
22	Primary dipterocarp (730)	125
23	Primary dipterocarp (890)	123
24	Primary dipterocarp (780)	123
25	Primary dipterocarp (870)	123
26	Logged dipterocarp (290)	100

*Very near ecotone with kerangas forest.

Elevation was measured with a barometric altimeter built into a Garmin GPSMAP® 60CSx.

In several instances (see below) we sought independent verification of the identification of animals in photographs.

Results

From January to May 2010 we accumulated 2,915 trap-nights across our entire study region: 1,371 trap-nights (at 11 sites) in primary dipterocarp forest, 1,168 trap-nights (11 sites) in logged dipterocarp forest, and 376 trap-nights (three sites) in kerangas forest. At one camera station (in primary dipterocarp forest), both cameras were destroyed by flooding. Cameras at several other stations had batteries fail before May 2010, although no station had fewer than 81 trap nights (Table 1). This sampling effort obtained 88 detections of small carnivores in the MBCA (Table 2). Station 17, at 1,115 m elevation in primary dipterocarp forest but near an ecotone with kerangas forest, recorded the highest number of species (seven). The small carnivore species with the highest independent detections were the Malay Civet, Leopard Cat, Banded Palm Civet and mongooses *Herpestes* (Table 1; Fig. 2). Detections of both Collared Mongoose *H. semitorquatus* and Short-tailed Mongoose *H. brachyurus* were confirmed from some photos, but in some photos it was impossible to distinguish between the two.

The Malay Civet, Leopard Cat and Banded Palm Civet appeared to be predominantly nocturnal and crepuscular, while

*Table 2. Number of small carnivore detections >1 hour apart at different camera-trap stations. Station characteristics are given in Table 1. Scientific names for species are given in the main text. We did not distinguish between the two species of mongoose (*Herpestes collaris *and* H. semitorquatus*).*

Species/Station	01	02	03	04	06	14	17	18	19	20	21	22	23	24	25	26
Leopard Cat						1						1	6	1	11	
Flat-headed Cat														1		
Marbled Cat							1			1		1				
Banded Linsang						1	2									
Binturong								1								1*
Malay Civet							2			1	1		14	5	3	
Common Palm Civet		1														
Masked Palm Civet							1							1		
Banded Palm Civet	4			1			1	1	2		1	1	1	5		1
Hose's Civet							3									
Mongooses			1	1	1		3		1		1	1				
Yellow-throated Marten		1														

*Photographic sequence contained three individuals, an adult and two young.

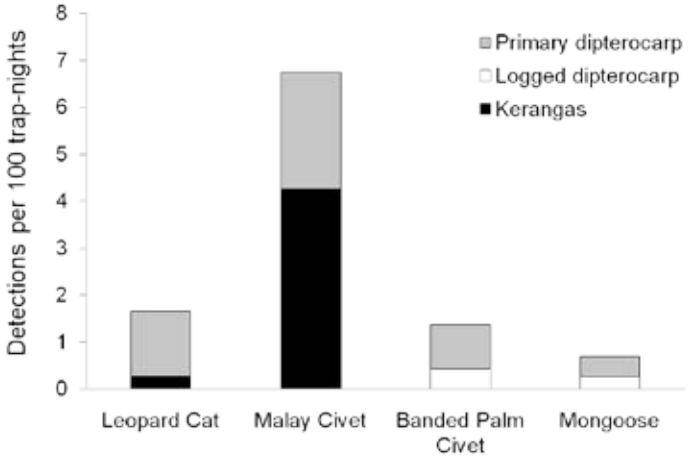

*Fig. 2. Number of detections >1 hour apart for the four most commonly detected small carnivores. We did not distinguish the two species of mongoose (*Herpestes collaris *and* H. semitorquatus*).*

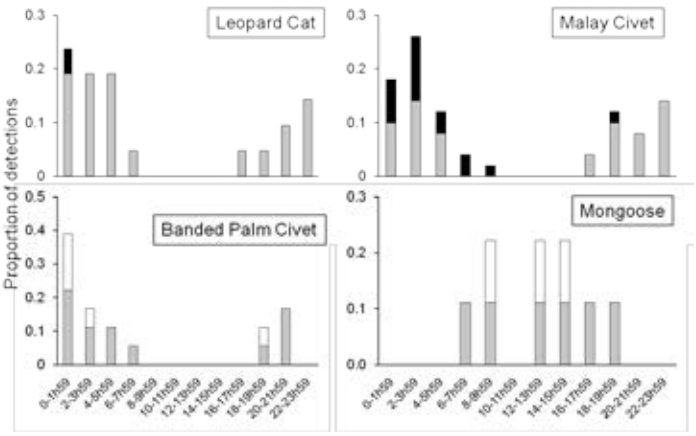

*Fig. 3. Detection times of the four most commonly detected small carnivores in primary dipterocarp forest (grey bars), logged dipterocarp forest (white bars) and kerangas forest (black bars). We did not distinguish the two species of mongoose (*Herpestes collaris *and* H. semitorquatus*). Typical sunrise and sunset times were 6h20 and 18h20, respectively.*

Fig. 4. Hose's Civet Diplogale hosei*, in primary mixed dipterocarp near an ecotone with kerangas forest; 20h41 on 26 April 2010; elevation = 1,115 m.*

mongooses were more diurnal (Fig. 3). We lacked the statistical power to assess whether activity patterns differed significantly among forest types. Hose's Civet was detected on three occasions (at 03h58, 19h41 and 20h41) at the same site (station 17) near the primary dipterocarp–kerangas ecotone (Fig. 4). Hose's Civet identifications were confirmed independently by Siew Te Wong, Joanna Ross, Andrew Hearn and Ch'ien Lee. The one Flat-headed Cat identification was confirmed by Jim Sanderson. Mongoose identification was assisted by Will Duckworth, Mohamed Azlan and Andreas Wilting.

Discussion

We are actively studying the mammal communities of the Maliau Basin, and report here the first assessments of small carnivore richness, habitat use, and activity patterns in the area. Since the Maliau Basin has some of the last floristically and faunally near-intact (i.e. unlogged and only lightly hunted) rainforest in all Southeast Asia, these data could provide useful baseline information with which to compare other sites.

The different forest types seem, based on the preliminary results here, likely to hold somewhat different small carnivore

representation. We detected more species in primary dipterocarp forest than logged dipterocarp forest, despite having only a slightly higher trapping effort in the former. Explicit correction for potential differences in detectability between habitats is planned for subsequent analyses. We did not detect Leopard Cat or Malay Civet in the logged forest, despite evidence from other sites that they are common in disturbed habitat (e.g. Lim 1999, Colón 2002, Azlan & Sharma 2006). Our ongoing research should eventually allow us to assess quantitatively the impacts on small carnivores as additional records increase sample sizes for statistical analysis.

Several records could help illuminate the natural history of little-known Bornean small carnivores. The sole Flat-headed Cat record (at 17h42) was from 782 m, whereas most records for this species come from below 100 m (Wilting *et al*. 2010b). Banded Palm Civet was detected much more often than Common Palm Civet (the latter only once; 20h57), contrasting with other sites (e.g. Wilting *et al*. 2010a).

Some other preliminary results corroborate previous studies (e.g. Mathai *et al*. 2010, Wilting *et al*. 2010a) that demonstrate a relative paucity of Malay Weasel, Banded Linsang, and Binturong records from camera-trapping. We detected Banded Linsang (03h51, 04h11 and 18h58) and Binturong (11h52 and 23h19) at only two sites each, although one photographic sequence of Binturong (station 26 in secondary forest) included three individuals: an adult and two young coming down to a small stream to drink.

One site (station 17) stood out as particularly rich in small carnivore species with seven species detected. It was in primary dipterocarp but very near the expansive kerangas forest on the Southern Plateau. Habitat heterogeneity near this boundary may at least be partially responsible for the high species richness observed. Also, this station was very near the southern rim of the basin, and animal movement may have been constrained by adjacent steep topography. This was also the highest camera-trap location (1,115 m); mid-elevation peaks in species richness have been observed in a variety of taxa, for example birds (McCain 2009), plants (Bachman *et al.* 2004, Grytnes & Beaman 2006), herpetofauna (Fu *et al*. 2006, McCain 2010) and small mammals (Rowe & Lidgard 2009).

With these additional species records presented here, few Bornean carnivores remain to be found in the Maliau Basin. Assuming that the UMS survey records, including the unconfirmed report of a Bay Cat, are valid, the only Bornean carnivores still unrecorded from the basin are the Otter Civet *Cynogale bennettii*, Bornean Ferret Badger *Melogale everetti* and Hairy-nosed Otter *Lutra sumatrana*. Other potentially unconfirmed species include the Eurasian Otter *Lutra lutra*, if it even occurs in Borneo (which is considered unlikely; Sivasothi & Nor 1994) and Hose's Mongoose *Herpestes hosei*, only doubtfully a distinct species, (see Corbet & Hill 1992, Patou *et al.* 2009). This high species richness of small carnivore species in the Maliau Basin of northern Borneo highlights the importance of this site, as well as other little-disturbed rainforest ecosystems, for rainforest mammal conservation.

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[1]Wildlife Biology Program, University of Montana, Missoula MT 59802, U.S.A.
Email: jedediah.brodie@gmail.com
[2]Dept of Natural Resources Management, Texas Tech University, Lubbock TX 79414, U.S.A.

Research priorities for the small carnivores of Colombia

José F. GONZÁLEZ-MAYA[1,2], Amancay A. CEPEDA[1,3], Jerrold L. BELANT[4], Diego A. ZÁRRATE-CHARRY[1], Sergio A. BALAGUERA-REINA[1] and Abelardo RODRÍGUEZ-BOLAÑOS[5]

Abstract

Small carnivores, families Mustelidae, Procyonidae and Mephitidae, are some of the lesser known species in Colombia; however, they represent an important component of Colombian mammal fauna. Thus, it is necessary to assess their basic natural history, distribution, and conservation status in the country. During 2010, the First Symposium on Small Carnivores of Colombia was held at the III Colombian Zoology Congress with the participation of numerous researchers and institutions from the country. After a series of presentations describing current knowledge and critical issues of small carnivores, an exercise defining research priorities was conducted with participants to establish a framework for small carnivore studies in Colombia. These priorities were categorised in three rank levels of importance by species and topical area. High priorities for species research included assessing the distribution and status of the Colombian Weasel *Mustela felipei* and olingos *Bassaricyon* spp. For topical areas, country-level assessments for all small carnivores, characterisation of types and magnitudes of threats to small carnivores and clarification of species taxonomy (including olingos, raccoons, and mountain coatis), especially of museum specimens, were considered highest priority. This priority-setting exercise provides a framework for small carnivore investigations in Colombia with an ultimate goal of aiding their conservation.

Keywords: conservation, distribution, ecology, Mephitidae, Mustelidae, Procyonidae

Prioridades de investigación para los pequeños carnívoros de Colombia

Resumen

Las especies de pequeños carnívoros, familias Mustelidae, Procyonidae y Mephitidae, son uno de los grupos menos conocidos en Colombia, sin embargo, representan un componente importante de la fauna de mamíferos del país. Por tal razón, es necesario evaluar aspectos básicos de su historia natural, distribución y estado de conservación a nivel nacional. Durante el 2010 se realizó el Primer Simposio de Pequeños Carnívoros de Colombia como parte del III Congreso Colombiano de Zoología con la participación de numerosos investigadores e instituciones del país. Luego de una serie de presentaciones describiendo el conocimiento actual y algunos otros temas críticos sobre pequeños carnívoros, se desarrolló un ejercicio de definición de prioridades de investigación con los participantes, con el fin de establecer un marco para el estudio de estas especies en Colombia. Estas prioridades fueron categorizadas en tres niveles de importancia según especies y tema. Las principales prioridades de investigación incluyeron la caracterización de la distribución y estado de conservación de la Comadreja Colombiana *Mustela felipei* y los olingos *Bassaricyon* spp. En cuanto a temas, evaluaciones a nivel nacional para todos los pequeños carnívoros, caracterización de las amenazas sobre los pequeños carnívoros y clarificación de la taxonomía (incluyendo olingos, mapaches y coatis de montaña), en especial especímenes de museo, fueron consideradas las prioridades más altas. Este ejercicio de definición de prioridades provee de un marco para la investigación sobre pequeños carnívoros en Colombia, con el fin último de aportar a su conservación.

Palabras clave: conservación, distribución, ecología, Mephitidae, Mustelidae, Procyonidae

Introduction

Small carnivores, as defined by the International Union for Conservation of Nature (IUCN), include nine families worldwide. Despite their diversity and global distribution, many small carnivores have received limited scientific attention; consequently there is often little information on their distribution, ecological roles, and conservation status. Colombia possesses three families of small carnivores: Mephitidae, Procyonidae, and Mustelidae, containing 14 species generally accepted to occur in the country and four species potentially present but unconfirmed (IUCN 2010, and one mountain coati as discussed here; Fig. 1; Table 1). For one of these species its purported occurrence requires reassessment (Northern Raccoon *Procyon lotor*; Alberico *et al*. 2000).

Available information on small carnivores in Colombia is not only scarce but in some cases neither verifiable nor reliable. In addition, some taxonomic and identification issues concerning potentially sympatric congeners (e.g. *Procyon* spp. and *Mustela* spp.) remain unclear, as does the basic ecology, biology and conservation status of all small carnivores. Some recent research has emphasised small carnivores in Colombia, including their ecological importance and role in ecological processes (Castaño-Uribe *et al.* 2010, Zárrate-Charry *et al.* 2010). In some cases, small carnivore distributions and regional conservation status have been used as conservation targets and surrogates for decision-making, particularly related to their demonstrated function, role, and influence on ecosystem processes (Castaño-Uribe *et al.* 2010, Zárrate-Charry *et al.* 2010).

To focus future efforts on these species, the First Symposium on Small Carnivores of Colombia was held as part of the III Colombian Zoology Congress in November 2010. The primary goal of this symposium, which comprised over 10 presentations and more than 30 participants, was to identify and prioritise information gaps for small carnivores, providing a framework to guide future research. An additional goal was to attract scientists and

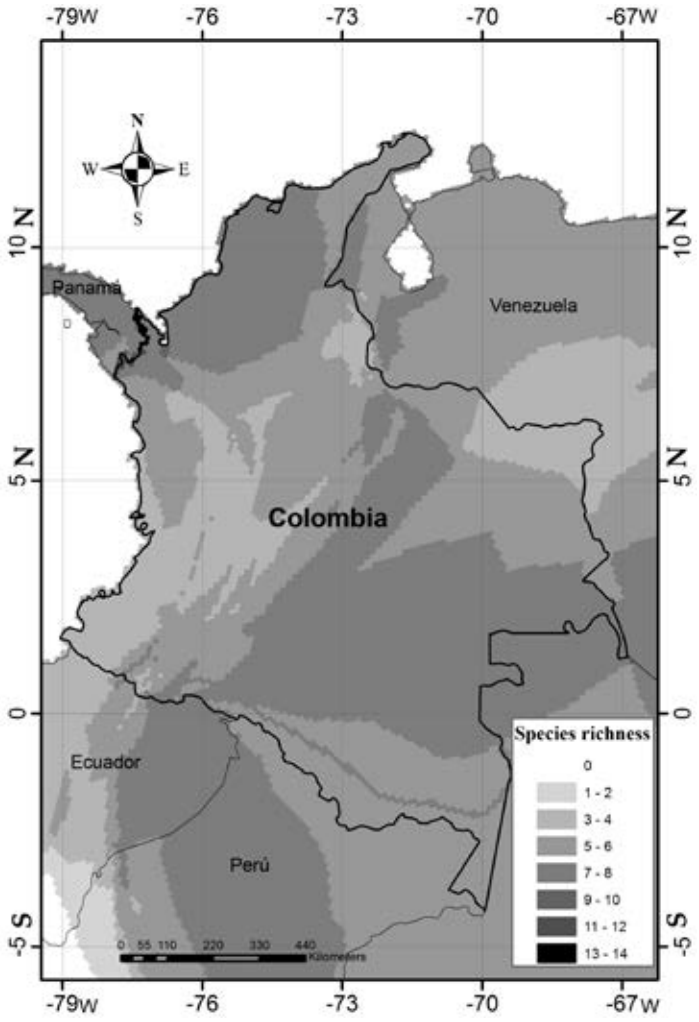

Fig. 1. Distribution of small carnivore species in Colombia (from IUCN 2010).

conservationists throughout Colombia to enhance communication and collaboration to advance our knowledge of small carnivores nationally. The congress proceedings, including summaries of all presentations at this symposium, were included in Asociación Colombiana de Zoología (2010). Herein, we summarise those presentations of greatest relevance to establishing small carnivore research priorities.

Methods

Defining priorities

As a multi-disciplinary and inter-institutional effort, we outlined information needs for small carnivores and developed priorities using the following guidelines: 1) describing the current state of knowledge of each species, 2) characterising specific questions and information needs for species, and 3) defining and ranking research priorities (Schipper *et al.* in ACZ 2010). The development of the process followed this order and began with oral presentations from researchers about most of the families and species and our current state of knowledge. This was followed by additional oral presentations on specific topics of small carnivores such as evidence for mesocarnivore ecological release after loss of top predators, conservation status in specific regions of the country, taxonomic issues and potential solutions, and finished with examples of small carnivore conservation priorities and status throughout the Western Hemisphere. Immediately following these presentations, a survey sought all symposium participants' opinions on small carnivore information and research needs. Following this, a final discussion session was held to define conservation and research priorities for Colombia based on the symposium presentations and results of the informal survey. This represents the first detailed reference for small carnivore information needs in the country. Information from surveys and presentations was synthesised defining priorities by species and research topic.

