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Reddish-orange mongoose *Herpestes*, apparently Collared Mongoose *H. semitorquatus*, Sabah, Malaysian Borneo (Photo: J. Ross and A. J. Hearn)

First record of Hose's Civet *Diplogale hosei* from Indonesia, and records of other carnivores in the Schwaner Mountains, Central Kalimantan, Indonesia

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Abstract

One of the least-recorded carnivores in Borneo, Hose's Civet *Diplogale hosei*, was filmed twice in a logging concession, the Katingan–Seruyan Block of Sari Bumi Kusuma Corporation, in the Schwaner Mountains, upper Seruyan River catchment, Central Kalimantan. This, the first record of this species in Indonesia, is about 500 km southwest of its previously known distribution (northern Borneo: Sarawak, Sabah and Brunei). Filmed at 325 m a.s.l., these records are below the previously known altitudinal range (450–1,800 m). This preliminary survey for medium and large mammals, running 100 camera-traps in 10 plots for one year, identified in this concession 17 carnivores, including, on *The IUCN Red List of Threatened Species*, three Endangered species (Flat-headed Cat *Prionailurus planiceps*, Bay Cat *Pardofelis badia* and Otter Civet *Cynogale bennettii*) and six Vulnerable species (Banded Civet *Hemigalus derbyanus*, Binturong *Arctictis binturong*, Sunda Clouded Leopard *Neofelis diardi*, Marbled Cat *Pardofelis marmorata* and Sun Bear *Helarctos malayanus*, as well as Hose's Civet).

Keywords: Borneo, camera-trapping, *Cynogale bennettii*, *Pardofelis badia*, *Prionailurus planiceps*, sustainable forest management

Catatan Pertama mengenai Musang Gunung *Diplogale hosei* di Indonesia, serta karnivora lainnya di daerah Pegunungan Schwaner, Kalimantan Tengah

Abstrak

Salah satu jenis karnivora yang jarang dijumpai di Borneo, Musang Gunung, *Diplogale hosei*, telah terekam dua kali di daerah konsesi hutan Blok Katingan–Seruyan- PT. Sari Bumi Kusuma, Pegunungan Schwaner, di sekitar hulu Sungai Seruya, Kalimantan Tengah. Ini merupakan catatan pertama spesies tersebut terdapat di Indonesia, sekitar 500 km dari batas sebaran yang diketahui saat ini (Sarawak, Sabah, Brunei). Lokasi berada pada ketinggian 325 m di atas permukaan laut (d.p.l), jauh lebih rendah dari catatan yang saat ini diketahui (450–1800 m d.p.l). Survey mengenai mamalia sedang dan besar ini menggunakan 100 kamera di 10 lokasi selama satu tahun, mendapatkan 17 spesies karnivora, termasuk tiga spesies katagori terancam (kucing hutan *Prionailurus planiceps*, kucing merah *Pardofelis badia*, musang air *Cynogale bennettii*) dan enam jenis katagori rentan pada daftar IUCN (musang belang *Hemigalus derbyanus*, binturong *Arctictis binturong*, macan dahan *Neofelis diardi*, kucing batu *Pardofelis marmorata*, beruang madu *Helarctos malayanus*, selain musang gunung).

Kata kunci: *Cynogale bennettii*, kamera perangkap, *Pardofelis badia*, pengelolaan hutan berkelanjutan, *Prionailurus planiceps*, Pulau Kalimantan

Introduction

Tropical rainforest in Southeast Asia, particularly on the island of Borneo, is known for its high species richness of carnivores (Primack & Corlett 2005). These include three endemic to Borneo: Bay Cat *Pardofelis badia*, Hose's Civet *Diplogale hosei* and Bornean Ferret Badger *Melogale everetti*, and one questionable species, Hose's Mongoose *Herpestes hosei* (Payne *et al*. 1985, Corbet & Hill 1992). There are many recent distribution records of carnivores in Sabah (e.g. Davies & Payne 1982, Heydon & Bulloh 1996, Wilting *et al.* 2010b, Brodie & Giordano 2011, Matsubayashi *et al.* 2011), and some from Brunei (e.g., Yasuma & Abdullah 1997a, 1997b), Sarawak (e.g., Azlan & Lading 2006, Giman *et al.* 2007, Mathai *et al.* 2010) and East Kalimantan (e.g., Yasuma 1994, Yasuda *et al.* 2007). However, little information has been collected in West, Central and South Kalimantan (e.g., Meijaard *et al.* 2005, Duckworth *et al.* 2006, Veron *et al*. 2006, Wilting *et al.* 2010a, Cheyne & Macdonald 2011), even though these three provinces comprise in total 46 % of Borneo.

Camera-traps are widely used to survey elusive mammals such as carnivores (Carbone *et al.* 2001, Chen *et al.* 2009). This report presents preliminary findings about carnivore species camera-trapped in a logging concession in Central Kalimantan, notably the first record of Hose's Civet for Indonesia.

Study area

The Katingan–Seruyan Block of Sari Bumi Kusuma Corporation (SBK) (1,476 km^2) lies in the Schwaner Mountains, part of the upper Seruyan River catchment, in Central Kalimantan near the border with West Kalimantan (0°38'S–1°07'S, 111°54'E–112°26'E; Fig. 1). To the east it borders Bukit Baka–Bukit Raya National Park (1,811 km^2). The concession's altitude ranges between 100 and 1,552 m. Average annual rainfall at the two base camps (at 200 m and 150 m a.s.l.) from 2001 to 2009 was 3,730 mm. Annual temperature ranges are 22°C–28°C by night and 30°C–33°C by day (SBK unpublished data). The dominant vegetation in the concession is mixed dipterocarp forest, with

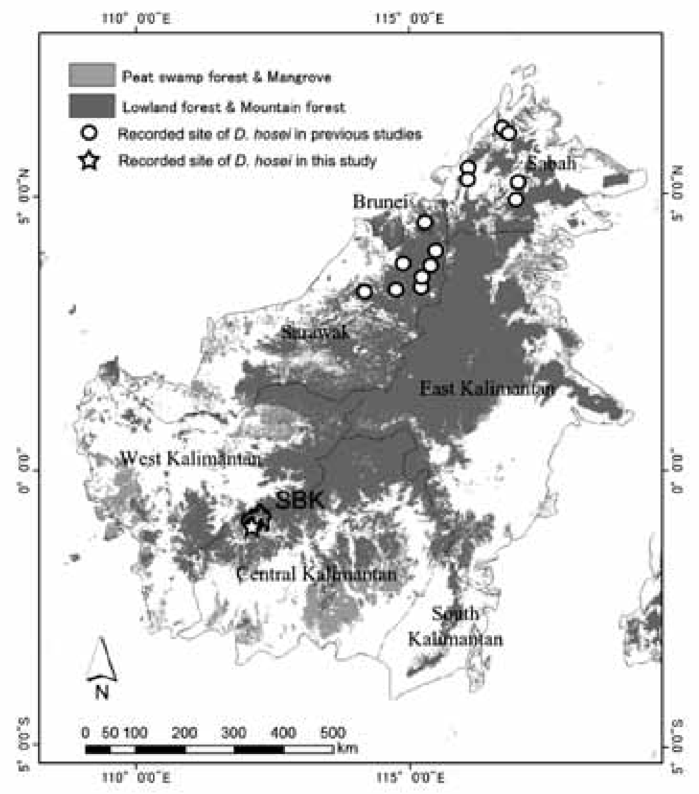

Fig. 1. Borneo, showing recorded sites of Hose's Civet *Diplogale hosei* (sources are detailed in the text) and the area of remaining natural forest (Miettinen *et al.* 2011).