Table 1. Small carnivores recorded in Colombia (after Alberico et al. *2000, IUCN 2010).*

Family	Sub-family	Genus	Species	Author	Common name	IUCN category
Mustelidae	Mustelinae	*Eira*	*barbara*	Linnaeus, 1758	Tayra	LC
Mustelidae	Mustelinae	*Galictis*	*vittata*	Schreber, 1776	Greater Grison	LC
Mustelidae	Mustelinae	*Mustela*	*felipei*	Izor and de la Torre, 1978	Colombian Weasel	VU
Mustelidae	Mustelinae	*Mustela*	*frenata*	Lichtenstein, 1831	Long-tailed Weasel	LC
Mustelidae*	Mustelinae	*Mustela*	*africana*	Desmarest, 1818	Amazon Weasel	LC
Mephitidae		*Conepatus*	*semistriatus*	Boddaert, 1785	Striped Hog-nosed Skunk	LC
Mustelidae	Lutrinae	*Lontra*	*longicaudis*	Olfers, 1818	Neotropical Otter	DD
Mustelidae	Lutrinae	*Pteronura*	*brasiliensis*	Gmelin, 1788	Giant Otter	EN
Procyonidae		*Bassaricyon*	*gabbii*	J. A. Allen, 1876	Bushy-tailed Olingo	LC
Procyonidae		*Nasua*	*narica*	Linnaeus, 1766	White-nosed Coati	LC
Procyonidae		*Nasua*	*nasua*	Linnaeus, 1766	South American Coati	LC
Procyonidae		*Nasuella*	*olivacea*	Gray, 1865	Western Mountain Coati	DD
Procyonidae		*Potos*	*flavus*	Schreber, 1774	Kinkajou	LC
Procyonidae		*Procyon*	*cancrivorus*	G. [Baron] Cuvier, 1798	Crab-eating Raccoon	LC
Procyonidae		*Procyon*	*lotor*	Linnaeus, 1758	Northern Raccoon	LC
Procyonidae*		*Bassaricyon*	*alleni*	Thomas, 1880	Allen's Olingo	LC
Procyonidae*		*Bassaricyon*	*beddardi*	Pocock, 1921	Beddard's Olingo	LC

* Species not yet confirmed but inferred or suspected based on IUCN (2010) or other sources detailed in the text. In addition, the potential occurrence of Eastern Mountain Coati *Nasuella meridensis* is discussed in the text.

Table 2. Species research priorities for small carnivore in Colombia, by level of priority.

Family	Species	Priority	Topics
Mustelidae	*Mustela felipei*	I	Distribution, ecology, natural history, threats and current conservation status, and check of collection specimens presently identified as *M. frenata*
Procyonidae	*Bassaricyon* spp.	I	Verification of specimens in collections and field surveys for confirmation of species presence. Definition of species distributions within multi-country biogeographical units.
Procyonidae	*Nasuella olivacea*	II	Reassessment of threat category and presence investigation of *N. meridensis* in the country.
Mustelidae	*Eira barbara* and *Galictis vittata*	II	Biology, ecology and distribution; new threats and mesocarnivore release processes
Mustelidae	*Lontra longicaudis* and *Pteronura brasiliensis*	II	Conservation status, extent of occurrence, threats
Mephitidae	*Conepatus semistriatus*	II	Occurrence and biogeography
Procyonidae	*Procyon* spp.	III	Taxonomy, phylogeography and distribution, and ecology in areas of sympatry within the genus
Mustelidae	*Mustela* spp.		
Procyonidae	*Nasua* spp.	III	Distribution and ecology in areas of sympatry within the genus

The research priorities developed emphasised the lack of information on species and recommended research based on previous studies of small carnivores in Colombia (Guzmán-Lenis 2004, Balaguera-Reina *et al.* 2009, Burneo *et al.* 2009, Helgen *et al.* 2009, Tirira & González-Maya 2009, Rodríguez-Bolaños *et al.* in ACZ 2010, among others) and more recent studies presented at the symposium. There was no geographical prioritisation, reflecting limited information on the distribution and biogeography of most species at the country level, although some projects are addressing this topic based on available information (e.g., Torres-Palacios *et al.* 2010). Finally, information gaps were categorised into three levels of priority: I = high, II = medium and III = low, using the following information: 1) current understanding of each species's status and threats; 2) extent of knowledge of species' ecology, biology and taxonomy; and 3) relative awareness of species and their roles in ecosystems, conservation planning, and country-level biodiversity information.

Results and Discussion

Species research priorities (Table 2)

Priority I

Colombian Weasel *Mustela felipei* — The Colombian Weasel is the least-understood small carnivore in Colombia, known only from six confirmed localities in Colombia and Ecuador, and with very little information on its biology and ecology (Tirira & González-Maya 2009). Although considered Vulnerable by the IUCN Red List (Emmons & Helgen 2008), with such limited information a re-evaluation is warranted: it is possible this species may be under greater threat or perhaps it may be simply overlooked. A recent review of several collections noted low representation of this species, still considering only six specimens confirmed (Ramírez-Chávez & Mantilla-Meluk 2009). Information regarding its distribution, ecology, natural history, threats, and current population status is urgently needed to understand its conservation status. We recommend a thorough review of available museum specimens and surveys within its estimated geographic range, to document this species's distribution and status.

Olingos *Bassaricyon* spp. — The genus is poorly known in Colombia and there is discussion about whether Allen's Olingo *B. alleni* and Beddard's Olingo *B. beddardi* occur in the country. Also, the genus's taxonomy and distribution, and each species's range, are poorly known, which is undoubtedly why some mapped distribution limits occur at political borders (e.g. *B. alleni*; Reid & Helgen 2008a). In Colombia the only confirmed species is Bushy-tailed Olingo *B. gabbi*, with few specimens in museums (Alberico *et al.* 2000), and limited information about its distribution and ecology (Alberico *et al.* 2000, Mejia Correa 2009). It is necessary to review specimens present in collections for confirmation of these species. Field surveys would help clarify taxonomic problems, providing specimens and genetic material (Allen's Olingo is only known from the type collection) to allow locality records based on firm species identifications. There is considerable need for biologists to collaborate at the regional or multi-national level to define species distributions within shared biogeographical units.

Priority II

Mountain coatis *Nasuella* spp. — The current Red List assessment of mountain coati, which treats all taxa as conspecific, is Data Deficient (DD; Reid & Helgen 2008b), but recent information suggests it could be Near Threatened (NT; Balaguera-Reina *et al.* 2009). More research is required to increase our understanding of this species in the Andean region of Colombia and Ecuador and to reassess the threat category currently assigned. There are serious threats to the species due to the close relationship with local communities in terms of use, conflicts, and knowledge. Further, the former single species of mountain coati was recently separated into two, Western Mountain Coati *N. olivacea* across the Andes mountains of Colombia and Ecuador, and Eastern Mountain Coati *N. meridensis* restricted to a disjunct portion of the Andes in Venezuela (Helgen *et al.* 2009). The known distribution of Eastern Mountain Coati is adjacent to Colombia, suggesting it may inhabit the country; it is also possible the two species are sympatric. Additional understanding of ecological and biological differences between *Nasuella* species is also warranted.

Tayra *Eira barbara* and Greater Grison *Galictis vittata* — Although available published literature and museum specimens suggest these species are common in Colombia with wide distributions, there is almost no information on their biology or ecology (Torres-Palacios *et al.* 2010). Recent data suggest increased potential threat of hunting from recent establishment of farms and

pastures for livestock grazing within these species' geographic distributions, and the general view by local human communities of these species as pests (González-Maya *et al.* 2010). Where large carnivores have been eliminated, Tayra abundance appears to have increased, suggesting mesocarnivore ecological release as demographical exploitation (Castaño-Uribe *et al.* 2010, González-Maya *et al.* 2010). We recommend that Tayra undergo a taxonomic review: its distribution across several ecoregions suggests potential intra-specific variation, and the possibility of as-yet unknown conservation needs and priorities.

Striped Hog-nosed Skunk *Conepatus semistriatus* — Based on the latest conservation assessment (Cuarón *et al.* 2008), this species has a disjunct distribution in Colombia with reports from the Pacific, Caribbean, and Orinoco regions. It seems likely to be found in the Andean and Amazon regions as well, because it has been reported in adjacent regions in Brazil (Cuarón *et al.* 2008). It is also important to assess the phylogeography of the species due to its disjunct distribution (Nowak 2005).

Otters *Lontra longicaudis* and *Pteronura brasiliensis* — Despite their widespread distribution in the country, these two species still lack some basic information. *P. brasiliensis* is well studied in the Amazon and Orinoco rivers (Alvarez-León 2009), however, its abundance and extent of occurrence in the rest of the country outside these two rivers is poorly known, as are the main threats to the species in the country (Donadio 1978, Gómez & Jorgenson 1999, Alvarez-León 2009). On the other hand, *L. longicaudis* is of special interest for research and conservation assessment due to the high pressure it suffered during the 1950s–1970s, involving local extinction of several populations (Donadio 1978). Currently, there is no information regarding its ecology and biology, or even its populations, distribution, and threats in the country, all of great importance for its conservation in Colombia. Both species have wide distributions in South America, so their global survival is not tied to any one country; but information regarding within-country status is needed to prevent national- and population-level extinctions.

Priority III

Raccoons *Procyon* spp. and weasels *Mustela* spp. — The current inability to differentiate species confidently within each genus in field conditions is a considerable barrier for biological and ecological investigations (Marín *et al*. 2010). It may be possible to develop identification criteria for these species in the field, and genetic tools may help differentiate species records, especially for *Mustela*. This is particularly important to describe these species' distributions accurately in Colombia and assess their status better for potential use in conservation planning. Clarification of species in each genus that inhabit Colombia, and each one's distribution, would help understand national small carnivore species richness and distribution. Surveys for Northern Raccoon in northwestern Colombia (adjacent to Panamá), and for Amazon Weasel *M. africana* in south and southeastern portions of the country, should be conducted to investigate the possibility of their presence in the country. If congeners were ultimately found to be sympatric, studies focusing on resource portioning or possible hybridisation would be warranted.

Coatis *Nasua* spp. — Current knowledge of distribution of *Nasua* species is poor across the country, particularly for *N. narica*. The few records regarding this species in areas where both this and *Nasua nasua* are potentially present are not reliable, with the only accurate and confirmed records for the country being from the Chocó area near the Panamá border (including a recent sighting by authors); the only two specimens in national museums available are from this area (Alberico *et al.* 2000). Overall, few certainly accurate records exist for both species; some others are inferred for some areas, but no evidence is presented (i.e. Sucre department, Caribbean; Galván-Guevara *et al.* 2009). Only extensive surveys for *N. narica* could define its distribution within the country and indeed its current presence in Colombia. If current hypotheses about distribution are supported, the ecology in sympatry of these two species is important to understand because it would be the only part of America where both species co-occur.

Topical research priorities (Table 3)

Priority I

Assessment of species — It is necessary to assess all species at the country level to understand their conservation status. This will require development of tools to identify some species, such as raccoons, weasels, olingos, and mountain coatis, based on common methods employed in the country such as camera-traps and track surveys. However, it is quite possible that track surveys cannot be used or developed as a reliable method for some of these genera. The extent of ecosystem or habitat degradation as well as the threat of expanding land uses, such as the development of oil palm plantations, should also be considered in future species conservation assessments (Cepeda *et al.* in ACZ 2010).

Table 3. Topical research priorities for small carnivore of Colombia, by level of priority.

Topic	Priority	Focal areas
Conservation reassessment	I	National assessment of all species, data for global assessments, and reliable identification methods
Threats	I	Threats and inclusion in management plans
Taxonomy and collections validation	I	Occurrence in Colombia and validity and error corrections of specimen identity
Small carnivore population expansion following major reduction in large-carnivore populations	II	Extent and magnitude of the phenomenon
Education	II	Community outreach and awareness in academic and rural realms.
Distribution	II	Occurrence at ecoregional scale, patterns and biogeographical analyses.
Areas of conservation importance	II	Identification of important areas for small carnivores.
General ecology	III	Habitat use, population size or density, changes in populations over time (i.e. monitoring), diet, among others

Threats to small carnivores — It is necessary to assess the potential threats to long-term persistence in Colombia thoroughly for each species. Based on the results of these assessments, the relative importance of integrating small carnivores into management plans, conservation strategies, and monitoring should be considered and these should result in improvement of existing use of these species as conservation targets in the country.

Taxonomy and collections validation — A thorough review of museum specimens throughout Colombia is needed to clarify taxonomic status for many species. Taxonomically, clarification of occurrence of some species, including those in the genera *Bassaricyon* (for which there is debate about the validity of these species; K. M. Helgen verbally 2009) and *Nasuella* is needed to complete the list of small carnivores of Colombia. Colombian Weasel is perhaps more widely represented in collections than currently recognised, due to misidentification as the similar-looking Long-tailed Weasel *M. frenata.* The genus *Procyon* is poorly represented in national and international collections, and warrants review in all the country's collections (Marín *et al.* 2010).

Priority II

Small carnivore ecological release — This process, understood as an ecological response of mesocarnivore populations' exponential growth after top-predator depletion, is potentially frequent in several tropical ecosystems (Terborgh *et al*. 2001). In Colombia it appears to be a widespread process (Castaño-Uribe *et al.* 2010, González-Maya *et al.* 2010). The loss of large predators like the Jaguar *Panthera onca* and Puma *Puma concolor*, species that may perform roles of population regulation in species assemblages, may be causing this process in several regions of the country (Castaño-Uribe *et al.* 2010, González-Maya *et al.* 2010). Preliminary studies in the Colombian Caribbean since 2008 suggest higher abundance of small and medium-sized carnivores where large predators are extirpated or are rare (Castaño-Uribe *et al.* 2010, González-Maya *et al.* 2010, Zárrate-Charry *et al.* 2010). Loss of apex predators represents an important change in mammal assemblages and it is important to assess these effects on ecosystem function, as well as the direct effects of increased abundance of several small carnivore species (e.g. Tayra, raccoons).

Education — Interest in the biology, ecology, and conservation of Mephitidae, Procyonidae and Mustelidae is limited among researchers and academia, and the rural people who coexist with these species. Education plans and projects for the public, particularly children, should be developed and implemented to raise awareness about the relevance of small carnivores. Also, cultural awareness, importance, and symbolism should be explored for small carnivores in general since this topic, often ignored and poorly studied, could be a great aid for understanding threats and as a conservation tool. It would also be advantageous to develop a network of communication and support among researchers regarding existing and future projects on small carnivores. To achieve this end, a macro-project called Small Carnivores of Colombia is being developed with the participation of several organisations and researchers.

Distribution — Distribution ranges are poorly known for all species. Projects regarding their current and potential distributions should be undertaken to better understand their conservation status. As mentioned before, there is probable misidentification of small carnivores in several museum collections, especially weasels, coatis, raccoons and olingos. A thorough review of specimens and localities should be undertaken to clarify occurrence, distribution, and museum holdings in the country.

Many global species distributions reflect suppositions of contributors from a range of countries and do not include verified data from each country itself. Therefore, a workshop with researchers familiar with small carnivores from field investigations and museum collections from throughout Colombia and adjacent countries, is the most efficient way to compile and use existing information to validate the presence of some species and refine understanding of distributions of all small carnivores in Colombia. Biogeography, especially of small carnivores, is poorly understood in the country: therefore, new research topics and interest could be raised to understand patterns of distribution at country and continental scale.

Areas of conservation importance — The presence of most small carnivores in many areas of high biodiversity priority in Colombia is currently unknown, hindering possible conservation measures. Clarifying the distribution patterns of all species relative to habitat attributes, threats, abundance, and existing protected areas would allow modelling (e.g., maximum entropy) and other approaches to estimate extent of occurrence and potential distribution for each species and overlaid in a geographic information system. From this, critical areas for small carnivore conservation could be proposed and delineated for Colombia, including probable presence in national and regional protected areas systems, for which conservation plans and management actions could be developed with caution. These types of analyses, especially those with a high degree of confidence, should be strongly linked to decision-making with information made available as outreach material to general public.

Priority III

Ecology and biology — A general paucity of information on the ecology and basic natural history of small carnivores in Colombia has few exceptions (see Balaguera-Reina *et al.* 2009); therefore, basic biological and ecological research on all species, such as habitat use, population size or density, changes in populations over time (i.e. monitoring), diet, general life traits, among others, should be developed in several areas of the country, including each of the biogeographic regions (i.e. Amazon, Andes, Caribbean, Orinoquía and Chocó), because differences between regions are potentially of importance to real comprehension of the species at country level.

Conclusions

In general, small carnivores are poorly known in Colombia, so initiatives to clarify these species' importance and conservation status are recommended. The presence of at least 14 species (as well as four more of potential occurrence), of which two are categorised as globally threatened (Endangered and Vulnerable), and a further two as globally Data Deficient on *The IUCN Red List of Threatened Species*, makes Colombia an important country for small carnivores emphasising the importance to evaluate and define actions for their conservation.

We have summarised the first national approach to define priorities for small carnivores in Colombia, based on the experiences and opinions of multiple investigators from several institutions. This is a considerable advance in our overall understanding of research needs to ensure their long-term conservation. This process

will require periodic reassessments to describe which actions have been completed and their outcomes, and assess whether other priorities remain valid, and if new priorities have emerged. Defining information gaps and prioritising research needs for small carnivores was a major step toward developing a better understanding of these species in Colombia, ultimately to enhance their conservation.

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[1]Proyecto de Conservación de Aguas y Tierras, ProCAT Colombia/Internacional. Calle 15 # 5-56, El Rodadero, Santa Marta, Colombia.

[2]Laboratorio de ecología y conservación de fauna silvestre, Instituto de Ecología, Universidad Nacional Autónoma de México, Ciudad Universitaria, AP 70-275, México D.F., 04510 México.

[3]Facultad de Ciencias Forestales y Conservación de la Naturaleza, Universidad de Chile, Santiago de Chile, Chile.

[4]Carnivore Ecology Laboratory, Forest and Wildlife Research Center, Mississippi State University, Mississippi State, MS, U.S.A.

[5]Grupo de Investigación en Biodiversidad de Alta Montaña. Universidad Distrital Francisco José de Caldas. Bogotá, Colombia.

***Corresponding author email: jfgonzalez@procat-conservation.org.**

Obituary: Dorothea AUGUST

Conservationists are deeply saddened by the sudden passing away of Dorothea August on 11 January 2011. Her tragic and unexpected death at the age of 35 following complications after a viral infection is a big shock for everyone who knew her and who had the joy to collaborate with her.

In 2004 Dorothea graduated as an engineer in land-use planning, landscape conservation, nature protection and environmental development from Universität Hannover, Germany, focusing on the conservation status of the European Mink *Mustela lutreola* in her dissertation. Already before her studies and still afterwards she was a keen supporter of European Mink and Eurasian Otter *Lutra lutra* conservation, with an emphasis on wetlands in the Danube Delta and also elsewhere in Eastern and South-eastern Europe.