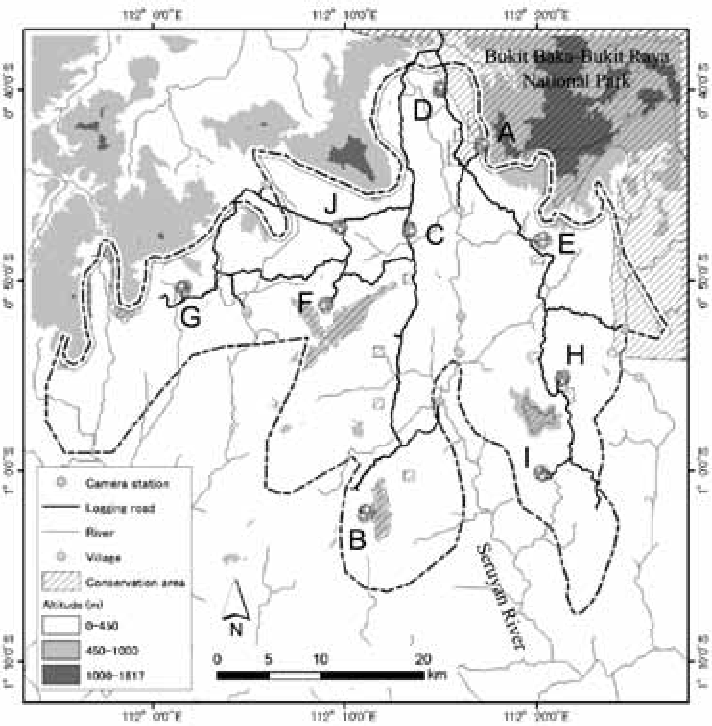

Fig. 2. Ten plots in the Katingan–Seruyan Block of Sari Bumi Kusuma Corporation, Central Kalimantan, Indonesia. Ten camera set points were randomly selected in each plot.

10.9% of the area under shifting cultivation by local villagers and forest fallow (Sari Bumi Kusuma 2009a). The major tree species in the mixed dipterocarp forest are meranti *Shorea*, melapi *Terictia*, kapur *Dryobalanops*, bangkirai *Shorea laevifolia*, keruing *Dipterocarpus* and mersawa *Anisoptera* (Hardiansyah *et al.* 2006).

This concession runs a natural forest management scheme in line with Indonesian regulations, including selective harvesting of large trees (diameter at breast height > 45 cm) and post-harvest planting of native species seedlings (at 5 m intervals) in lines on relatively flat parts of the concession. The lines are spaced 25 m apart and a 3 m width is totally cleared before planting. This system is called *Tebang Pilih dan Tanam Jalur* (selective cutting and strip planting system, TPTJ). A 20-year logging license was granted to SBK and selective logging started in 1978. The second lease, for 70 years, was given in 1998 with approval to implement the TPTJ system. Harvesting consists of a long cutting cycle (35 years) using a reduced-impact logging technique (Hardiansyah *et al.* 2006). To support the original composition of flora and fauna, and for use as a seed resource for seedling production, several parts of the concession are not logged (Fig. 2). As a result of these efforts, SBK was certified as sustainably managed by the Forest Stewardship Council (FSC) in 2007. There are about 2,000 permanent and contract staffs in SBK (SBK unpublished data), six villages inside and four villages near the border of the concession, and (in 2009) a total population of 3,145 people among 762 households. The village population has increased 1.87-fold from 2004 (Sari Bumi Kusuma 2009b). Company regulations strictly prohibit any hunting activities by all staff categories within the concession, but are very difficult to enforce, given the large number of contract field staff and local residents. For the latter, hunting within the concession area of common animals for domestic consumption, while prohibited, is tolerated.

Methods

Ten circular plots (1 km in diameter) were established in this concession, 100–1,000 m from main logging roads (Fig. 2, Table 1). Four plots were in primary forest (A, C, H, J). Primary forest in plot A is contiguous with Bukit Baka–Bukit Raya National Park, while the other three (C, H, J) were 'islands' of only a few square kilometers, each surrounded by logged forest. The other six plots were harvested once during 1999–2010. Line planting was conducted in four of those plots (D, E, G, I) but not in B and F.

Ten points within each plot, thus totally 100 points, were randomly selected using the statistical software R 2.10.0 (R Development Core Team 2011). A digital camera-trap with an infrared sensor (Model 119435, Bushnell Trophy Cam) was set in video mode at each point. Each random point was located using a GPS receiver (GPSMAP 60CSx, Garmin Ltd, Olathe, KS, U.S.A.). The camera was set on a tree near the random point, to face open ground with a capture area of about 2–7 m^2, avoiding intrusive large trees and bushes; these would hinder identification of filmed species. The camera was set about 2 m from the capture area and 50–100 cm above the ground. At a sloped set point, the camera faced upslope to obtain images that were easy to identify, while at a flat set point, the camera faced downward to limit the captured area from becoming too large and thus not to vary greatly among the set points. At random points lacking any good setting opportunity, an appropriate location was used

Table 1. Altitudes of camera set points and forest condition of the 10 plots in the Katingan–Seruyan Block of Sari Bumi Kusuma Corporation, Central Kalimantan.

Plot	Coordinates	Altitudes mean (range)	Forest condition
A	00°43'08"S, 112°17'07"E	463 (407–520)	Primary forest (large)
B	01°02'17"S, 112°11'10"E	287 (234–347)	Harvest (2003)
C	00°47'30"S, 112°13'26"E	192 (182–205)	Primary forest (small)
D	00°40'05"S, 112°14'49"E	238 (232–251)	Harvest and strip planting (2004)
E	00°47'56"S, 112°20'32"E	231 (208–248)	Harvest and strip planting (2003)
F	00°51'22"S, 112°09'02"E	201 (180–238)	Harvest (2007)
G	00°50'29"S, 112°01'45"E	219 (209–236)	Harvest and strip planting (2010)
H	00°55'05"S, 112°21'25"E	198 (178–222)	Primary forest (small)
I	01°00'12"S, 112°20'23"E	149 (138–177)	Harvest and strip planting (1999)
J	00°47'20"S, 112°09'47"E	207 (197–215)	Primary forest (small)

up to 20 m away. Altitudes of the setting points were derived from the topographic database of the Shuttle Radar Topography Mission (SRTM, http://www2.jpl.nasa.gov/srtm/): they ranged between 138 m and 520 m (Table 1).

The camera-trap was set to film for 10 seconds after being triggered with a triggering interval of 10 seconds (default setting). The camera-traps took colour images during daytime and monochromatic images, with infrared, during night or in poor light. Memory cards and batteries were changed every 2–5 months. Cameras were changed if they had stopped working. All 100 camera-traps were run from December 2010 to December 2011.

After images were downloaded from the memory cards in the camera-traps, the animal species, the number of individuals, and the date and time of each image were tabulated. Species identification was conducted by HS and GS by referring to Payne *et al*. (1985, 2000), discussion of some images with J. W. Duckworth, A. Wilting, J. Hon, Y. Nakashima, M. Nakabayashi and Y. S Fitriana, and some by comparison with Museum Zoologicum Bogoriense specimens. Then, the number of images of each species in each plot was counted, excluding images of a species already filmed at the same point within the previous 30 minutes. Active-camera-days, the period from the date a camera started until the date it was retrieved (or the date of last image filmed, in cases of camera malfunction), were summed per plot.

Results

The 10 plots had 17,974 active-camera-days. Many cameras stopped working during the study. The total active-camera-days was smallest at plot E with 894 camera-days, with 1,618–2,491 camera-days at the other plots (Table 2).

In total, 303 images of 17 carnivore species were obtained (Table 2), including three species listed as Endangered (Flat-headed Cat *Prionailurus planiceps*, Bay Cat *Pardofelis badia* and Otter Civet *Cynogale bennettii*) and six as Vulnerable (Banded Civet *Hemigalus derbyanus*, Hose's Civet *Diplogale hosei*, Binturong *Arctictis binturong*, Sunda Clouded Leopard *Neofelis diardi*, Marbled Cat *Pardofelis marmorata* and Sun Bear *Helarctos malayanus*) on *The IUCN Red List of Threatened Species* (IUCN 2011). An otter (Lutrinae), 10 images of mongooses *Herpestes*, and 17 images of civets could not be identified to species level.

The most frequently filmed species, accounting for 45.5% of all images, was Banded Civet. This was filmed in eight of the 10 plots, particularly often in plots A and F. The second most frequently filmed species was Sun Bear, the only species filmed at all 10 plots, followed by Banded Linsang *Prionodon linsang* (filmed at nine plots), Common Palm Civet *Paradoxurus hermaphroditus* (at six plots) and Malay Civet *Viverra tangalunga* (at five plots; Table 2).