As of early 2005 Dorothea worked for the Ramsar Secretariat to provide assistance and advice to countries in Europe. Participants at Ramsar Conference of the Parties (CoP) 9 in Uganda may remember her as a particularly helpful soul at the CoP. In 2006, she organised the successful planning meeting for the Carpathian Wetland Initiative for Ramsar. In 2007 Dorothea started to work for WWF Germany's Freshwater Department as River Basin and Water Resources Management Officer. There she worked on a number of innovative projects across Europe, focussing on sustainable wetland and resources management, water stress mitigation and spatial planning, always keeping an eye on threat mitigation and supporting habitat needs for European Mink and Eurasian Otter. From her office in Frankfurt she managed a regional conservation project portfolio overseeing WWF Germany's investment in Madagascar and in the Mara river basin in East Africa. Dorothea always conducted her work in a very professional and holistic way, involving state actors as well as the local communities, the non-government sector and the scientific community. We will always remember Dorothea as a very dedicated, friendly, generous and enthusiastic person. Besides her work as a conservationist, she was committed to many other projects, including the provision of key support as founding member and liaison person to France for the '*Youth for Dora*' association within the memorial foundation for the survivors of a Second World War concentration camp close to her home town, and her family's horticulture business.

Dorothea will be sorely missed by her family, friends, colleagues and all those who knew her.

Roland MELISCH, TRAFFIC International and WWF Germany
Email: roland.melisch@wwf.de

Dorothea August during a recent work visit to Kenya (Photograph © WWF)

Collection of African Civet *Civettictis civetta* perineal gland secretion from naturally scent-marked sites

WONDMAGEGNE Daniel, AFEWORK Bekele, M. BALAKRISHNAN* and GURJA Belay

Abstract

Natural scent marking by African Civet *Civettictis civetta* was studied in three locations from the Jimma area, western Ethiopia. Scent-marks were found on 96 artefacts including trees, shrubs, bushes, electric and fencing poles, at a mean height of 31 cm above ground. Thirty-five percent of the scent-marked artefacts were located within 5 m of civetries. Each of the 13 sites where remarking was observed yielded a maximum of 0.4698 g/site and a minimum of 0.0092 g/site during the first collection and 0.1289 g and 0.0132 g, respectively, during subsequent collections. Re-marking was observed within five days after collection. The colour of the scent marks changed from whitish-yellow to dark-brown in a week. Non-invasive collection of perineal gland secretion in the wild, if properly managed, may be a sustainable alternative resource to African Civet farming.

Keywords: civet, civetry, perineal gland secretion, scent-mark, sustainable use

ማጠቃለያ

የዝባድ አቀባብ ዘዴ በጅማ አካባቢ ምሳራብ ኢትዮጳያ በሶስት የተለያዩ ቦታዎች ጥናት ተካሂዶ ነበር። ይህም የዝባድ ቅባት በ96 ቦታዎች ማለትም በዛፍ ግንድ፣ በቁራሮ፣ በኤሌክትሪክና አጥር ላይ ከመሬት ከፍታ 31 ሳ.ሜ. ተገኝቷል። 35 በመቶ ዝባድ የተቀቡበት ቁሳቁሶች የተገኙት ጥርኞቹ ከማጀዳደብት አካባቢ 5 ሜኙር በላይ ከማይርቅበት ቦታ ነበር። ከ13 ቅባቱ ከተገኝበት ቦታዎች ከመጀመሪያ ስብስብ ከ0.0092 እስከ 0.4698 ግራም ሲገኝ በቀጣዩ ደግሞ ከ0.0132 እስከ 0.1289 ግራም ተገኝቶ ነበር። ዝባድም ከተሰበሰበ በኃላ በአምስት ቀናት ወስጥ እንደገና መቀባት ችለው ነበር። የዝባዱም ከለር ከነጭማ ቢጫ ወደ ቡናማ ጥቁር በሳምንት ወስጥ ሊቀየር ችላል። እንስሳወን ሳይረብሹ ዝባዱን ከአካባቢ ቦታዎች መሰብሰብ በማባ ከተሠራበት ጥርኝን ከቤት ወስጥ አኑሮ ከማኝው ወጪ የተሻለ አማራጭ ሊሆን ይችላል።

ቁልፍ ቃላት፡ ጥርኝ፣ መቀዳጃ ቦታ፣ ዝባድ፣ መቀባት፣ ዘላቂ አጠቃቀም

Introduction

Most viverrids have perineal scent glands (Pocock 1915), which secrete a musky fluid used for marking territories. The scent, when the gland is rubbed on natural surfaces like those of trees and rocks, is recognised by conspecifics and is used in olfactory communication (Ralls 1971, Eisenberg & Kleimen 1972, Roeder 1980, Ray 1995). Terrestrial civets (Viverrinae), including African Civet *Civettictis civetta* (Schreber, 1776), have perineal glands that produce a fluid known as 'civet' (Kingdon 1997, Balakrishnan & Sreedevi 2007a, 2007b, Bekele Tsegaye *et al.* 2008). In this species, perineal glands are rubbed after raising the tail on diverse species of trees, shrubs, grass, dry logs, poles, and rocky surfaces (Randall 1977, 1979, Bekele Tsegaye *et al.* 2008). Even though, with the advent of synthetics, 'civet' collection is not nearly so prevalent as it used to be, in Ethiopia, African Civets are kept in captivity to collect the 'civet' at an average yield of about 3–4 g per animal per week during optimal conditions. Perineal gland secretions (i.e. 'civet') are collected from captive individuals, and later refined into a compound, civetone, used as a fixative in the perfume industry (Yilma D. Abebe 2003). Civetone is also produced from the perineal gland secretion of Small Indian Civet *Viverricula indica* (É. Geoffroy Saint-Hilaire, 1803) in China (Ding 1986) and India (Mohan 1994), among other countries.

In the absence of properly bred, captive populations, African Civets are regularly captured from the wild. Most die within the first three weeks of captivity, presumably from stress during capture, transport, and quarantine (FDRE-LSMA 2003). In Ethiopian farms, wild African Civets are usually confined to a cage of approximately 90 × 30 × 30 cm. They are also treated cruelly at the time of extraction of the glandular secretion and hence animal rights activists have severely criticised African Civet farming practices in Ethiopia (WSPA 2000).

In response to such criticisms, the Ethiopian Wildlife Conservation Authority has initiated programmes to improve African Civet farming by limiting the capture to male African Civets from the wild and providing nominal incentives to farmers through supply of cages at a subsidised rate. However, poor success in keeping captive African Civets alive suggests a better alternative might be to collect secretions themselves from wild settings, thus incurring no physical risk to the animals (Balakrishnan & Sreedevi 2007a, Bekele Tsegaye *et al.* 2008). The present investigation aimed to assess the possibility of collection of African Civet perineal gland secretion from scent-marked sites in their natural habitat.

Study area and methods

The investigation was carried out in the Jimma Zone (7°18′–8°56′N, 35°52′–37°37′E), Ethiopia, where African Civet has been traditionally farmed. Jimma town is surrounded by the districts of Mana in the north, Dedo in the south, Seka Cherkosa in the west, and Kerisa in the east. The land-use types of the Zone are approximately: 42% cultivated land (crops and coffee plantation), 25% forest, 12% grazing land, 4% reserve areas for cultivation, 14% for construction and related purposes, and 3% of wetlands (Anon. 2010).

Civets have specific defecation sites or latrines called 'civetries' that help confirm their presence in their habitats. Of 13 areas where latrines were found during preliminary observations, three villages, Kito (Bosa Kito), Beda Buna (Ankeso) and Jeran (Merewa or Kujo Muja) (Fig. 1), were selected for their representation of

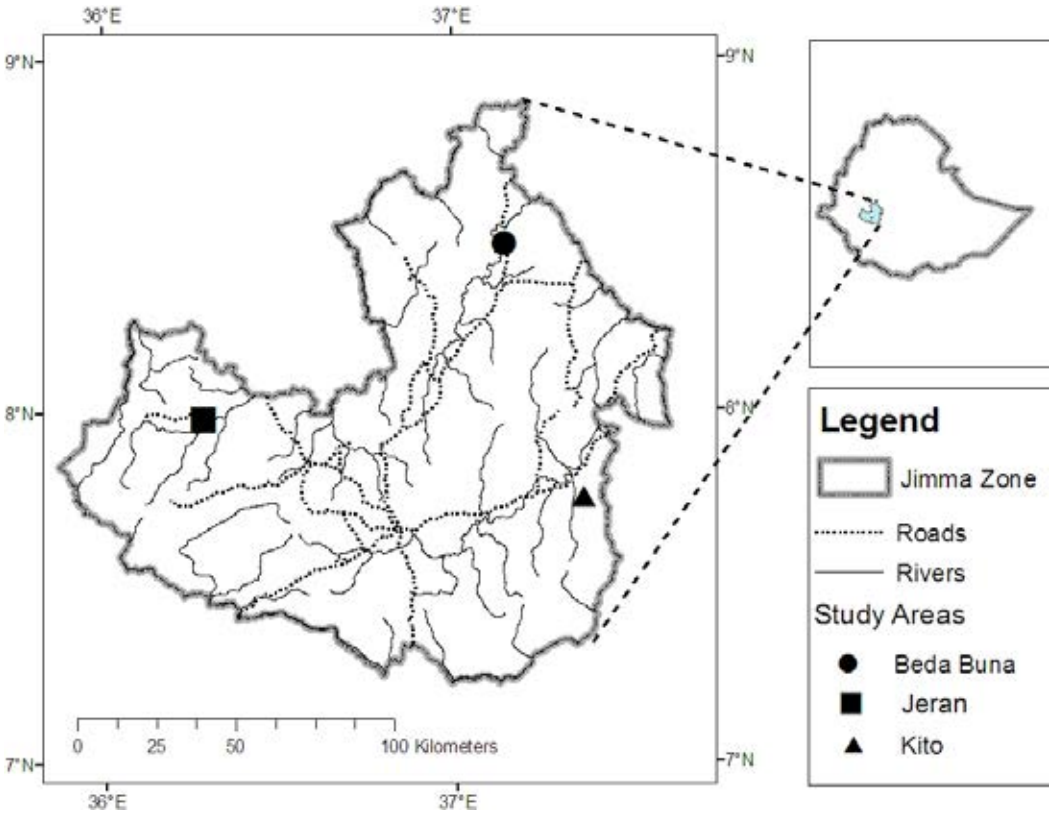

Fig. 1. Study area, showing locations of study sites.

diverse, human-encroached habitat types. Kito was close to human settlements, with *Eucalyptus globulus* plantations and sugarcane fields nearby. Beda Buna was dominated by coffee *Coffea arabica* plantations, but also had some natural forest nearby. The Addis Ababa – Jimma highway passes through this area. Jeran is a small farming village. In this area, most latrine sites were within farmland. The predominant crop types in the farm were maize *Zea mays*, sorghum *Sorghum vulgare*, and barley *Hordeum vulgare*.

Data were gathered between August 2005 and February 2006, involving 105 days of field observations. Every month, five days of field observations were made uniformly in each of the three study sites. Data were collected while walking through the roads and foot tracks, looking for African Civet latrines and scent marks. Objects with scent marks were counted. Identities of each object, height at the centre of each scent mark, and, for vegetation, girth at height of marking were recorded. Distance of scent-marked object from nearest latrine, distance of mark from nearest road or foot path, and general colour of the mark were recorded. Objects with scent-marks were numbered consecutively and the maximum available secretion was scraped out using a leaf blade without disturbing the marked site. The collected secretion was separately packed in a pre-weighed plastic sheet (6 × 6 cm). Each sample was weighed at a laboratory of Addis Ababa University using a digital balance. Sites were checked every day for at least 25 days during the field observation periods to know frequencies of scent-marking and re-marking.

To check for preference in object type for scent-marking, 20 quadrats of 5 × 5 m² were laid in different parts of the study area. All suitable objects in each quadrat were taken into account. Paired t-test analysis was carried out to check whether there was a difference in the quantity of 'civet' available on the scent-marked sites during the first and second markings. Data were treated under SPSS 14.0 (Levesque 2007).

Table 1. Height and girth of locations of different vegetation/ object in the Jimma study areas where African Civets Civettictis civetta *scent-marked.*

Plant/Object	Number of trees/plants scent-marked	Height (cm) Mean ± SD	Girth (cm) Mean ± SD
Eucalyptus globulus	60	31.87 ± 1.91	5.26 ± 4.80
Psidium guajava	7	29.43 ± 3.10	3.27 ± 1.58
Erythrina brucei	4	31.44 ± 2.47	11.08 ± 5.26
Solanum campylacanthum	7	31.89 ± 1.95	2.31 ± 0.85
Coffea arabica	12	31.86 ± 2.18	4.96 ± 2.66
Sorghum vulgare	2	30.00	4.00
Maytenus sp.	1	30.00	0.80
Electric pole	2	30.25	36.0
Vernonia amygdalina	1	30.00	2.30
Total/ Mean	96	31.00 ±1.41	5.66 ± 3.10

Results

African Civet scent-marks were found on a total of 96 trees, shrubs, bushes, and poles in the three study sites (Table 1). Scent-marks were most often found on natural surfaces around civetries, and along road-sides and foot paths. Scent markings were recorded at a mean height of 31.00 ± 1.85 cm (Fig. 2). Newly scent-marked sites with fresh glandular secretion were whitish-yellow, turning dark brown in a week. Marking heights on different species of trees/ vegetation did not show any statistically significant variation. The average girth of the vegetation where scent-marks were located

Fig. 2. A site of repeated scent-marking of African Civet Civettictis civetta *on a eucalyptus, Ethiopia.*

was 5.66 ± 3.10 cm. The lowest circumference at the marks was seen on *Maytenus* (0.8 cm) and the thickest was an electricity pole (45 cm). The circumference of marked objects showed wide variation.

The amount of secretion collectable from the sites varied from 0.0571 to 0.4715 g, but amount available on different types of objects showed no systematic variation. Nor did quantity of secretion available per marked site vary systematically with distance from civetry ($F = 5.706$, $df = 6$, $p > 0.05$; Table 2). Scent-marked objects were seen from <1–125 m distant from latrines. The highest percentage of scent-marking was observed close to civetries: within 5 m radius, 35% of suitable objects were scent-marked, but the quadrat 125 m away from any latrine had only 12.5% of suitable objects scent-marked (Table 3).

Interval of re-marking was not uniform. In all scent-marked locations whence 'civet' was collected and the animals re-marked, this occurred within five days. Among the 13 scent-marked locations with repeated collection of 'civet', the maximum and minimum available was 0.4698 g and 0.0092 g, at first collection, and 0.1289 g and 0.0132 g during subsequent collections (Fig. 3). The quantity of 'civet' available may have declined from the first to second collections (Table 4).

Table 2. Amount of perineal gland secretion of African Civet Civettictis civetta *collected from scent-marked objects in Jimma study areas in relation to the nearest latrine site, Ethiopia.*

Distance of marked sites from the latrine (m)	Number of samples	Secretion (g) Mean± SD
0–100	40	0.1244 ± 0.01
101–200	22	0.0925 ± 0.07
201–300	10	0.1104 ± 0.02
301–400	8	0.0653 ± 0.02
401–500	7	0.0849 ± 0.02
501–600	6	0.1015 ± 0.03
601–700	3	0.0942 ± 0.07

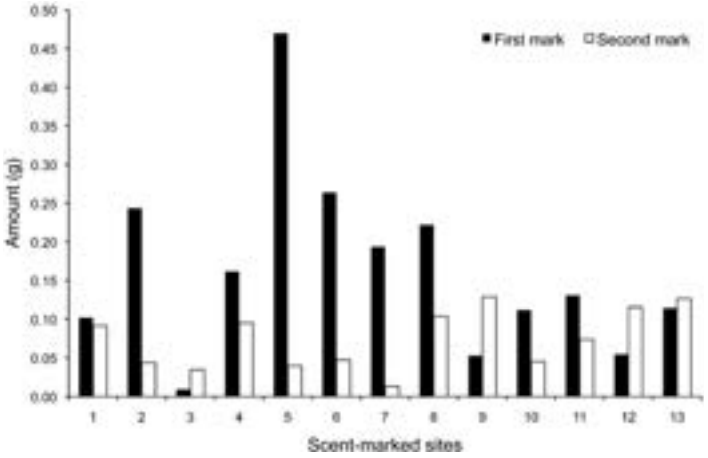

Fig. 3. Maximum quantity of perineal gland secretion of African Civets Civettictis civetta *available for collection on first and second collections from 13 scent-marked sites in Jimma area in Ethiopia.*

Table 3. Number of suitable objects for scent-marking in quadrats in Jimma study areas, Ethiopia, and proportion with observed scent-marks of African Civets Civettictis civetta *(quadrat size = 25 m²).*

Distance of quadrat from latrine site (m)	Number of suitable objects for scent-marking	Number of scent-marked objects	Percent of scent-marked objects
<10	20	7	35.00
20	4	1	25.00
25	6	2	33.33
30	15	3	20.00
70	14	2	14.28
80	15	3	20.00
90	22	3	13.63
125	8	1	12.50
300	0	0	0
600	13	0	0
750	21	0	0

Discussion

More scent marks were observed on *Eucalyptus globulus* than on any other trees in the study area, where there were a large number of coppices of the former species that might explain the greater number of scent-marking on this species. The smooth surfaces of

Table 4. Availability of 'civet' during the first vs second marking by African Civet, Ethiopia.

Variables	Samples	Mean (g)	Standard error	Standard deviation	95% Confidence Interval	
First marking	13	0.1638	0.0332	0.1199	0.0913	0.2362
Second marking	13	0.0738	0.0107	0.0387	0.0504	0.0972

the eucalypts might also facilitate active scent-marking in opposition to rougher surfaces of the barks of other trees, even though African Civets can scent-mark on trees with rougher barks (Bekele Tsegaye *et al*. 2008). Randall (1979) reported that African Civets scent mark at a significantly higher proportion on trees and shrubs from which they eat the fruits. The present findings show that they not only scent-mark fruit-bearing plants in the surroundings, but any suitable objects including non-fruit-bearing plants, and electric and fencing poles.