The two records of Hose's Civet were filmed at a point (1°02'03"S, 112°10'58"E; 325 m a.s.l.) in plot B, at 02h26 on 10 August and at 20h38 on 11 November 2011 (Fig. 3). Both films, which may or may not show the same individual, showed a singleton walking slowly on the forest floor (see Electronic supplementary materials). The animals had dark upperparts, white underparts, and tail lengths about 70% of the head-and-body lengths. The closest possible confusion species could be Small-toothed Palm Civet *Arctogalidia trivirgata* which, however, has a tail length 110–120% of the head-and-body length (Payne *et al*. 1985). The camera-set point was in a secondary forest with tree harvest eight years previously, about 5 m from an old feeder road (Fig. 4), and about 600 m from a protected area eastward (Fig. 2). Forest canopy was still sparse, the floor was relatively well-lit, and ferns *Blechnum* were growing.

Discussion

The finding of Hose's Civet in this concession was extraordinary. This location is at least 500 km from all previous records, in northern Sarawak (e.g. Mathai *et al.* 2010), Brunei (e.g. Francis 2002, Yasuma 2004) and Sabah (e.g. Francis 2002, Dinets 2003, Wells *et al.* 2005, Brodie & Giordano 2011, Matsubayashi *et al.* 2011; Fig. 1), and is 125 m lower in altitude than the lowest previous record, at 450 m a.s.l. and itself regarded as unusually low (Francis 2002, Van Rompaey & Azlan 2004, Hon & Azlan 2008). The protected area east of plot B is a small 680-m high peak (Fig. 2), perhaps too small to sustain a Hose's Civet population. North of the concession are the border mountains between Central and West Kalimantan, with a large land area over 450 m a.s.l. (Fig. 2), but more than 30 km

Table 2. Number of images of each carnivore species in the 10 plots in the Katingan–Seruyan Block of Sari Bumi Kusuma Corporation, Central Kalimantan.

Species	*Red List* status	Plot										Total
		A	B	C	D	E	F	G	H	I	J	
Banded Civet *Hemigalus derbyanus*	VU	55	11	6	2		47	8	1		8	138
Sun Bear *Helarctos malayanus*	VU	1	8	3	11	1	12	1	2	8	2	49
Common Palm Civet *Paradoxurus hermaphroditus*		1					9	4	3	3	1	21
Banded Linsang *Prionodon linsang*		4		1	3	1	3	1	4	1	2	20
Malay Civet *Viverra tangalunga*			12	2				1		1	3	19
Collared Mongoose *Herpestes semitorquatus*	DD	10	1				1	2			1	15
Yellow-throated Marten *Martes flavigula*					1		4		2	1	3	11
Short-tailed Mongoose *Herpestes brachyurus*			6		2			2				10
Masked Palm Civet *Paguma larvata*		2	3						1			6
Leopard Cat *Prionailurus bengalensis*		1					1			2	1	5
Flat-headed Cat *Prionailurus planiceps*	EN			1						1		2
Hose's Civet *Diplogale hosei*	VU		2									2
Bay Cat *Pardofelis badia*	EN						1					1
Binturong *Arctictis binturong*	VU						1					1
Sunda Clouded Leopard *Neofelis diardi*	VU						1					1
Marbled Cat *Pardofelis marmorata*	VU										1	1
Otter Civet *Cynogale bennettii*	EN									1		1
Total number of images		74	43	13	19	2	80	19	13	18	22	303
Total number of species		7	7	5	5	2	10	7	6	8	9	17
Total camera working days		1,714	2,136	2,095	1,828	894	2,491	1,618	1,684	1,869	1,645	17,974

EN = Endangered, VU = Vulnerable, DD = Data Deficient on *The IUCN Red List of Threatened Species* (IUCN 2011); the other species are Least Concern. Images not identifiable to species (see text) are not included in this table.

from plot B. Therefore, areas below 450 m a.s.l. may be a part of the main habitat for Hose's Civet, at least in this area.

This Hose's Civet record highlights how much remains to be discovered about the mammals of West, Central and South Kalimantan. Moreover, the area may support another surprise: Sunda Stink-badger *Mydaus javanensis* is said to occur, albeit patchily, all over Borneo (Payne *et al*. 1985, Yasuma 1994), but there are few records from West, Central and South Kalimantan (Samejima *et al*. in prep.) and its current status in these provinces is not well known. Some staff of SBK said that they have observed animals similar to the image of Stink-badger in Payne *et al*. (1985), and which make a distinctive smell, in this concession and around their villages along the Melawi River, West Kalimantan (particularly in rubber gardens), 50 km from this concession. They called the animal *Kenseduk* or *Onsoduk* in the local language (Dayak Limbai). To investigate the distribution and status of Hose's Civet, Sunda Stink-badger and other carnivores in this region, more camera-trap study is necessary.

Hunting pressures in the survey plots are notable. Although camera set points were not along human trails, hunters were filmed at six of the ten plots (C, E, G, H, I, J). Snaring occurs, with about 50 snares found in plot A and somewhat fewer in plot I (GS pers. obs.). Bearded Pig *Sus barbatus* and Sambar *Rusa unicolor* are their main targets, but carnivores were also hunted (Y. S. Fitriana & GS pers. obs.). The plots are relatively close to the main logging road, so hunting intensity may not be as high as in areas more distant. To reduce hunting, we recommend closing old logging roads by destroying bridges or constructing gates and trenches after harvesting, so that hunters cannot bring vehicles far inside the forest (Meijaard & Sheil 2008). In Sarawak, Malaysian Borneo, strict government control over bullet-trading has reduced hunting over the past decade (HS pers. obs.). Locals in Sarawak do not make bullets, although making a gun is relatively easy, particularly for logging camp mechanics. However, this policy might not much decrease hunting pressure in this study area: concession staff said that local people can also make bullets.

The presence of Hose's Civet in plot B, where forest was harvested only eight years ago, suggests some degree of tolerance of this species to selective logging, particularly under a scheme of sustainable forest management (SFM). The presence of many other threatened carnivore species in this concession also supports the notion that SFM can maintain high species richness of mammals in Borneo (Meijaard & Sheil 2008, Wilting *et al*. 2010b, Samejima *et al.* 2012). However, the filmed individual(s) of Hose's Civet might be just passing the plot and may not be able to subsist there. Moreover, previous harvesting activity might have irreversibly decreased many species' density, leaving populations too small for long-term viability. Continued monitoring is necessary to evaluate the longer-term impact of the logging activity.

SFM of natural forest, as certified by FSC, is considered to be effective to retain these threatened carnivore species. Because much of Borneo is now rapidly converted to oil palm and pulp wood plantation (Cooke 2002, McCarthy & Cramb 2009, Potter 2011) with attendant large loss of biodiversity (Fitzherbert *et al.* 2008), SFM of natural forest should be strongly supported to maintain the regional bodiversity. However, the economic premium from forest certification to plywood, the main product from this and other concessions

Fig. 3. Hose's Civet *Diplogale hosei* filmed at 02h26, 10 August 2011 (left and centre) and 20h38, 11 November 2011 (right) in a camera set point in plot B of Katingan–Seruyan Block of Sari Bumi Kusuma Corporation, Central Kalimantan, Indonesia.

in Borneo, is presently too small to promote SFM. More domestic and international institutions that effectively promote SFM, such as direct payment for the SFM implementation or achievement of biodiversity conservation (as can be evaluated by camera-trapping), should be considered (Dennis *et al*. 2008).

Fig. 4. The camera set point in plot B of Katingan–Seruyan Block of Sari Bumi Kusuma Corporation, Central Kalimantan, where Hose's Civet *Diplogale hosei* was filmed; the point itself (top), and old logging feeder road about 5 m from the camera-point (bottom).

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Electronic supplementary material
The images of Hose's Civet are uploaded in the following:
http://youtu.be/zqHGzjUaSRQ
http://youtu.be/Ge9IAciK6w0

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Erratum

Corrections on second column (Sex) of Table 3 and Table 4 in **Mallick, J. K. 2011. New records and conservation status review of the endemic Bengal Mongoose Herpestes palustris Ghose, 1965 in southern West Bengal, India. *Small Carnivore Conservation* 45: 31–48**. For the entire Tables, including other columns (none of which need correction) and corrected second columns, kindly refer the journal website www.smallcarnivoreconservation.org.