The height at which the scent-marks were laid denotes mostly the height of the posterior quarters of the animals, which might also give an indication about the approximate age of the individuals (Bekele Tsegaye *et al*. 2008) when marking on rigid artefacts. The range of the signal and the level of perception of the message are influenced by the height at which the signal is laid, since the latter can be easily perceived by conspecifics if the scent-marked sites are at or around the height of the nostrils (Müller-Schwarze 1983). Civets exhibited a tendency to scent-mark at higher frequencies on objects within 5 m of civetries, meeting with the fact that the species was reported to spend more time around civetries when active (Bekele Tsegaye 2006).

Out of the 96 scent-marks observed during the present investigation, only thirteen were found to be re-marked. The low rate of re-marking might reflect the long lasting nature of the odour (Eisenberg & Kleiman 1972). There were several scent-marks on objects on road-sides and on foot paths. As for many wild mammals, roads, foot paths, and animal tracks (Odendaal *et al.* 1980) might be the main foraging tracks of the civets. Areas close to human settlements also had several scent-marked sites. Out of the total scent-marked sites located during the present investigation, 74% were in Kito, where availability of food in natural habitat and human settlements was high.

The difference in the quantity of marked secretion available for collection might be linked to the age of the individual, since adult and more dominant individuals might secrete more than the young and subdominant ones (Eisenberg & Kleiman 1972). In many mammals, sign-posts are repeatedly scent-marked (Mykytowycz 1970). African Civet scent-marks sign-posts repeatedly, but the present investigation reveals only 13.5% of objects being remarked, when the marked secretion was collected from the site. Even though more objects around civetries were scent-marked, there was no systematic variation in the amount of secretion available on sign-posts in relation to the distance from the civetry. As the scent once marked persists for a long duration, re-marking is not essential over a short time-scale for the purpose of communication (Mykytowycz 1970, Ralls 1971).

Sexual dimorphism is well known in size, frequency and pattern of scent marking in various mammal species (Mykytowycz 1970, Ralls 1971, Eisenberg & Kleiman 1972, Adams 1980), with larger glands in males. However, this has not been observed in Small Indian Civet (Balakrishnan 2002). Ethiopian owners of African Civets expect more secretion from the males (Bekele Tsegaye unpublished) and hence they are interested to keep only males in their farms. Wild scent-marked sites cannot be discriminated into that of males and females, and hence to evaluate this belief, a detailed experimental study would be required.

The present investigation suggests the feasibility of collection of civet gland secretion from the wild. Even though there may be a drop in amount of secretion available between first and second marking, it was possible to collect the scent-marked secretion from scent-marked sites. Trained local people could collect this resource; such sustainable use might be a good source of foreign exchange for Ethiopia, and support the livelihood of local people. At present, there is only one African Civet farm with government license as per the records of the Oromia Forest & Wildlife Enterprise, which is the Ethiopian government authority to issue license for such farming. However, there are not less than 200 unauthorised African Civet farms in Ethiopia (Bekele Tsegaye unpublished). As African Civet farming and extraction processes in Ethiopia are under severe ethical criticism (WSPA 2000), it is essential to develop techniques of extraction of the gland secretion without maintaining African Civets in deplorable captive conditions. In response to such criticism, the Ethiopian Wildlife Conservation Authority ordered that only males be held captive. This will not help to improve the situation in relation to captive conditions, for which civets need to be maintained in semi-natural enclosures (see Balakrishnan & Sreedevi 2007a, 2007b), providing an appropriate place to breed and to collect the 'civet' without harming animals.

The present investigation supports the earlier view (Bekele Tsegaye *et al*. 2008) that gland secretion might be collected from the wild with minimal disturbance to African Civets in their natural habitat and there is no need to keep them captive for the 'civet' business to run effectively. It remains essential to study behaviour of African Civets, so as to fix the frequency of the collection of 'civet' from the wild as not to disrupt civet behaviour. In a recent study on River Otters *Lontra canadensis*, Oldham & Black (2009) showed that the response of otters to the removal of scent marks was no longer significantly different from the baseline values by the third day, even though there was a 9-fold increase in urine marking and a 5-fold increase in the number of scat-jellies on the first day. A similar study on free-living African Civets could be made to evaluate their behavioural response to the removal of scent marks from the marked environmental sign-posts. Individuals already running African Civet farms can be incorporated and trained in collection of the glandular secretion from the wild. To increase in-country benefit, the secretion can also be processed and civetone can be extracted in the country itself before its export.

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Department of Biology, Addis Ababa University,
P.O. Box 1176, Addis Ababa, Ethiopia.
***Corresponding author email: balak212@yahoo.com**

Behaviour of the Tayra *Eira barbara* near Medellín, Colombia: preliminary data from a video-capturing survey

Carlos A. DELGADO-V.[1], Andrés ÁRIAS-ALZATE[2], Sebastián BOTERO[2] and Juan D. SÁNCHEZ-LONDOÑO[2]

Abstract

Based on 11 video clips (234 seconds total duration) obtained with an effort of 994 camera-trap-days, we describe some natural history observations of the Tayra *Eira barbara* in a small reserve about 30 km southeast of Medellín, the second largest urban centre in Colombia. Territory marking, foraging in pairs, defecating, and escape behaviours were detected. We also estimated daily activity pattern using video footage. This conservative approach allowed us to suggest that *E. barbara* exhibits two activity peaks, one around midday (13–15h) and one just before evening (17–18h); also, a weak peak of activity was observed in the morning (07–09h). We encourage the use of long-term automatic video-trapping instead of still image trapping in order to acquire more detailed natural history and behaviour observations.

Keywords: automatic cameras, daily activity pattern, natural history, peri-urban habitat, video-trapping

Comportamiento de la Taira *Eira barbara* cerca a Medellín, Colombia: datos preliminares de un estudio de video trampeo

Resumen

Con base en 11 video clips (234 segundos en total) obtenidos con un esfuerzo de 994 trampas-cámara/día, describimos algunos aspectos de la historia natural de la Tayra *Eira barbara* en una pequeña reserva situada a aproximadamente 30 kilómetros al sureste de Medellín, segundo centro urbano más grande de Colombia. Marcado de territorio, forrajeo en parejas, defecar y comportamiento de escape fueron algunos de los aspectos registrados en nuestras trampas-cámara. Así mismo, estimamos de forma preliminar el patrón de actividad diaria utilizando como parámetro el número de videos obtenidos. Este enfoque nos permite sugerir que *E. barbara* en el área de estudio presenta principalmente dos picos de actividad, uno al medio día (13–15 h) y uno justo antes del anochecer (17–18 h). Igualmente, se observó otro pico corto de actividad en la mañana (07–09 h). En este sentido promovemos el uso a largo plazo de las video-capturas, en lugar de sólo la captura de imágenes fijas, con el fin de obtener más detalles de historia natural.

Palabras clave: patrón de actividad diaria, hábitat periurbano, Historia Natural, video captura, cámaras automáticas

Introduction

Little information has been published on the natural history of small and medium-sized Neotropical carnivores (e.g. Kaufmann & Kaufmann 1965, Schipper 2007). Although natural history studies of small carnivores are of valuable importance for their conservation and management, numerous facets of their behaviour in nature remain unknown, especially in areas with heavy direct human influence such as reserves surrounding urban centres (see Pedó *et al*. 2006).

Despite Tayra *Eira barbara* being among the most common medium-sized predators in the Neotropics (Emmons & Feer 1997), it is one of the least-known carnivores close to Medellín, one of the main urban centres in Colombia with growing levels of deforestation and urbanisation in its surroundings (Delgado-V. 2007).

Crab-eating Fox *Cerdocyon thous* has recently been studied in locations surrounding the city (Delgado-V. 2002), but limited attention has been given to other families such as procyonids and mustelids. We describe some natural history aspects of the Tayra *Eira barbara*, which was videotaped using automatic cameras in one of the reserves with high biodiversity surrounding Medellín (Delgado-V. 2009).

Methods

Study Site

Reserva Ecológica San Sebastián-La Castellana (about 30 km southeast of Medellín city; 6°06′N, 75°33′W), comprises approximately 200 ha and is located in the municipality of El Retiro (Departamento de Antioquia, Central Mountain Range) from 2,500 to 2,800 m asl; it has an average temperature of 16.7 °C, relative humidity of 75.5%, and annual rainfall of 2,280 mm. A preliminary floral inventory documented disturbed primary forest as the principal cover in this zone and the dominant tree species includes *Quercus humboldtii* (Fagaceae), *Schefflera arborea* (Araliaceae), *Ilex laurina* (Aquifoliaceae), *Weimannia balbisiana* (Cunnoniaceae) and *Hyeronima antioquensis* (Euphorbiaceae) (Delgado-V. 2002). Interspersed within this vegetation mosaic are homogeneous patches supporting dense bamboo thickets of *Chusquea* (Gramineae) and some exotic plantations of *Pinus patula* (Pinaceae) (Delgado-V. 2002). One main trail (1–2 m wide, from 2,500 to 2,800 m in altitude) crosses the reserve and is used for bird watching, hiking, and downhill and mountain biking.

Video-trapping and analyses

The automatic video cameras used were Bushnell Infrared and Motion Activated Trophy Cam with the following settings: 5MP

high-quality full colour resolution, day/night auto-sensor, programmable trigger interval of 1–2 sec, 1 image per trigger and 60 sec video length. One to three automatic cameras (one camera per station) were used from December 2009 to February 2011 (one camera from 11 December 2009 to 11 April 2010, two from 12 April 2010 to 9 May 2010, and three from 10 May 2010 to 7 February 2011) comprising a total effort of 994 video camera-days. Cameras were set parallel to the main trail (3–5 m apart) in secondary native forest. Bananas and sardines were used as bait.

Results presented are part of the urban nature initiative called aburranatural.org, where scientists and naturalists compile, publish and diffuse (through the Web) natural history and biodiversity information of the Valle de Aburrá and San Nicolás regions where the reserve is located. The objective of the project is to provide many video clips of the reserve's fauna to promote conservation of the region's biodiversity and raise awareness of the fauna still present near an important urban area. No protocol was followed to standardise the camera placement, and only few video clips were obtained, so other analyses sometimes seen in studies using camera-traps (e.g. Kuijper *et al*. 2009) were not performed.

Results and discussion

Eleven video clips (234 sec total) of at least two different individual Tayras (according to form and placement of the yellow back spot) were captured. Each video was considered an independent occasion, except for three obtained on 30 May 2010 which were consecutive (1–2 min apart) and the same individual was captured by the same camera (see Marking section below).

Behaviour

Four behaviours that merit comments are summarised below. Date, time of day, description and approximate duration are provided.

Marking: three consecutive videos were captured on 30 May 2010 at 14h57, 14h59, and 15h00 about 1 m from the defecation site of another individual (see below). Neck, cheeks, throat and upper back were rubbed firmly (90 sec total) against an exposed root segment on the forest floor. Occasionally, the individual seemed to lick the root gently.

Defecating: this was the second most frequently filmed behaviour, occurring twice on the same spot. The same individual (a male) defecated at the same site on 13 (at 13h46) and 15 May 2010 (at 14h16) for two and one second, respectively. On both occasions the Tayra ran from the place once it finished defecating. Defecating at the same site suggests Tayras may defecate for territorial marking.

Escape: while rubbing on the root (see Marking section, above) the Tayra was disturbed by something not detected in the video on 20 May 2010 at 15h00. The Tayra shook its body and then rapidly climbed up the tree it was standing next to. It remained in the canopy for 15 sec, and then it climbed down (descended vertically head first) and ran away.

Foraging in pairs: A single video (18 sec) was obtained on 8 October 2010 at 17h07. One individual was roaming behind the other. Both ate the banana bait and kept sniffing around the site before continuing on their way.

Activity patterns

Morning peak: A single video clip was obtained on 24 May 2010 at 08h34.

Midday peak: Six video clips were obtained between 11h and 15h: one each day on 13 and 15 May 2010, and 27 January 2011, and three consecutive videos (considered same event) of the same individual on 30 May 2010 at 14h57, 14h59 and 15h00.

Afternoon peak: Four videos were obtained, on 24 May 2010, 27 August 2010, 8 October 2010 and 4 February 2011, between 17h00 and 18h00.

Some behaviours reported herein, such as two adults travelling together and tree climbing, were also reported from a study in a Belizean rain forest (Konecny 1989) and in the general overview of Emmons & Feer (1990). However, other literature describes the species as mainly solitary (e.g. Presley 2000).

Tayras exhibited diurnal activities at our study site with most activity in the afternoon. Although our data are too few to make a strong conclusion, they are congruent with previous observations about the daily activity patterns recorded in other Neotropical regions (Konecny 1989, Emmons & Feer 1990, González-Maya *et al.* 2009).

Our experience using Bushnell trophy cameras suggests that video-trapping versus still image capturing offers the possibility of recording data of an observed behaviour more completely than with still cameras. For example, our cameras running in still image mode would probably have not documented some fast Tayra behaviours observed here (e.g. defecation; climbing up and down), had they been performed during trigger time or the gap between pictures. In agreement with others (e.g. Bridges & Noss 2011), video trapping has the potential of offering new data about aspects of natural history and behaviour.

Several types of information have been collected from automatic camera surveys in still image mode, including patterns of relative abundance, density, distribution, habitat use and activity, all of which could be quantitatively analysed (Jiménez *et al.* 2010). However, video-trapping probably has the potential of studying not just these mentioned parameters (although new analytical advances should be developed) but also valuable natural history data which provide more qualitative evaluation and appreciation not just for scientific proposal, but also for promulgation and education (Kays *et al.* 2009).

Video-trapping offers the possibility to record continuous movements of a behaviour with almost no interruption. Picture trapping experiences a more frequent lag between detection and recording as well as delays due to trigger time (at least on the model we used). Both still image capturing and video-trapping have allowed us to inventory mammal and bird species in Valle de Aburrá during our experience with aburranatural.org, but natural history data of some vertebrates have exclusively been recorded (or more easily identified and detected) by video recording. Moreover, notes on the Aburrá-Natural web-page are often more commented by readers and shared with others when videos (instead of pictures) are included (Delgado-V. *et al.* unpublished data).

Although new analytical advances should be developed in order to increase its use in the future (Kays *et al.* 2009), we promote the use of long-term automatic video-trapping versus still image capturing if acquiring basic natural history information is the main goal of a project. Still pictures offer accurate species identification (Meirelles *et al.* 2008) but they could be pieces of a natural history puzzle more difficult to analyse, describe, and disclose. In this sense, as we obtain more natural history data, we can better supplement management and conservation plans for Tayras and other species occurring not only in natural ecosystems but also in those ecosystems surrounding urban centres.

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[1]Institute for Conservation Biology and Environmental Management, School of Biological Sciences, University of Wollongong, Wollongong, NSW 2522, Australia.
Email: cadv943@uowmail.edu.au
[2]Grupo de Mastozoología CTUA, Instituto de Biología, Universidad de Antioquia, Medellín, Colombia.

Records of Spotted Linsang *Prionodon pardicolor* from Thap Lan and Pang Sida National Parks, Thailand

T. REDFORD[1], S. BANPOT[2], C. PADUNGPONG[3] and T. BIDAYABHA[4]

Abstract

Spotted Linsang *Prionodon pardicolor* was recorded twice in Thap Lan National Park, Thailand, in 2008 and twice in Pang Sida National Park, Thailand, in 2011. These records represent a significant south-eastern extension of known range in Thailand, but are consistent with the species's recent discovery in the Cardamom mountains of Cambodia.

Keywords: Cardamom mountains, distribution, range extension, poaching

บันทึกการพบ ชะมดแปลงลายจุด *Prionodon pardicolor* จากอุทยานแห่งชาติทับลาน และอุทยานแห่งชาติปางสีดา ประเทศไทย

บทคัดย่อ

ในประเทศไทยมีการบันทึกว่า พบชะมดแปลงลายจุด สองครั้งในอุทยานแห่งชาติทับลาน เมื่อปีพ.ศ. 2551 และในอุทยานแห่งชาติปางสีดา เมื่อปีพ.ศ. 2554 ซึ่งจากหลักฐานการพบเหล่านี้แสดงให้เห็นว่าในประเทศไทย สัตว์ชนิดนี้มีขอบเขตถิ่นอาศัยขยายเพิ่มจากเดิมลงมาด้านตะวันออกเฉียงใต้อย่างมีนัยสำคัญ แต่ทั้งนี้ก็มีความสอดคลองกับการค้นพบสัตว์ชนิดนี้ในบริเวณ เทือกเขากระวาน ในประเทศกัมพูชา

คำสำคัญ: การแพร่กระจาย, การเพิ่มขยายจากถิ่นอาศัยเดิม, ถิ่นที่อยู่อาศัย, การล่า

There are few published records of Spotted Linsang *Prionodon pardicolor* from Thailand, reflecting a statement in the IUCN/SSC action plan for mustelids and viverrids (Schreiber *et al*. 1989: 9) that "the Spotted Linsang is one of several tropical species which, in spite of a large range, remains virtually unknown and could disappear without anybody noticing". From across its range (the eastern Himalayas, southern China and northeast India: Corbet & Hill 1992) there are relatively few historical specimens, leading to a wide perception that it is rare, including by Lekagul & McNeely (1977) for Thailand. Recent surveys in parts of its range, such as southern China (Lau *et al*. 2010), suggest that the paucity of records more reflects difficulty of finding the species rather than genuine rarity, and the species is currently listed on the *IUCN Red List of Threatened Species* (IUCN 2010) as Least Concern. However, further records are required to allow more informed judgement.

This note documents two records of Spotted Linsang from Thap Lan National Park (NP) and two more from Pang Sida NP, gathered during general wildlife survey in the protected areas with a focus on reducing illegal hunting and wildlife trade. The first record came from a Camtrakker camera-trap film photograph collected in Thap Lan NP, located in moist evergreen forest at 14°16′18.18″N, 102°16′01.41″E, recorded altitude (from GPS) 561 m, on 15 April 2008 at 22h20 (Fig. 1; the development of film resulted in over-prominence of orange tones). This is the only such record in two years of continuous camera-trapping (8,475 camera-trap-nights) in the park. Ongoing carnivore monitoring surveys are implemented across Thap Lan NP in collaboration with park management, to assess carnivore distribution in each

Fig. 1. Spotted Linsang Prionodon pardicolor *camera-trapped in Thap Lan National Park, Thailand, on 15 April 2008.*

management zone. To gain a broad overview, cameras are checked and moved on a 30-day cycle and placed along transects with a minimum separation of 1 km. During the session the Spotted Linsang was recorded, no bait was used with the camera-traps.