Table 3. Past records (1964–2006) of Bengal Mongoose *Herpestes palustris* from its entire world range[1].

Location	Sex[2]
District: Howrah	
Shibpur (22°33'N, 88°18'E)	1♂
Nazimganj (south of Shibpur)	1♂+1♀
District: North 24-Parganas	
Salt Lake (22°35'N, 88°25'E), Bantala (22°31'N, 88°26'E), Duttabad (22°36'N, 88°26'E), Hederhat (22°29'N, 88°23'E), Nalban (22°34'N, 88°25'E) (East Kolkata Wetlands)	19♂+8♀
Sahebmara bheri (22°33'N, 88°25'E) (East Kolkata Wetlands)	not known
Sukantanagar (22°33'N, 88°24'E) and N° 4 bheri, Nalban (22°33'N, 88°25'E) (East Kolkata Wetlands)	20 unsexed
N° 4 bheri, Nalban (East Kolkata Wetlands)	3♂+3♀
Sukhchar (22°43'N, 88°22'E)	1♂
District: South 24-Parganas	
Bhasna (= Bhajna in Soota & Chaturvedi 1970) (exact location not known)	1♀; "very common"
Budge Budge (22°28'N, 88°10'E) and Patiatala (exact location not known)	Not known
IIM wetland, Joka (22°26'N, 88°17'E)	Not known

[1]All locations lie in southern West Bengal.
In addition, Kundu *et al*. (2008) indicated occurrence in Chowbhaga (opposite Bantala), Jhagrasisa and Mahishbathan, but these records are ignored here (see text).
Specimens (skin, skull and incomplete postcranial skeleton) of a male and two unsexed Bengal Mongooses are held by the Museum Victoria, Australia (registration nos 4388/4389; 4838/4839/4840; 4920/4921). They came through the Royal Melbourne Zoo (N. W. Longmore *in litt*. 2011), and their origin is apparently not recorded
[2]Sex could be determined only for animals handled by ZSI and NEWS.
[3]No details are given, and the photograph puportedly of the species lacks any black patch on the muzzle.

Table 4. Recent records (2007–April 2011) of Bengal Mongoose *Herpestes palustris* from its entire world range.

Location	Sex
District: Howrah	
Santragachhi Jheel (lake) (22°34'N, 88°16'E)	1 unsexed
Shibpur	4 unsexed (n+q)*
District: North 24-Parganas	
N° 4 bheri, Nalban, East Kolkata Wetlands	3 unsexed (n)
	1♀+3 cubs (r)
	1 unsexed
	1♂ (n)
	1♂+2 unsexed (n+p)
	2♂ (n)
	2 unsexed (n)
	4 unsexed (n+p)
Keshtopur, Rajarhat wetland (near Bagjola canal) (22°37'N, 88°25'E)	1 unsexed
District: South 24-Parganas	
Green View wetland, Joka (22°26'N, 88°18'E)	1 unsexed
Indian Institute of Management wetland, Joka	1 unsexed
Kadamtala, Behala (22°29'N, 88°18'E)	1 unsexed
Survey Park, Ajaynagar, Santoshpur (22°29'N, 88°23'E)	1 unsexed
Subhasgram (22°24'N, 88°26'E)	1 unsexed
	1 unsexed
South Kolkata (exact locality not known)	2 (p)

*n= single, p= duo, q= trio, and r= group of four.

The occurrence of reddish-orange mongooses *Herpestes* in the Greater Sundas and the potential for their field confusion with Malay Weasel *Mustela nudipes*

J. ROSS[1], E. GEMITA[2], A. J. HEARN[1] and D. W. MACDONALD[1]

Abstract

Five recent camera-trap records of mongooses *Herpestes* from two different survey areas in Sabah, Malaysian Borneo, show strongly reddish-orange pelage. These animals otherwise resemble Collared Mongoose *H. semitorquatus*, and appear to represent colour variation within this species. Collared Mongooses of typical mahogany-brown colour and with pelage of intermediate colour were also recorded, as were Short-tailed Mongooses *H. brachyurus*. A single photograph of a similarly bright reddish-orange mongoose was taken in Harapan Rainforest, Sumatra, Indonesia. This coloration is relatively rare within the Collared Mongoose population of Borneo; it may predominate in Sumatra. It is a hitherto unappreciated identification pitfall for Malay Weasel *Mustela nudipes*, itself more variable in pelage colour than is popularly appreciated.