Subsequently, the remains of a Spotted Linsang were confiscated on 28 May 2008 at 14°12′15.17″N, 102°12′35.73″E. Its tail had been removed, but retained, prior to the remainder of its body being semi-smoked to preserve it for later personal consumption. The five suspects were apprehended in the forest in possession of the poached wildlife and weapons. Spotlighting and using home-made muzzle-loading guns is local poachers' preferred method of hunting, except when longer forays are made, such as during aloeswood/agarwood *Aquilaria crassana* collection, when small snares are set for galliforms such as Red Junglefowl *Gallus gallus*. Other wildlife in this same haul included two medium-sized civets—perhaps Large Indian Civets *Viverra zibetha*, because these have been recorded in camera-traps in the area—skinned and smoked, one juvenile Pileated Gibbon *Hylobates pileatus*, and two Water Monitors *Varanus salvator*, all confiscated (Fig. 2). This poached Spotted Linsang can safely be assumed to come from the same area as the arrest site (Lam Praeng, in management zone 3), just 9 km from where the camera-trap photo was taken.

The two records from Pang Sida NP came from the same camera location, the first on 10 February 2011 at 05h30 and the second on 20 February 2011 at 20h08 (Fig. 3), using a 5 megapixel Moultrie™ Game Spy D50 digital camera-trap set on a well-used animal trail and with no bait or lure. The evergreen forest in this location (14°07′20.7″N, 102°15′18.7″E) at altitude (from GPS) 564 m is approximately 16 km directly south of, and contiguous with, the sites where Spotted Linsang was recorded in Thap Lan NP. The area falls under the responsibility of Pang Sida NP's Huay Nam Yen sub-station.

It seems that these two Pang Sida records represent one individual: the animal's pelage in each photograph shows similar patterning. These two records are the product of just two months' camera-trapping (1,607 overall camera-trap-nights with 72 at this one location) in Pang Sida NP.

The only previous Thai records published or in international collections seem to be: one at the United States National Museum of Natural History, Washington DC, U.S.A. (NMNH 308234) from Khar village #9, Ban Muang, Loei province, collected in August 1958; one at the Thailand Institute of Scientific and Technological Research, Bangkok, lacking collection locality or date but acquired in 1973; and a field sighting of one around the headquarters of Doi Inthanon NP, Chiang Mai province (about 18°32′N, 98°32′E) on 8 December 1995 (Tizard 2002). In addition, Nabhitabhata & Chan-ard (2005) reported presence, without details of the records, in Lum Nam Pi (Mae Hong Son province) and Phu Ka (Nan province).

These records from Thap Lan NP therefore represent a considerable southerly extension of range for the species within Thailand, that from Loei province (about 17°N, depending on where the precise site lies) being the southernmost previous Thai record. Presence in Thap Lan NP does, however, accord with the two records (both recent) from the Cardamom mountains of Cambodia: in possession of a hunter in semi-evergreen forest (thus, altitude of capture not known), and in primary evergreen forest at 1,200 m (Kong & Tan 2002, Holden & Neang 2009). These come from even further to the south-east, globally, than lie these two Thai national parks.

Just west of Thap Lan NP lies Khao Yai NP, which has supported among the highest levels of both formal survey and leisure wildlife-watching of any South-east Asian site without, apparently, finding the species. In Khao Yai NP, high levels of camera-trapping spread over many years and various sites have been conducted (Austin & Tewes 1999, Lynam *et al*. 2006, Suzuki *et al*. 2006; and 6,253 camera-trap-nights during October 2003 – March 2007; K. Jenks *in litt*. 2010). Much of this was, however, aimed at larger carnivores, specifically Tiger *Panthera tigris* and Clouded Leopard *Neofelis nebulosa*, and the extent to which linsangs might best be detected with different specific methodology is unknown. The moist evergreen forest in which the Thap Lan NP and Pang Sida NP animals were camera-trapped is better represented as a habitat in Khao Yai NP, and there seems no obvious reason why Spotted Linsang would not also inhabit Khao Yai NP. Whether the lack of records from Khao Yai NP reflects genuine scarcity or absence, or that optimal techniques have not yet been used intensively enough there, is difficult to tell. Similarly, the

Fig. 2. Poached Spotted Linsang Prionodon pardicolor, and other wildlife, photographed in Thap Lan National Park, Thailand, on 28 May 2008.

Fig. 3. Spotted Linsang Prionodon pardicolor camera-trapped in Pang Sida National Park, Thailand, on 20 February 2011.

species's true conservation status in Thailand remains to be clarified.

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[1]Training Coordinator, FREELAND Foundation, 591 UBC II Bldg., 10th Fl., Room 1001, Sukhumvit Soi 33, North Klongton, Wattana, Bangkok 10110, Thailand.
Email: tim@freeland.org
[2]Superintendent, Thap Lan National Park, 520 Moo 1, Buphram District, Nadee, Prachinburi 25220, Thailand.
Email: thaplannp@hotmail.com
Present address: Senior Forestry Officer, World Heritage Office, Office of Conservation Area 1 (Prachinburi), 498/1 Road, T. Na Muang Na Muang, Prachinburi 25000, Thailand.
[3]Superintendent, Pang Sida National Park, P.O. Box 55, Tayak Sub-district, Amphur Muang Sa Kaeo, Sakaeo 27000, Thailand.
Email: pangsida@live.com
[4]Project Field Coordinator, FREELAND Foundation, 591 UBC II Bldg., 10th Fl., Room 1001, Sukhumvit Soi 33, North Klongton, Wattana, Bangkok 10110, Thailand.
Email: thattaya@freeland.org

First sighting of the Giant Genet *Genetta victoriae* in Rwanda

Vladimir DINETS

Abstract

A large genet photographed in 2005 in Nyungwe National Park, Rwanda, was identified as a Giant Genet *Genetta victoriae*, previously known with certainty only from the Democratic Republic of Congo and the adjacent part of Uganda and never before photographed in the wild.

Keywords: montane rainforest, Nyungwe National Park, spotlighting, Viverridae

Première observation de la Genette Géante *Genetta victoriae* au Rwanda

Résumé

Une genette de grande taille photographiée en 2005 dans le Parc National de Nyungwe au Rwanda, est identifiée comme représentant la Genette Géante *Genetta victoriae* ; cette espèce n'était connue que de la République Démocratique du Congo et de la partie limitrophe de l'Ouganda, et n'avait jamais été photographiée dans la nature.

Mots clés: forêt ombrophile de montagne, Parc National de Nyungwe, spotlighting, Viverridae

Giant Genet *Genetta victoriae* Thomas, 1901 is an enigmatic carnivoran species, currently known with certainty only from northern and eastern parts of the Democratic Republic of Congo (DRC), where it inhabits lowland and montane rainforests up to 2,000 m (Van Rompaey *et al*. 2008). It has been predicted to occur in Rwanda and Uganda, but there are no confirmed observations or museum specimens from outside DRC (Gaubert *et al*. 2006), except in Semiliki Forest in Uganda on the border with DRC (Bere 1962).

A captive specimen has been photographed by Rahm (1966), but there are no photos obtained in the wild, and no published information on wild animals, except for observations by Kingdon (1977) in Uganda, which appear questionable (Schreiber *et al*. 1989).

At 02h10 on 10 July 2005, a large genet was located by spotlighting in montane rainforest in Nyungwe National Park, Rwanda (2°29′S, 29°17′E), at the altitude of approximately 1,800 m. The animal was first observed on the ground, but it immediately climbed a tree, where it was photographed (Fig. 1). Then it jumped to another tree, returned to the ground and disappeared from view. Attempts to re-locate it on two subsequent nights were unsuccessful.

Colour patterns of dorsal pelage and feet were not clearly seen, but the thick, black-tipped tail with 6–7 narrow white rings indicates that this animal was most likely a Giant Genet *Genetta victoriae*. Other details, such as small lateral spots, a black line below the chin, and large ears, are consistent with this identification (see Gaubert *et al*. 2008). Four other genet species are known from the region (Gaubert *et al*. 2005). However, the tail of Aquatic Genet *G. piscivora* has no rings; the tail of Common Genet *G. genetta* has 8–9 broad bright rings and a bright tip; the tail of Rusty-spotted Genet *G. maculata* is thin, with 6–9 broad bright rings; the tail of Servaline Genet *G. servalina* is thin, with 9–11 bright rings and a bright tip (Gaubert *et al*. 2008).

Although there is a museum specimen of Giant Genet from a location in DRC (Kahuzi-Biéga National Park: 2°22′S, 28°45′E; Gaubert *et al*. 2006), which is less than 50 km from Nyungwe National Park, the photo provides the first documentation of this species's occurrence in Rwanda. This is a positive development for the species's conservation. Giant Genet is classified as a species of Least Concern by *The IUCN Red List of Threatened Species* (Van Rompaey *et al*. 2008), and is known or expected to occur in a few protected areas in DRC (Gaubert *et al*. 2006), but Nyungwe National Park currently offers better protection than any protected areas in DRC (Hart & Jefferson 1996, Plumptre *et al.* 2002), where all genets are hunted for bushmeat and skins (Colyn *et al*. 1987).

Fig. 1. Giant Genet Genetta victoriae *in Nyungwe National Park, Rwanda, 10 July 2005.*

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294 Cox Science Center, University of Miami, Coral Gables, FL 33146, U.S.A.
Email: dinets@gmail.com.

A market record of Owston's Civet *Chrotogale owstoni* from Lao PDR, west of the known range

Kongkeo SIVILAY[1], Thipphaphone ANOUVONG[1] and C. D. HALLAM[2]

Abstract

An Owston's Civet *Chrotogale owstoni* photographed for sale at a roadside wildlife meat stall in Vientiane province, Lao PDR, at 18°44′09″N, 102°58′03″E in 2009 suggests occurrence west of the known world range. Historical Lao records come from only one locality; recently animals have been seen captive at one site in the country and camera-trapped in three others.

Keywords: Distribution, locality record, range extension, wildlife meat trade

ບັນຊີການພົບເຫັນຕາມທ້ອງຕະຫຼາດ ຂອງເຫັງນລາຍເສືອໂຄ່ງອິນດູຈີນ (Owston's Civet *Chrotogale owstoni*) ໃນ ສປປ ລາວ, ໃນນອກເຂດທາງເບື້ອງຕາເວັນຕົກຂອງຖິ່ນອາໃສເຊິ່ງເປັນທີ່ຮູ້ຈັກ

ບົດຂັດຫຍໍ້

ເຫັງນລາຍເສືອໂຄ່ງອິນດູຈີນ *Chotogale owstoni* ໄດ້ຖືກພົບເຫັນ ແລະ ບັນທຶກພາບ ໃນປີ 2009 ທີ່ຮ້ານຂາຍຊີ້ນສັດປ່າ ແຫ່ງໜຶ່ງລຽບແຄມທາງ (18°44'09"N, 102°58'03''E) ໃນແຂວງວຽງຈັນ ສປປ ລາວ. ການພົບເຫັນຄັ້ງນີ້ສະແດງໃຫ້ເຫັນເຖິງວ່າ ສັດຊະນິດນີ້ມີຢູ່ໃນນອກເຂດທາງເບື້ອງຕາເວັນຕົກ ຂອງຖິ່ນອາໃສເຊິ່ງເປັນທີ່ຮູ້ຈັກ. ບັນຊີເກົ່າຂອງການພັບເຫັນສັດຊະນິດນີ້ແມ່ນໄດ້ມາຈາກພຽງແຕ່ທ້ອງຖິ່ນດຽວ. ໃນເມື່ອບໍ່ດົນມານີ້, ເຫງັນຊະນິດນີ້ ໄດ້ຖືກພົບເຫັນກັກຂັງເປັນສັດລ້ຽງ ໃນພື້ນທີ່ແຫ່ງໜຶ່ງ ແລະຖືກບັນທຶກພາບໄດ້ໃນອີກ 3 ແຫ່ງອື່ນໆພາຍໃນປະເທດ.

ຄຳສັບຫຼັກ: ການກະຈາຍ, ເຂດຂະຫຍາຍຂອງຖິ່ນອາໃສທີ່ເປັນທີ່ຮູ້ຈັກ, ບັນຊີພົບເຫັນຂັ້ນທອ້ງຖິ່ນ, ການຄ້າຂາຍຊີ້ນສັດປ່າ

On 1 May 2009, an Owston's Civet *Chrotogale owstoni* was photographed at a roadside stall selling wildlife products to passers-by by David Green (Project Implementation Department Manager, Phu Bia Mining Limited), during routine work travel (Fig. 1). The stall was near Ban Muanglong, Vientiane province (18°44′09″N, 102°58′03″E). Also visible in the photograph is a chevrotain *Tragulus* and a large, long-tailed, rat. The Owston's Civet was freshly killed, apparently by gunshot. The road runs through rural northern Lao PDR and presently carries many vehicles per day, mostly between the Phu Bia Mining area and route 13 south from Vientiane. No discussion was held with the trader on the origin of the animal, but it is unlikely that it had been brought any significant distance by road for sale at this stall. Such stalls are common beside main roads in Lao PDR, and there is therefore no reason to transport relatively low-value animals long distances. Although no price for this animal was recorded, that it was hanging openly for sale indicates that it was seen as of no special value. High-value species (which would be worth transporting long distances to likely sales points) are rarely on open display nowadays. However, it cannot be ruled out that it had come, through some chance factor, from a longer distance than expected. The locality should not be considered to hold Owston's Civet, pending further records.

The sale point lies in an extensive landscape of forested hills (ranging from 300 m to over 2,000 m altitude), subject to widespread, heavy, shifting cultivation for many decades at least. Little old-growth forest survives. It is effectively unsurveyed for wildlife. Until recently remote, roads are being newly cut and upgraded from tracks widely in this region, in connexion with various large activities such as hydroelectric power development and mining. The site of sale lies only 24 km north of the boundary of the 1,390 km² Phou Khaokhoay National Protected Area (NPA), a forested massif so far only superficially surveyed for mammals, despite its proximity to Vientiane (Evans *et al*. 2000).

Owston's Civet occurs only in Lao PDR, Vietnam, and adjacent parts of China, and was identified as a high conservation priority in the 1989 *IUCN/SSC Action Plan for Mustelids and Viverrids* (Schreiber *et al*. 1989). It is internationally red-listed as Globally Threatened – Vulnerable (IUCN 2009). There are few records from Lao PDR (Fig. 2). The only historical information is from (Ban) Xiangkhouang (19°20′N, 103°22′E), where one was collected and a locally prepared pelt was procured between 15 December 1925 and 13 January 1926 (Thomas 1927). In the 1990s many captives were held in Ban Lak-20 (= Ban Lak Xao; 18°11′N 104°58′E) (Duckworth *et al*. 1999, King 2002a, 2002b). In the 2000s there were camera-trap records from Nakai–Nam Theun NPA (many; Johnson & Johnston 2007) and Nam Et–Phou Louey NPA (one; Johnson *et al*. 2009). All these areas support evergreen forest with a relatively benign dry season. It is likely that areas with similar climate and pre-clearance forest type occur around the Ban Muanglong sale point.

A recent camera-trap record (IEWMP 2010) from January 2010 in the Phou Chomvoy Provincial Protected Area, Bolikhamxai province, is the first confirmed record of the species from that pro-

Fig. 1. Freshly killed Owston's Civet Chrotogale owstoni *for sale at a roadside stall, Ban Muanglong, Lao PDR, 1 May 2009 (Photo: David Green / Phou Bia Mining Limited).*

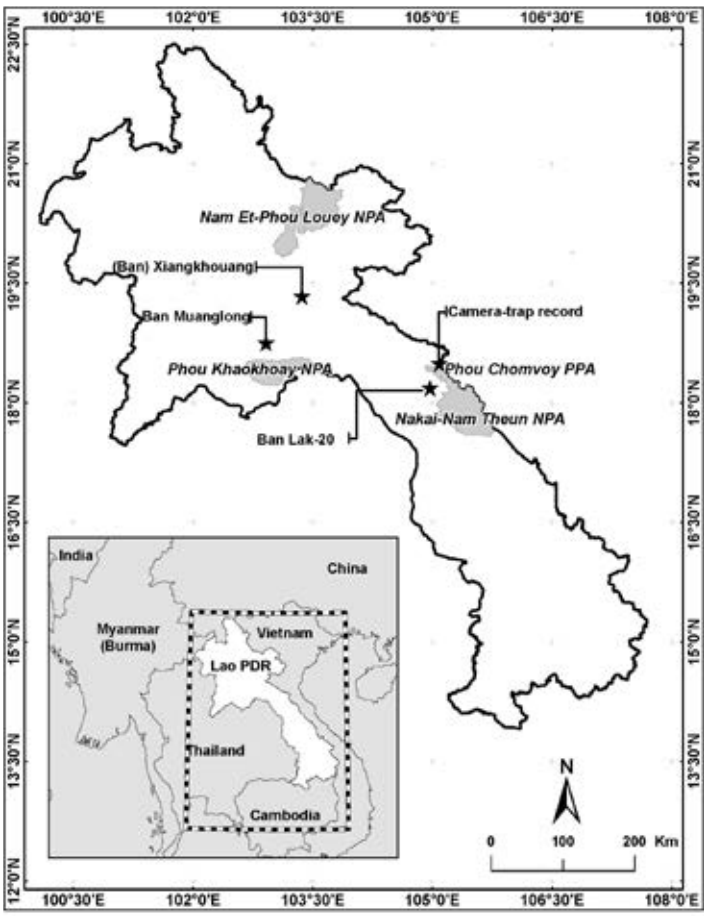

Fig. 2. Lao PDR, showing sites and protected areas mentioned in the text. Owston's Civet records come from all except Phou Khaokhoay NPA.

tected area, which also lacks a harsh dry season. The photograph was taken at 18°29′20″N, 105°05′12″E at an altitude of approximately 1,100 m a.s.l. on the northern border of the protected area. The point is around 1.3 km from a heavily degraded road that is accessible by hand-tractor but not pick-up; it is around 7.5 km from the nearest village and around 2.5 km from the Vietnam border.

Overall, the species's distribution and status in Lao PDR remains poorly understood, because methods suitable to locate it, spotlighting and camera-trapping, have been used to sufficient intensity in few places in the northern highlands or in the Annamites, the mountains forming much of the boundary between Lao PDR and Vietnam. Extensive spotlighting in the southern two-thirds of the country in the 1990s failed to locate it (Duckworth 1997), suggesting that it is not common in, and may be absent from, the Mekong lowlands and adjacent foothills, where the dry season is generally harsher than in the Annamites and northern highlands.

Because of the species's perilous global conservation status, investigation as to whether it does occur around the Ban Muanglong sale point is urgently needed. Assuming that it does so, surveys are warranted to understand its status in the generally rugged landscape not under protected area designation from Phou Khaokhoay NPA north to Nam Et–Phou Louey NPA and southeast to Nakai–Nam Theun NPA, given the number of large landscape-scale projects planned or underway. Even clarification of whether Owston's Civet occurs in Phou Khaokhoay National Protected Area is important, because the area is heavily hunted (Evans *et al*. 2000). The habitat use of the species and its tolerance of encroachment and hunting are too poorly understood to predict responsibly its status in this part of Lao PDR.

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[1]Phu Bia Mining Limited, PO Box 5559, Vientiane, Lao PDR.
Email: Kongkeo.Sivilay@pbm.panaust.com
[2]PO BOX 6712, Vientiane, Lao PDR.
Email: challam@wcs.org

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Dr. Barney Long, Editor, Email: barneylong@boltblue.com

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An observation of Common Palm Civet *Paradoxurus hermaphroditus* mating

Jimmy BORAH[1] and Karabi DEKA[2]

Abstract

Common Palm Civets *Paradoxurus hermaphroditus* are nocturnal animals for which behaviour and ecology are not well documented despite the species's abundance and in some places commensal habits. We present an observation of this civet mating from Assam, India. The sighting occurred in daytime in a tree crown near human habitation.

Keywords: behaviour, commensal, copulation, Kaziranga National Park

শিৰোনামাঃ ভাৰতবৰ্ষৰ অসমত ক'ম'ন পাম চিভেটৰ (*Paradoxurus hermaphroditus*) যৌন আচৰণ পৰ্য্যবেক্ষণ।

সংক্ষিপ্ত বিৱৰণঃ ক'ম'ন পাম চিভেট (*Paradoxurus hermaphroditus*) এবিধ নিশাচৰ জন্তু। যদিও ইহত অতি সহজে উপলব্ধ, নিশাচৰ হোৱাৰ বাবে ইহঁতৰ আচৰণ আৰু পাৰিপাৰ্শিকতা ভালদৰে জানিব পৰা হোৱা নাই। আমি ভাৰতবৰ্ষৰ অসম ৰাজ্যত এইবিধ জন্তুৰ যৌন আচৰণ পৰ্য্যবেক্ষণ কৰিছিলো। এই সংগম দিনৰ পোৱৰ গছৰ ওপৰত মানুহৰ জনবসতি পূৰ্ণ জেগাত হৈছিল।

মূল শব্দঃ আচৰণ, জনবসতি, দিনৰ ভাগত, কাজিৰঙা ৰাষ্টীয় উদ্যান।

One of the most widespread species of civets (family Viverridae) found in India and South-east Asia, the Common Palm Civet *Paradoxurus hermaphroditus* occurs commonly in many habitats ranging from the most degraded and isolated human environments to pristine evergreen forests, and in some parts of its range, up to 2,400 m (e.g. Pocock 1939, Duckworth 1997, Azlan 2003, Su Su 2005). Due to their solitary and nocturnal habits, little is known about the reproductive processes and behaviour of civets (Ewer & Wemmer 1974, Prater 1980, Balakrishnan 2002). Although Common Palm Civet is quite common, we traced no documented observations of this species mating, from standard sources in any part of its range. This paper notes a chance observation of it mating near Kaziranga National Park in Assam, India.

The state of Assam is located in northeast India that forms a part of rich bio-geographic unit that represent one of the world's biodiversity hotspots (Myers l99l). The Common Palm Civet is common all over Assam, including within forests and well-wooded villages (Choudhury 1997).

On the overcast, rainy day of 26 March 2010, by the village of Kohora (26°35′9.6″N, 93°24′41.8″E; altitude 70 m), near Kaziranga National Park, at around 16h45, some residents grew excited after seeing two small animals in the crown of a *Syzygium cumini* (Jamun) tree, around 45 m from the nearest building. On close inspection (from about 25 m), we saw that it was a pair of Common Palm Civets attempting to mate. We moved closer, to observe the animals through binoculars. The animals were quite oblivious to such close human presence. Initially the animals were behind the tree branch with lots of leaves allowing only a brief sight. After some time they slightly moved down along the branch giving us a clear view. The pair copulated on the tree branch for about five minutes (Figs. 1–2). During that period the male mounted the female 4–5 times. The female lay down on her abdomen on the tree branch, arching her back and turning her head frequently towards the male during the course of mating. After each mounting the pair separated for few moments and repeated the same procedure. After completion of mating, the pair frolicked around for some time, moving from branch to branch on the tree. The animals separated after about six minutes and moved off to different branches and rested there (Fig. 3).

The habitat of the area was tropical moist mixed deciduous forests (Champion & Seth 1968), with Jamun, the bamboo *Bambusa bambusa* and Mango *Mangifera indica* being the major species, which mostly were planted by the villagers.

Common Palm Civet is considered a nocturnal animal but the present sighting took place in daylight, in a wet and dim condition. A somewhat similar sighting was reported in Fraser's Hill at Malaysia where two Common Palm Civets were seen copulating in a large (about 10 feet diameter) leafy cluster of lianas 35–45 feet above the ground amid montane forest in daytime between 11h30–13h00 on 21 September 1997; although in relict primary forest, this sighting was also close to habitation, about 50 m from the nearest building (J. W. Duckworth *in litt*. 2011).

Fig. 1. Mating of Common Palm Civet Paradoxurus hermaphroditus *in the crown of a Jamun* Syzygium cumini *tree; Assam, India, time: 16h51.*

Fig. 2. Mating of Common Palm Civet in a Syzygium cumini *(Jamun) tree; time: 16h52.*

Fig. 3. Two Common Palm Civets resting on different branches of the same tree after mating; time: 16h58.

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The authors express their thanks to Mr Jayanta Deka, Assistant Field Officer and Dr Pranab Bora, Coordinator, Kaziranga Karbi Anglong Landscape, WWF India, for their help in providing information and identifying the vegetation within the sighting area. We also acknowledge the local communities' attitude towards wildlife conservation, who incidentally, were the first to sight the event. Thanks to an anonymous reviewer for providing useful remarks.

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[1]c/o WWF-India, Parbati Nagar, Tezpur-784001, Assam, India.
Email: jimmyborah@gmail.com
[2]Kailash Nagar, South Hazarapara, Tezpur-784001, Assam, India.

A sighting of Stripe-backed Weasel *Mustela strigidorsa* at Doi Lang, Thailand

Dion HOBCROFT

Abstract

On 3 March 2011 a single Stripe-backed Weasel *Mustela strigidorsa* was seen in Doi Lang, contiguous with Doi Pha Hom Pok National Park, site of one of the few previous Thai records of the species. In 2009, a credible report was received of one on the summit of Thailand's highest mountain, Doi Inthanon.

Keywords: altitude, daytime activity, Doi Inthanon, location records

รายงานการพบเห็นเพียงพอนเส้นหลังขาว *Mustela strigidorsa* ที่ดอยลาง, ประเทศไทย

บทคัดย่อ

เมื่อวันที่ 3 มีนาคม พ.ศ. 2554 มีรายงาน เพียงพอนเส้นหลังขาวถูกพบเห็นในพื้นที่ดอยลาง ซึ่งเป็นพื้นที่เชื่อมต่อกับอุทยานแห่งชาติดอยผ้าห่มปก และเป็นหนึ่งในพื้นที่ไม่กี่แห่งที่มีการพบเห็นสัตว์ชนิดนี้ในประเทศไทย นอกจากนั้นในปี พ.ศ. 2552 ยังมีรายงานที่น่าเชื่อถือ ได้ว่ามีการพบเห็น เพียงพอนเส้นหลังขาว บนยอดสูงสุดของดอยอินทนนท์ ซึ่งเป็นภูเขาที่สูงที่สุดในประเทศไทย

คำสำคัญ: สถานที่ถูกบันทึก, ระดับความสูง, กิจกรรมตอนกลางวัน, ดอยอินทนนท์

The Stripe-backed Weasel *Mustela strigidorsa* of Southeast Asia and adjoining areas has generally been seen as a rare and presumably threatened species, but a recent collation of records across its range suggested that it was, instead, much overlooked by standard wildlife survey techniques and much more common than generally assumed (Abramov *et al*. 2008). While Abramov *et al*. (2008) traced a fair number of records from Lao PDR and Myanmar (and Streicher *et al*. [2010] added several more from the former country), they found records from only five sites in Thailand. Given the generally higher levels of wildlife research, survey, and leisure watching in Thailand than in Lao PDR and Myanmar, this suggests the possibility that the species may be genuinely scarce in Thailand, indicating that further records from the country warrant publication.

On 3 March 2011, at about 08h00, whilst leading a bird tour group, a single weasel was observed crossing the road at Doi Lang in far northern Thailand at 20°06′00″N, 99°17′00.61″E (co-ordinates from Google Earth). The location was at an altitude, very roughly, of 1,900 m, in primary montane broadleaf evergreen forest. Doi Lang, adjoining the border of Myanmar (Burma), is contiguous with Doi Pha Hom Pok National Park.

The observation lasted too few seconds for the use of binoculars. The weasel was about 4 metres from our group when it crossed the road. Small passerine birds were agitated by its presence. The weasel was less than 30 cm in length, with a bushy tail. It appeared almost entirely dark chocolate blackish brown including the visible parts of the belly. The pale buffy golden yellow was restricted from lower chin to fore-neck with the contrasting dark colouration extending beyond below the ear. There was no contrasting colour at the tail tip or any black face mask. It was not possible to assess the presence of any pale stripe on the back, given the angle as the weasel crossed the road, side-on to the observers. In sum, it appeared a perfect match for the illustration of Stripe-backed Weasel in Francis (2008).

Given the features observed, the only possible confusion species is Yellow-bellied Weasel *M. kathiah*, which at the angle of viewing would have shown clearly the continuation of the foreneck colour back along the venter. Siberian Weasel *M. sibirica* is a highly variable species but seems never to have the contrasting foreneck–hindneck-and-dorsum coloration observed here. The author has been fortunate enough to see Siberian Weasel twice in Wolong Nature Reserve in Sichuan, China.

This is the first weasel the author has encountered in northwest Thailand in five field trips. In March 2009 a group of birders reported to him a sighting of Stripe-backed Weasel at Doi Inthanon (Thailand's highest mountain, rising to 2,565 m; roughly, 18°33′N, 98°34′E), apparently running across the edge of the car park at the summit. The exact details are unknown, but they did observe the stripe on the back.

Among the few Thai sites with records traced by Abramov *et al*. (2008) is Doi Pha Hom Pok NP, adjacent to Doi Lang. None of the previous records is from near Doi Inthanon.

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6 Kentwell Ave, Concord, NSW 2137, Australia.
Email: dionhobcroft@bigpond.com

An attack by Ratel *Mellivora capensis* on pre-release Asian Houbara Bustards *Chlamydotis macqueenii* in central Saudi Arabia

M. Zafar-ul ISLAM, P. M. BASHEER, Waliur RAHMAN and Ahmed BOUG

Abstract

On 8 December 2009 a Ratel *Mellivora capensis* broke into a purportedly predator-proof pre-release cage for Asian Houbara Bustards *Chlamydotis macqueenii* in Mahazat as-Sayd Protected Area, Saudi Arabia, and caused the death of 29 of the 75 housed Houbaras. The Ratel ate six of them; 23 more died through panic-stricken collision with the walls. This is the first documented instance of Ratel, one of six predators in the area, attacking the reintroduction Houbaras, but on three occasions Ratels have attacked captured foxes *Vulpes*. Loss of juveniles by predation in the first few weeks after release is the single largest cause of Houbara mortality in the project and radio-tracking studies of Ratel are planned.

Keywords: Honey Badger, MacQueen's Bustard, Mahazat as-Sayd Protected Area, Ratel–human conflict, Reintroduction.

هجوم حيوان غرير العسل (ميليفيرا كابينسيس)على طيور الحباري الآسيوية (كلاميديوتس ميكويناي) في مسيجات المعدة لمرحلة ما قبل الإطلاق في منطقة وسط المملكة العربية السعودية .

ملخص :في الثامن من ديسمبر من سنة 2009 ميلادي قام حيوان غرير العسل باقتحام المسيج الخاص بطيور الحباري المعد لمرحلة ما قبل الإطلاق ولحمايتها ضد المفترسات في محمية محازة الصيد مما تسبب في قتل 29 من 75 طير حباري متواجدة في المسيج التهم حيوان الغرير 6 من طيور الحباري و 23 الأخرى نفقت بسبب خوفها واصطدامها بجدار المسيج وهذه أول حالة موثقة عن غرير العسل وهو واحد من ستة أنواع أخرى من المفترسات المتواجدة في المنطقة التي تقوم بمهاجمة طيور الحباري المعاد توطينها , ولكن في ثلاث حوادث أخرى قام حيوان الغرير بمهاجمة الثعالب التي تم الإمساك بها في أقفاص . وخسارة صغار الحباري الآسيوية بواسطة الافتراس في الأسابيع الأولى من بعد إطلاقها هو اكبر سبب لوفيات الحباري الآسيوية في مشروع إعادة التوطين وهناك دراسة يتم إعدادها لمتابعة غرير العسل بواسطة أجهزة الراديو في المحمية .

مفاتيح الكلمات : غرير العسل , طيور الحباري الاسيوية , محمية محازة الصيد , التحكم في المفترسات , التداخل بين الغرير و الانسان .

Introduction

The reintroduction of Asian Houbara Bustard *Chlamydotis macqueenii* into Mahazat as-Sayd Protected Area, Makkah province, Saudi Arabia, started in 1989 (Child & Grainger 1990). This note documents an incursion of a Ratel (Honey Badger) *Mellivora capensis* that caused the death of 29 Houbaras in a fenced enclosure in Mahazat as-Sayd PA.

Mahazat as-Sayd Protected Area (centred on 22°15′N, 41°40′E; elevation 900–1,100 m a.s.l.), declared in 1988 and ratified in 1989 by the Council of Ministers, covers about 2,200 km² of fairly level sandy plain (Islam *et al*. 2008a, 2010a, 2010b). In 1988 the whole area was fenced to protect it from grazing: it is one of the world's largest fenced protected areas. The 2 m high chain-link fence is topped with three strands of barbed wire, has 0.9 m of mesh buried in the ground, and lies behind a large earth embankment. The consequent spectacular recovery of native vegetation has allowed the re-introduction of Arabian Oryx *Oryx leucoryx* (IUCN Red List: Endangered), Sand Gazelle *Gazella subgutturosa marica* (Vulnerable, as *G. subgutturosa*), Mountain Gazelle *Gazella gazella cora* (Vulnerable, as *G. gazella*), Asian Houbara Bustard (Vulnerable, as *C. undulata*) and Ostrich *Struthio camelus* (Least Concern) (Islam *et al*. 2007, 2008a, 2008b, 2010b; Red List categories from IUCN 2011).

A 4 km² pre-release enclosure for Houbara was built in 1989, with an anti-predator electric fence, containing six tunnels of 10 m × 28 m in three net-houses covered with a shade-cloth synthetic net. On arrival from the captive-breeding unit of the National Wildlife Research Center in Taif [NWRC], the Houbaras are kept in the tunnels for 3–4 weeks to allow acclimatisation to the natural environment, with minimal human intervention.

Mammalian carnivores threaten the Houbaras at three stages: prior to release; after release, when they are inexperienced with wild predators; and during the breeding season, when eggs and chicks are vulnerable to predators. Carnivores are thus trapped in and around the pre-release enclosure. Six small carnivore species are trapped regularly: Rüppell's Fox *Vulpes rueppellii*, Red Fox *V. vulpes*, Sand Cat *Felis margarita*, Wild Cat *F. silvestris*, feral cat *F. catus* and Ratel. Of them, Red Fox is the major predator of Houbara in Mahazat as-Sayd PA (Islam *et al*. 2010a).

Loss of juveniles by predation in the first few weeks after release is the single largest cause of Houbara mortality. Hence, it has become the practice to trap predators directly before the Houbara release. Levels of predator translocation from the enclosure have varied over the last 20 years. The high probability of return by translocated foxes and cats hinders the maintenance of low predator densities around the release site. Red Fox and Ratel are released some 200 km away from the re-introduction site, while Rüppell's Fox and cats are released back to the Reserve with numbered ear tags. Thus, prior to the Houbara releases in early 2010, 19 Tomahawk live-traps (collapsible double-ended traps, 40 × 40 × 108 cm in size; Tomahawk Live Trap Company, Wisconsin,

Table 1. Measurements of Ratels trapped in Mahazat as-Sayd Protected Area, Saudi Arabia, 2010–2011.

Date of capture	Age/sex	Head-and-body length (cm)	Tail (cm)	Shoulder height (cm)	Body mass (kg)
26 February 2010	Adult male	89	19	24	3.98
25 January 2011	Adult male	98	21	28	4.76

U.S.A.) were set for 12 nights, baited with pieces of raw chicken. In total, 17 animals were caught, mostly Rüppell's and Red Foxes, including the problematic male Ratel inside the enclosure.

The incident

On 8 December 2009, a male Ratel penetrated the net-houses (which held forty Houbaras of the 2007 cohort and 35 of the 2008 cohort) and ate six of them; a further 23 died due to panic, and crashing into the walls of the net-house. The Ratel might have climbed the enclosure fence (footprints were found in one corner of the enclosure); and at the net-house, the net in the ground had tears in two corners of around 20 cm diameter, where the Ratel presumably penetrated. This is the first such incident in 20 years of re-introduction of Houbaras.

After this incident, traps placed inside the pre-release enclosure and baited with fresh chicken meat did not capture the Ratel, although it twice broke a trap. Next, a live chicken was placed in one closed trap with three open traps left, right and on top of it; after waiting through the night of 26 February 2010, a Ratel was trapped at around 03h00 and taken to NWRC, where it is held captive. Were it to be released in Mahazat as-Sayd PA, it might well return to the pre-release enclosure and swiftly re-enter it, using its knowledge of the presence of easy prey. As C. M. Begg (*in litt*. 2011) points out, reflecting her experience of seeing Ratels return multiple times to vulnerable prey, the only long-term security against future such attacks is to keep the pre-release birds in completely predator-proof enclosures.

Other notes on Ratels in Mahazat as-Sayd Protected Area

Ratels are caught in the protected area more frequently than the following list suggests, because they break the trap and escape if the traps are unattended for 5–6 hours (Islam *et al*. 2010a). The following did not escape: an adult female on 22 December 1992 at 22°09′30″N, 41°44′30″E (Olfermann 1994); two (unsexed) at the boundary of the pre-release enclosure in 1994 (P. M. Basheer own data); two (unsexed) in 1996 (Meloney 1996); an adult male on 18 October 1999 at 22°11′25″N, 42°03′59″E, and a male and a female at 22°13′54″N, 41°59′00″E on 5 May 1997 (Lenain 2000); one (unsexed) in 1998 (Judas 1998), singles (unsexed) in each of September and October 2000, around the pre-release enclosure (Judas *et al*. 2000); the male in February 2010 detailed above; and another male on 25 January 2011 from the same location, released 200 km away from the Houbara re-introduction site (Fig. 1). Measurements of the two most recent are in Table 1. In addition, a sub-adult female has been caught in Saja Umm ar Rimth Reserve, around 180 km from Mahazat as-Sayd PA (Shah 2007).

Three cases of Ratel attacking trapped foxes have been observed. In October 1996, a male Rüppell's Fox was captured and the trap had been moved by 4.5 m and turned a few times

Fig. 1. Male Ratel Mellivora capensis *captured in Mahazat as-Sayd PA, Saudi Arabia, 25 January 2011 (Picture by M. Z. Islam).*

by the Ratel. One ear of the fox and both hind legs were missing. In January 1997, two Ratels attacking a caged male Rüppell's Fox growled aggressive noises and after few minutes ran away (Lenain 1997). In May 1997 a young Red Fox died from massive haemorrhaging when a Ratel removed its tail and hindquarters (Lenain 2000).

Concluding remarks

Globally, Ratel is considered Least Concern on *The IUCN Red List of Threatened Species* (IUCN 2011). Ratels are widespread in Saudi Arabia, but sightings are relatively rare. They are protected in the Kingdom under the 1977 National Hunting Law, Decree n° 457. Ratels are generalist carnivores with an extremely wide diet (Kingdon 1977, Dean & Macdonald 1981, Dean 1985, Paxton 1988, Harrison & Bates 1991, Begg *et al*. 2003).

The incident documented here was a serious setback to the Houbara reintroduction programme. Elsewhere in their range, Ratels come into conflict with farming of bees (e.g. Begg & Begg 2002) and also livestock (e.g. they reportedly frequently attack poultry in chicken-coups; C. M. Begg *in litt*. 2011), emphasising the risk of further such incidents with the Houbaras. Thus far, there has been no proof of Ratels taking Houbaras after release, even females sitting on nest. However, hundreds of Houbaras have been predated, and while most were surely taken by foxes or cats, it is possible that Ratel might be involved as well. To address this uncertainty, radio-collared Ratels will be monitored in the Reserve in 2011–2012.

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National Wildlife Research Center, PO Box 1086, Taif, Saudi Arabia, and Saudi Wildlife Commission, Riyadh, Saudi Arabia.
Corresponding author email: mzafarul.islam@gmail.com

Sightings of Javan Small-toothed Palm Civets *Arctogalidia trivirgata trilineata* on Gunung Salak, West Java, Indonesia

R. S. MOORE

Abstract

Eleven independent sightings of the Javan Small-toothed Palm Civet *Arctogalidia trivirgata trilineata* on Gunung Salak, West Java, Indonesia, are only the second series of records in recent decades. The animals were observed from January to October 2010 at altitudes between 900 and 1,450 m a.s.l., mainly as solitaries and once possibly as a group of three. An island-wide survey and an accurate taxonomic assessment are needed to help clarify the overall conservation status of this taxon, which remains one of the least-known larger mammals in Java.

Keywords: Gunung Halimun Salak National Park, spotlighting, survey, Viverridae

Catatan perjumpaan *Arctogalidia trivirgata trilineata* di Gunung Salak, Jawa Barat, Indonesia

Abstrak

Sebelas kali perjumpaan independen musang akar *Arctogalidia trivirgata trilineata* di Gunung Salak, Jawa Barat, Indonesia merupakan catatan lapang kedua dalam beberapa dekade terakhir. Semua perjumpaan antara Bulan Januari sampai Juni 2010 berada pada ketinggian antara 900 dan 1450 dpl terdiri dari satu individu, kecuali satu kali yang tampaknya dalam grup berjumlah tiga ekor. Perlu dilakukan survey menyeluruh di Pulau Jawa untuk mengetahui status konservasi dari salah satu jenis mamalia yang paling jarang diketahui ini.

Kata kunci: spotlighting, survey, Taman Nasional Gunung Halimun Salak, Viverridae

A paucity of information regarding the Javan Small-toothed Palm Civet *Arctogalidia trivirgata trilineata*, a taxon restricted in its known distribution to the westernmost part of the island of Java, Indonesia, renders its current conservation status unclear (Eaton *et al*. 2010). The only documented recent sightings in decades occurred between 2008 and 2010 in the Gunung Halimun Salak National Park, West Java, prompting the urgency to publicise other contemporary records (Robson 2008, Eaton *et al*. 2010). From January to June 2010, we conducted 50 km of nocturnal surveys over 100 hours on the north face of Gunung (Mount) Salak (6°41′S, 106°44′E), part of the same national park. The surveys covered an area of approximately 18 km². Spotlight reconnaissance surveys were employed to assess the presence or absence of Javan Slow Loris *Nycticebus javanicus* for the purposes of a reintroduction programme; however, chance sightings of other nocturnal mammals were also recorded. In addition, five months of night monitoring of reintroduced lorises, totalling approximately 800 hours from June to October 2010, meant substantial time was spent in that area. Animals were located by their eye-shine using Petzl zoom halogen lamps with red filters (as per Nekaris 2003). To help identify the animals, a Sony Handycam DCR-SR35E with a night-shot function was used. In general, views of Small-toothed Palm Civets were excellent, allowing confident identification, and photographs were circulated to J. A. Eaton and others, who concurred with the identifications. These photographs did not allow precise assessment of pelage colour.

Eleven separate sightings of Javan Small-toothed Palm Civets were recorded on Gunung Salak. During the initial survey period, the species was seen four times, being found on only two of the eleven 3 km trails; these two trails were spaced approximately 700 m apart. The subsequent monitoring period yielded a further seven sightings. All eleven sightings were within a 4 km² area of forest where approximately 70% of our total time (in the 18 km² block) was spent. Whilst Small-toothed Palm Civets were never observed outside this area, this may only be a reflection of limited survey effort in the remaining 14 km².

Sightings occurred between altitudes of 900 m and 1,450 m a.s.l. at various times between 20h00 and 04h00, and were mostly of solitary animals. Once, a group of three individuals were observed playing for a 15-minute period high in a large tree, then moving off together. One animal was a Small-toothed Palm Civet, but the others were seen too poorly for secure identification. All civets were seen at heights of 1–12 m in the trees, never on the ground. One was watched feeding on the fruits of *Cinnamomum sintoc* for approximately two minutes only three meters from the observer. In September 2010, whilst monitoring a released slow loris, a Small-toothed Palm Civet was observed close to the slow loris and appeared to be following it. Both animals disappeared from sight, moving higher up in the canopy. A few minutes later the loris was seen fleeing from the scene exhibiting a large facial wound. It is uncertain whether this wound was caused from an attack by the civet, as the event was not witnessed. No other animals were seen in the area at that time, although, owing to the cryptic nature of many nocturnal species, an attack from another unnoticed species cannot be ruled out.

These recent sightings on Gunung Salak were approximately 23 km northeast of those documented by Robson (2008) and Eaton *et al*. (2010) at Cikaniki in the Gunung Halimun Salak National Park. Cikaniki lies at 1,000 m a.s.l., consistent with the altitudinal range of the Gunung Salak records. At such altitudes, forest cover in Java is significantly greater compared with the level lowlands (Lavigne & Gunnell 2006); further sightings here perhaps imply better survival prospects for this taxon than would be the case for one dependent on lowland forest. Although Gunung Salak

is within a protected area and, therefore, should not be entered without permission, in all areas of our study, we made frequent encounters with hunters, loggers, and locals collecting the foliage of *Calliandra calothyrsus* for their livestock. Consequently, the forest areas near to villages are relatively disturbed, with many invasive and non-native plant species present. The civet sightings occurred approximately 3 km from established villages, and thus fell within this human-influenced area. Without proper policing of these areas, gradual degradation of the flora and fauna on Gunung Salak is likely to continue. Hunters encountered during the day in the National Park were mainly trapping birds, using lime sticks and live bird decoys, or shooting small mammals with air rifles. Four ground snares were also found. On only one occasion were hunters seen at night, using spotlights and accompanied by dogs; it is not known what they were hunting. Since Small-toothed Palm Civets are highly arboreal, it is possible neither snares nor dogs constitute much threat.

Further studies of the ecology and behaviour of Small-toothed Palm Civet in this area would help in assessing the potential threats in this region. Perhaps of greater immediate importance to the taxon's survival, however, is the need to survey for Javan Small-toothed Palm Civet across Java in order to reveal the extent of its geographical range. This report combined with the only other recent sightings (Robson 2008, Eaton *et al*. 2010), from a single site a relatively short distance away, could suggest this taxon has a localised distribution and is, therefore, potentially susceptible to habitat loss or disturbance. Alternatively, as Eaton *et al.* (2010) proposed, a paucity of sightings could be attributed to a paucity of published spotlight surveys in Java, and the taxon may be more widespread than the records suggest. Obtaining such information, together with an accurate taxonomic placement as either a separate species of *Arctogalidia* or remaining as a subspecies of *A. trivirgata*, would help to provide a better understanding regarding current conservation priorities for Javan Small-toothed Palm Civets.

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132, The Wheatridge, Gloucester, GL4 5DP, U.K.
Email: richard@internationalanimalrescue.org

An early claim of Red Panda *Ailurus fulgens* from Vietnam

G. B. SCHROERING

Abstract

There remains no proof that Red Panda *Ailurus fulgens* inhabited Lao PDR or Vietnam in historical times, but in 1904, a generally reputable account of the mammals of Indochina (accompanying results of the Pavie expedition) stated, without caveat, that it occurred in Tonkin, the northernmost part of Vietnam. No basis is given for this statement so its accuracy is unclear; but it expands suggestions of Red Panda occurrence from solely within hunters' memoirs into the scientific literature.

Keywords: geographic range, historical opinion, Pavie expedition, Tonkin

In a recent review of reports of Red Panda *Ailurus fulgens* from south and southeast of its known geographic range, Duckworth (2011) discussed extensively the history of such reports from Vietnam and nearby countries. The earliest source traced for Red Panda in Indochina was Roussel (1913), but the compilation overlooked de Pousargues (1904). Moreover, other early sources from this region (excepting simple tabulated lists of species believed to inhabit Indochina) are all hunters' memoirs; de Pousargues's (1904) text discuses the results of the Pavie scientific exploration during 1879–1895 and provides a comprehensive overview of the mammals of Indochina.

De Pousargues (1904: 521) wrote that "cette petite espèce méridionale est représentée vers le Nord, dans le Tonkin [the northernmost part of modern-day Vietnam], par une autre plus robuste, l'Ours du Tibet, *Ursus tibetanus* [*sic*] (G. Cuv.), qu'accompagnent quelques individus du genre unispécifique, *Ailurus fulgens* (F. Cuv.), ou Panda éclatant" (this small southern [in Indochina] species [Sun Bear *Ursus malayanus*] is replaced to the north, in Tonkin, by Asian Black Bear *U. thibetanus* and by several individuals of a monospecific genus, the Red Panda). Nothing in de Pousargues (1904) illuminates the meaning behind 'several individuals'. That it is not simply a text compilation error is indicated by the Table of mammals of Indochina on p. 545, which indicates again (by use of a 'ditto' mark) that Red Panda inhabits Tonkin.

De Pousargues (1904) did not detail his basis for believing that Red Panda occurred in Tonkin (the northernmost part of Vietnam). It seems unlikely that the expedition had acquired any specimens of it, because the collection was exhibited in the Muséum National d'Histoire Naturelle, Paris (MNHN) shortly after its return to France in 1895, yet Delacour (1940), who used the MNHN collections extensively in his account of the mammals of Indochina, did not countenance the occurrence of Red Panda there. However, the ship carrying the Pavie collection was wrecked off the Somali coast and although much of the collection survived, some cases of material were lost (de Pousargues 1904), so it is possible that Red Panda specimen(s) had been collected. All the other carnivores stated by de Pousargues (1904, table and text) to occur in Indochina without caveat are now known to do so, independently from de Pousargues, in the regions mentioned for them: this statement of Red Panda occurrence gains credibility because it is not accompanied by multiple obviously implausible claims. (The listing for Thailand of the mongoose *Herpestes griseus* is here unidentifiable as this name was applied historically to all of *H. ichneumon*, *H. auropunctatus* and *H. edwardsii* [Van Rompaey & Colyn 1996], and the possibility of occurrence of *H. auropunctatus* in Thailand [also listed by Pavie directly] remains unclear [Veron *et al*. 2006]; and the listing of the Sundaic *Felis diardi* is a simple nomenclatural error for the northern Southeast Asian *Felis* [now = *Neofelis*] *nebulosa*.)

De Pousargues's (1904) laconic treatment of Red Panda, with no comment that occurrence in Tonkin was surprising in the context of contemporary perceptions of Red Panda distribution, suggests the possibility that yet earlier statements of the species in Vietnam may exist. Alternatively, it may simply reflect de Pousargues's (1896: 180) earlier expressed opinion that "d'un autre côté, toute la partie Sud du Yun-nan ne diffère pas géographiquement de la Birmanie, du Haut Tonkin et du Sud-Est de la Chine, et nous retrouvons dans les types mammalogïques rapportés de cette region par le prince Henri d'Orléans la plupart des espèces signalées déjà par Anderson sur les frontières du Yun-nan et de la Birmanie, et par Swinhoe dans les provinces sud-orientales de l'empire chinois" (in contrast [to the similarities between northwest Yunnan and Szechwan], all southern Yunnan resembles, geographically, Burma, upper Tonkin and southeast China, and most of the mammal forms reported from southern Yunnan by Prince Henry d'Orléans [the collection under discussion] have already been found by Anderson along the Yunnan–Burma frontier or by Swinhoe in southeast China): de Pousargues's (1896) noted (*fide* Anderson) that Red Panda was particularly common on the Yunnan–Myanmar frontier, and so would not have been particularly surprised to find it in Tonkin.

It remains difficult to see how such a distinctive animal could have inhabited the area into the late 19th century and presumably into the first half of the 20th century, the main era of specimen-collecting expeditions, and not have been found. Two Red Panda specimens purchased in Hanoi in 1931 were taken at the time to be from international trade (Duckworth 2011), raising the possibility that de Pousargues's (1904) view was also based, unbeknownst to him, on trade animals from Hanoi or elsewhere in Tonkin. A fair amount of Vietnam's northern highlands lie at altitudes suitable for Red Panda, but habitat would be atypical (it is not annually snowbound, for example), so it is conceivable that Red Panda did inhabit Vietnam but was eradicated before being collected or otherwise securely documented there.

In conclusion, the mention of Red Panda in de Pousargues (1904) makes it less surprising that hunters were discussing the species in the memoirs of Indochina, secure in the knowledge from its listing in this generally authoritative source that it did indeed live there.

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125/5 Ruam Rudee, Ploenchit Rd., Bangkok 10330, Thailand.
Email: gbs119@gmail.com

Species composition and relative sighting frequency of carnivores in the Analamazaotra rainforest, eastern Madagascar

Rainer DOLCH

Abstract

Observations of endemic Malagasy Carnivora (Eupleridae) from Analamazaotra rainforest in Andasibe, Madagascar, from 1992 to 2010 show that the carnivoran assemblage consists of at least four species. They are (in decreasing relative sighting frequency) Malagasy Ring-tailed Mongoose *Galidia elegans*, Fanaloka or Malagasy Civet *Fossa fossana*, Fossa *Cryptoprocta ferox* and Eastern Falanouc *Eupleres goudotii*. An increase in the number of euplerid observations with time is paralleled by a reduction of snaring terrestrial mammals in Analamazaotra, and may suggest recovering populations. While the number of carnivoran species observed was not different from other rainforest sites in Madagascar, the relative observation frequency of particular species showed marked disparities, with *Galidia elegans* accounting for almost 70% of all observations in Analamazaotra.

Keywords: Andasibe, *Cryptoprocta ferox, Eupleres goudotii*, Eupleridae, *Fossa fossana*, *Galidia elegans*

Fitambaran'ireo vondrona carnivores fahita matetika amin'ny ala mando Analamazaotra, antsinanan'i Madagasikara

Famintinana

Ny fanaraha-maso ireo carnivores malagasy (ireo karazana biby mihinan-kena) ato anatin'ny ala mando Analamazaotra eto Andasibe, izay heverina fa misy karazany efatra eo ho eo ny taona 1992–2010. Izy ireo nefa dia (nandritra ny fanaraha-maso dia hita fa nihena ny fahitana azy ireo) *Galidia elegans*, *Fossa fossana*, *Cryptoprocta ferox*, ary ny *Eupleres goudotii*. Ny fitomboan'ny isan'ireo fanaraha-maso ny Eupleridae ara-potoana dia napetraka mira-zotra amin'ny fampihenana ny fihazana ireo biby mampinono an-tanety eto Analamazaotra, izay heverina fa mety mbola ahitana fonenana maromaro. Nandritra ny fanaraha-maso ny isan'ireo karazana carnivores izay tsy nisy fahasamihafana tamin'ireo faritra misy ala mando hafa eto Madagasikara, dia voatsikaritra fa nisy fihenana ireo karazana voatokana izay nanaovana fanaraha-maso matetika, tamin'ny *Galidia elegans* izay mampiseho fa ny 70% ny fanaraha-maso rehetra natao teto Analamazaotra.

Introduction

Except for feral cats *Felis catus*, domestic dogs *Canis familiaris* and the introduced Small Indian Civet *Viverricula indica*, all Malagasy carnivoran species belong to the endemic family Eupleridae (Wozencraft 2005). Formerly considered to belong dispersed among various other families, their taxonomic distinctness has been revealed by molecular studies (Veron & Catzeflis 1993, Veron *et al*. 2004).

Eupleridae are a monophyletic lineage (Yoder *et al*. 2003) most closely related to hyaenids and herpestids (Baryka 2007). While the species of the subfamily Galidiinae also phenotypically resemble mongooses, the more ancient Euplerinae are more civet-like, with one species, Fossa *Cryptoprocta ferox*, showing a number of characteristics convergent with cats that had earlier led to now futile assumptions of its phylogeny (e.g. Köhncke & Leonhardt 1986).

The nomenclature of Eupleridae could unhesitatingly be called unfortunate. For example, the Fossa (or Fosa) *Cryptoprocta ferox* often gets confused with the Fanaloka *Fossa fossana*. But in some regions of Madagascar, the term 'fanaloka' or 'falanoka' is also being used for *Eupleres goudotii* (hence its anglicised name of Falanouc). The Fanaloka itself (i.e. *Fossa fossana*) has—again according to region—a wide range of vernacular names, including 'teza' (in Andasibe) or indeed 'fosa' (in Ranomafana). The use of scientific names therefore nowhere seems to be more appropriate than in the case of the Eupleridae, which currently comprises 10 species (Table 1).

Given the elusive nature of carnivores, behavioural and ecological studies are difficult. Studies of Malagasy carnivores have generally focused on analysing faeces to investigate feeding ecology (Goodman *et al*. 1997, 2003, Hawkins & Racey 2008, Andriatsimietry *et al*. 2009). Initially, research on Malagasy carnivorans focused on the larger species in the western dry forests rather than on the eastern rainforests (e.g. Hawkins 1998, Hawkins & Racey 2005, 2008).

Rainforest sites in Madagascar where carnivorans have been studied include Betampona (Britt 1999, Britt & Virkaitis 2003), Andrigitra (Goodman 1996) and Andohahela (Goodman & Pidgeon 1999). Most observations on euplerid carnivorans in rainforest come from Ranomafana (Dunham 1998, Dollar 1999a, 1999b, Gerber *et al*. 2010).

While almost all these studies have focused on population ecology of particular species, few have looked at community ecology. Gerber *et al*. (2010) produced the first intensive account of the carnivore community of a particular site, looking at species composition, apparent relative abundance and density.

Here are presented data on the carnivore community of another rainforest site, Analamazaotra, gathered over a period of almost 20 years.

Survey area and methods

The Analamazaotra forest (18°56′17″S, 48°24′51″E) lies immedi-

ately south of the village of Andasibe, formerly known as Périnet, at altitudes of 920–970 m. The annual rainfall is 1,700 mm, and the vegetation is mid-altitude rainforest. Analamazaotra consists of two parcels (700 ha and 800 ha, respectively) bisected by a 3-km road that links Andasibe to the Antananarivo–Toamasina paved Route Nationale 2. These parcels are the Station Forestière (SF), managed by Association Mitsinjo, and the former Réserve Spéciale (RS), now part of Andasibe–Mantadia National Park and managed by Madagascar National Parks (e.g. Dolch 2003). Agents of Association Mitsinjo started regular patrols in 2001, in the course of taking over the management of Station Forestière Analamazaotra from the Ministry in charge; they have maintained the same level of patrolling effort since. Reflecting Analamazaotra forest's proximity and connection via a paved road to the capital, Antananarivo, it is both a very popular nature tourism destination and a well-studied forest (Dolch 2003). Yet, the carnivores of the area have never been subject to any detailed study, although many species have been observed and/or collected in and around Andasibe (e.g. Albignac 1973). Still, information on their distribution and relative abundance remains scant.

Having lived (with minor breaks) in Andasibe from 1992 to 2010, I have recorded all personal observations of carnivores during that period, noting the date and time. Encounters were opportunistic, usually made walking along or close to the road bisecting the Analamazaotra forest.

Although walking on that road was pretty much a daily business, it is difficult to quantify in retrospect, how often I actually walked it. While total time spent on this road may appreciably differ between single years, the overall duration of the observation period may be sufficient to level out these differences.

Table 1. Extant species of Eupleridae.

English name	Scientific name	IUCN category
Euplerinae		
Fossa	*Cryptoprocta ferox*	VU
Eastern Falanouc	*Eupleres goudotii*	NE
Western Falanouc	*Eupleres major*	NE
Fanaloka or Malagasy Civet	*Fossa fossana*	NT
Galidiinae		
Malagasy Ring-tailed Mongoose	*Galidia elegans*	LC
Broad-striped Mongoose	*Galidictis fasciata*	NT
Giant-striped Mongoose	*Galidictis grandidieri*	EN
Malagasy Narrow-striped Mongoose	*Mungotictis decemlineata*	VU
Brown-tailed Mongoose	*Salanoia concolor*	VU
Durrell's Mongoose	*Salanoia durrelli*	NE

English names for species and Red List categories follow IUCN (2010). EN = Endangered, NT = Near Threatened, VU = vulnerable, LC = Least Concern, NE = Not Evaluated. The Not Evaluated species comprise *E. major,* which has only lately been proposed as a species in its own right (Goodman & Helgen 2010) and thus by consequence the residual *E. goudotii*, and *S. durrelli*, recently described from the marshlands of Lac Alaotra (Durbin *et al*. 2010).

Results and discussion

In total, 36 observations involving carnivorans were made. The species found, in decreasing order of number of observation events, were *Galidia elegans* (n=25), *Fossa fossana* (n=8), *Cryptoprocta ferox* (n=2) and *Eupleres goudotii* (n=1; Table 2). Neither *Galidictis fasciata* nor *Salanoia concolor* (both known to occur in the area; Albignac 1973) were observed.

Although *F. fossana* superficially resembles the introduced *V. indica*, it can easily be distinguished from it by its stocky appearance, bushy tail without complete rings, elongated snout and absence of longitudinal bands on the back (Garbutt 2007). Local hunters also clearly discriminate between the two species by using the vernacular names 'teza' for the former and 'jaboady' for the latter. The absence of any observation of *Viverricula* in Analamazaotra comes despite its abundance in degraded habitats in the vicinity as reflected by records of hunters (J. Rafalimandimby verbally 2005). With the exception of *Viverricula* records, the species composition and relative sighting frequency of all euplerid species found in Analamazaotra are supported by accounts from hunters in the wider Andasibe region (RD unpubl. data).

The euplerid assemblage in Analamazaotra resembles that of other rainforest sites, and is identical to that reported from Makira (Golden 2009). While no details on the relative encounter rate of euplerids are given by Golden (2009), data from Ranomafana in Gerber *et al*. (2010) represent the first investigation of the relative abundance and density of carnivores in the eastern rainforest of Madagascar.

Gerber *et al*. (2010) conducted their study in the austral win-

Table 2. Euplerid observations in Analamazaotra forest, Andasibe. Madagascar, 1992–2010.

Species	Month of observation	Season	Time of day
Cryptoprocta ferox	Oct 2000	dry	night
Cryptoprocta ferox	Oct 2010	dry	day
Eupleres goudoti	Apr 1993	dry	night
Fossa fossana	Sep 1992, May 1996, Aug 1996, Aug 1999	dry	night
Fossa fossana	Jan 2001, Nov 2007, Nov 2008, Mar 2009	wet	night
Galidia elegans	Mar 1994, Nov 2000, Jan 2001, Jan 2002, Feb 2002, Feb 2002, Jan 2003, Dec 2003, Feb 2004, Mar 2004, Mar 2005, Feb 2006, Dec 2007, Aug 2008, Mar 2008	wet	day
Galidia elegans	Apr 1995, Aug 1996, Oct 1999, Oct 1999, Oct 2000, Jul 2004, Sep 2004, Oct 2005, Jun 2009, Oct 2010	dry	day

Observations were defined as 'wet season' between November and March, and 'dry season' between April and October.

Table 3. Relative sighting frequency of euplerids in Analamazaotra (1992–2010) and Ranomafana (2007), Madagascar. Tabled values are number of observations (percentage).

Species	Analamazaotra[1]	Ranomafana[2]
Cryptoprocta ferox	2 (5.6%)	63 (11.3%)
Eupleres goudoti	1 (2.8%)	0 (0)
Fossa fossana	8 (22.2%)	342 (61.5%)
Galidia elegans	25 (69.4%)	143 (25.7%)
Galidictis fasciata	0 (0%)	8 (1.5%)
Total	36 (100%)	556 (100%)

[1]Data from this study; all observations are individual sightings.
[2]Data from Gerber *et al*. (2010); all observations are individual capture events (with one capture event defined as all photographs of that species taken by a camera trap within a 30-minute period).

Table 4. Snares found during regular patrols in Station Forestière Analamazaotra, Madagascar, 2001–2010.

Year	Number of snares
2001	12
2002	6
2003	2
2004	2
2005	1
2006	0
2007	0
2008	1
2009	0
2010	0

ter, while in Analamazaotra observations were gathered across all months of the year. Still, Gerber *et al*. (2010) provide the only investigation of relative abundance of euplerids in a rainforest. In the following, sightings from Analamazaotra are therefore primarily compared with their findings from Ranomafana (Table 3).

While *G. elegans* is the most frequently seen species in Analamazaotra and accounts for more than two-thirds of all observations, it makes up about a quarter of all observations in Ranomafana. For *F. fossana*, the ratio is almost exactly reversed, accounting for about a quarter of observations in Analamazaotra, as opposed to more than two-thirds of observations in Ranomafana.

These differences may be explained by *G. elegans* being largely diurnal (Hawkins 2008a) and *F. fossana* strictly nocturnal (Hawkins 2008b). Since I walked the Analamazaotra road largely during the daytime or the early evening hours, diurnal species were likely to be encountered more often than nocturnal ones. In fact, all *G. elegans* observed in Analamazaoatra were encountered during the daytime, whereas all *F. fossana* were seen after sunset (Table 2). The camera traps in the Ranomafana study (Gerber *et al*. 2010) were set to operate 24 hours per day, so are more likely to have documented nocturnal or cathemeral species as well.

This difference in methodology may also explain why the relative sighting frequency of the cathemeral (Hawkins 1998, Dollar 1999b) *C. ferox* in Analamazaotra was found to be only half of that in Ranomafana. In both sites, *C. ferox* was only the third most frequently seen euplerid species, which is most likely to be explained by its larger territorial requirements (and therefore lower population density) due to its strictly carnivorous top-predator trophic position.

The least frequently seen carnivore in Analamazaotra was *E. goudotii*, encountered just once in 19 years. Its elusiveness is reflected by Gerber *et al*. (2010) not finding it during 755 camera-trap days, although it inhabits the Ranomafana area (Dollar 1999a). Little is known about the biology of the species (e.g. Albignac 1974) or the factors explaining its apparent natural rarity.

Despite reported sightings of hunters of 'vontsira fotsy' in the wider Andasibe region (J. Rafalimandimby verbally 2005), I never encountered *Galidictis fasciata* in Analamazaotra. Again, this species is largely nocturnal (Goodman 2003) and therefore likely to be missed when not searched for at night. Even in Ranomafana, the species was found only very rarely (Gerber *et al*. 2010).

There is no large difference (sufficient to suggest seasonal suspension of activity) in the occurrence of observations between seasons. The number of observations per year increased during the survey period (Spearman's rank correlation, $r_S = 0.43$, $P = 0.066$; Table 2). Observation effort was neither held constant nor measured over the years, but no strong directional trend in effort occurred over the years, despite some variation between years. Thus, the increase in sightings might be due to my increasing capacity to spot these animals with the years. Alternatively, it could also reflect a real increase of overall carnivore abundance in Analamazaotra due to more effective protection and a considerable decrease of snaring in these forests. Whereas some species of carnivorans are considered 'fady' (taboo) in certain regions (Jones *et al*. 2008), almost all species are widely consumed in many rainforest areas to supplement local people's diet (e.g. Golden 2009). Andasibe is no exception, and the Analamazaotra forest has traditionally been a target for people hunting with snares ('fandrikandia'). The number of snares found during patrols decreased across years (Spearman's rank correlation, $r_S = -0.818$, $P = 0.004$; Table 4), consistent with general perceptions of progressive reduction in snaring effort in the area during the period. This might have led to a relief of euplerids (the main targets of snaring) from hunting pressure.

The opportunistic way data were gathered in Analamazaotra allow only very rudimentary conclusions. Complementing these data by a more methodical approach (preferably camera-trapping) in the future would allow much more rigorous conclusions.

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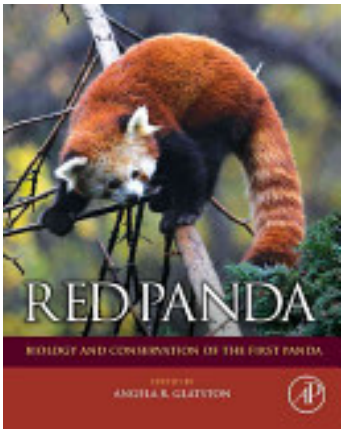
Association Mitsinjo, Andasibe 514,
Madagascar.
Email: rdolch@gmx.de

Book Review



Glatston, A. R. (ed.) 2011. ***Red Panda: biology and conservation of the first panda***. 474 pages. Academic Press, London, U.K. (Price: $89.95, Hardcover)

This volume brings together, for the first time, contributions from 31 biologists and conservationists including the editor herself, on a poorly known, endearing mammal of the Himalayas—the Red Panda *Ailurus fulgens*. Being a living fossil and the sole representative of a family of carnivorans, Ailuridae, the Red Panda has been a puzzle because of its habit of feeding on bamboo, its restricted distribution, and taxonomic uniqueness. The Red Panda was described to western naturalists well before the discovery of the more popular Giant Panda *Ailuropoda melanoleuca* (now known to be more closely related to bears) leading the editor to refer to the former as the first panda.

The aim of the book is to provide complete information on a remarkable species that is very poorly known scientifically and among the general public, both within its distribution range as well as outside. The book also aims to popularise the species among naturalists and the public. Further, it tries to resolve two taxonomic puzzles about the species ever since its description by Cuvier in 1825—its relatedness to other carnivores such as bears (Ursidae), Giant Panda, or raccoons *Procyon*, and whether the two extant subspecies, *Ailurus fulgens fulgens* and *A. f. styani*, each deserve full species status.

This is the only authoritative and up-to-date account of the species, with contributions on a wide variety of aspects of Red Panda biology. Most of the knowledge of the species comes from observations in captivity rather than from the steep mountainous regions it inhabits. Although a majority of the chapters in this book is based on understanding and management of the species in captivity (13 of the 24 main chapters), the editor has ensured that most of what is known of the wild populations and their ecology is made available here.

Some of the chapters of general interest might be about the role or absence of Red Pandas in local cultures and about conservation initiatives in Nepal and China. Although it was found that they are largely insignificant in local traditions and cultures of the range states, the Red Panda seems to be gaining in popularity outside its distribution range—as mascots of various products including the popular internet browser Firefox (the Chinese name for the species), in movies, and in commercial merchandise.

Three chapters provide a detailed overview of the evolution of Red Panda based on the scanty fossil record. It would have been interesting and would have made this section more complete, if the information on recent fossil finds in Asia (mentioned in passing in another chapter) had been included. The only chapter on the ecology of the Red Panda (from China) is reflective of the paucity of recent field studies in other range countries. There is also one chapter each on the species's status in India and China. The status of Red Panda in Myanmar is provided only in an appendix extracted from a 2008 research article in *Small Carnivore Conservation* (Vol. 38: 2–28). The status of the species in Nepal is discussed in the chapter that provides information on a community-based conservation intervention. A critical assessment has been made of the reports of the species from atypical sites outside the Himalaya. A glaring gap is the absence of any information from Bhutan, a region probably with a very high potential for the conservation of the species in the wild.

It is reported in an appendix to the synthesis chapter that the species is not as much threatened by trade as it is from habitat loss, fragmentation, and developmental activities. Still, much importance appears to have been given by various authors, including the editor, to captive breeding and reintroduction, although with necessary caution. Given lack of information on many aspects of Red Panda biology in the wild, and given the risk of trade linked to captures and 'rescues', the focus on captive breeding and reintroduction seems somewhat premature and over-emphasised. It would have helped to have a chapter dealing with methods to study and survey the species, the key questions we need answers for from wild populations, and most importantly, threats and conservation of the species in the wild, and potential sites for reintroduction where such threats have been addressed.

The book clearly achieves its primary aim of providing a scientifically comprehensive overview of Red Panda biology. The book is fortunately uncompromising in its high technical quality, but this may make it of less interest to lay persons and wildlife enthusiasts. The taxonomic puzzles over Red Panda dealt with in one chapter and in the synthesis presents evidence suggesting that the two forms are indeed distinctive enough to be considered species, with the possibility of additional species or sub-species yet to be described.

Useful aspects of the book include the concluding summary of each chapter that also highlights the gaps in the knowledge, and the synthesis of all the chapters by the editor. Organisation of multiple chapters into a common theme (e.g. Evolution, Ecology, etc.) would have been useful as would have a detailed range-wide map showing the localities mentioned. The bibliography is extensive, and the book is adequately illustrated with neat and attractive images and figures wherever necessary. There are few typographical errors but some of the chapters could have benefited from language editing. The book is an essential reference for students, researchers, and biologists planning any further work on captive or wild Red Panda. The book is a necessary addition to any natural history, life sciences, or wildlife library.

Divya MUDAPPA
Nature Conservation Foundation
3076/5, IV Cross, Gokulam Park, Mysore - 570002, India.
Email: divya@ncf-india.org

Malay Civet *Viverra tangalunga* (Photo: Shankar Raman)

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