Keywords: Borneo, Collared Mongoose, field identification, *Herpestes semitorquatus*, pelage variation, Sumatra

Kejadian kemerah jinggan pada mongooses di Greater Sunda dan potensi kekeliruan di lapangan dengan Malay Weasel *Mustela nudipes*

Abstrak

Lima rekod perangkap kamera terkini tentang mongooses *Herpestes* daripada dua kawasan tinjauan di Sabah, Malaysia Borneo, menunjukan warna bulu kemerah jinggan yang sangat ketara. Binatang ini adalah sangat serupa dengan Bambun ekor panjang (Collared Mongooses *H. semitorquatus*), dan muncul mewakili variasi warna dalam spesis ini. Bambun ekor panjang (Collared Mongooses) dan Bambun ekor pendek (Short-tailed Mongooses *H. brachyurus*) yang biasanya berwarna mahogany coklat, dan dengan warna bulu perantaraan juga direkodkan. Satu rekod bergambar mongooses yang mempunyai warna bulu kemerah jinggan juga didapati di Hutan hujan Harapan, Sumatra, Indonesia. Perwarnaan seperti ini relatifnya jarang berlaku di dalam populasi Bambun ekor panjang (Collared Mongoose) di Borneo, dan mungkin predominan di Sumatra. Sehingga sekarang ia sukar dikenali kerana salah pengecaman dengan Pulasan Tanah (Malay Weasel *Mustela nudipes*), kerana ia berbeza dalam warna bulu daripada apa yang selalu dikenali.

Kata kunci: Borneo, Collared Mongoose, pengecaman lapangan, *Herpestes semitorquatus*, variasi bulu, Sumatra

Ongoing camera-trap surveys of AJH, JR and DWM of seven forest areas and two oil palm plantations in Sabah, Malaysian Borneo, have accumulated over 30,000 trap-nights and over 11,000 photographic captures of 22 carnivore species. These surveys have generated five independent photographic records of mongooses showing markedly reddish-orange pelage from two contiguous survey areas, Ulu Segama Forest Reserve and Danum Palm oil palm plantation (Table 1; Fig. 1). Such animals are not mentioned in the standard mammal identification guide for Borneo, Payne *et al*. (1985). A full compilation of our records of reddish-orange mongooses is in preparation. Ideally, a later analysis will also include a comprehensive review of museum specimens. This interim note draws attention to the existence of these animals, to (1) appeal for other relevant records, (2) assist those who may currently be in a position to review museum specimens, and (3) highlight the risk of confusion with Malay Weasel *Mustela nudipes*.

An example of this reddish-orange coloration is shown in Fig. 2, photographed in the Danum Palm Estate (5°04'31.5"N, 117°45'19.7"E; measured altitude 263 m) on 7 May 2009 at 09h44. This animal closely resembles typical Collared Mongooses *Herpestes semitorquatus* (Fig. 3) in its general proportions and other characters, such as the pale neck-stripe, as do all photographs of reddish-orange mongooses from these surveys (e.g. photograph on front cover). In these characters, they differ markedly from the only other mongoose native to Borneo, Short-tailed Mongoose *H. brachyurus*, which additionally is even less warm brown in pelage than are typical Collared Mongooses (Fig. 4). A total of 86 independent detections (one record per camera site, per hour) of Collared Mongoose showing typical brown or reddish-brown pelage were recorded during these nine surveys, highlighting the relative rarity of the orange-coloured animals. These compare with 230 independent detections of Short-tailed Mongoose, and while slight variation was noted within the latter's pelage, no extremes in coloration were recorded. An additional 61 independent records of mongooses, none showing the reddish-orange coloration, could not be identified to species. Whilst the number of Collared Mongooses exhibiting the extreme reddish-orange coloration was limited to five (5.49%) records, significant variation in pelage coloration is present in typical animals, some being somewhat more red in tone, with darker,

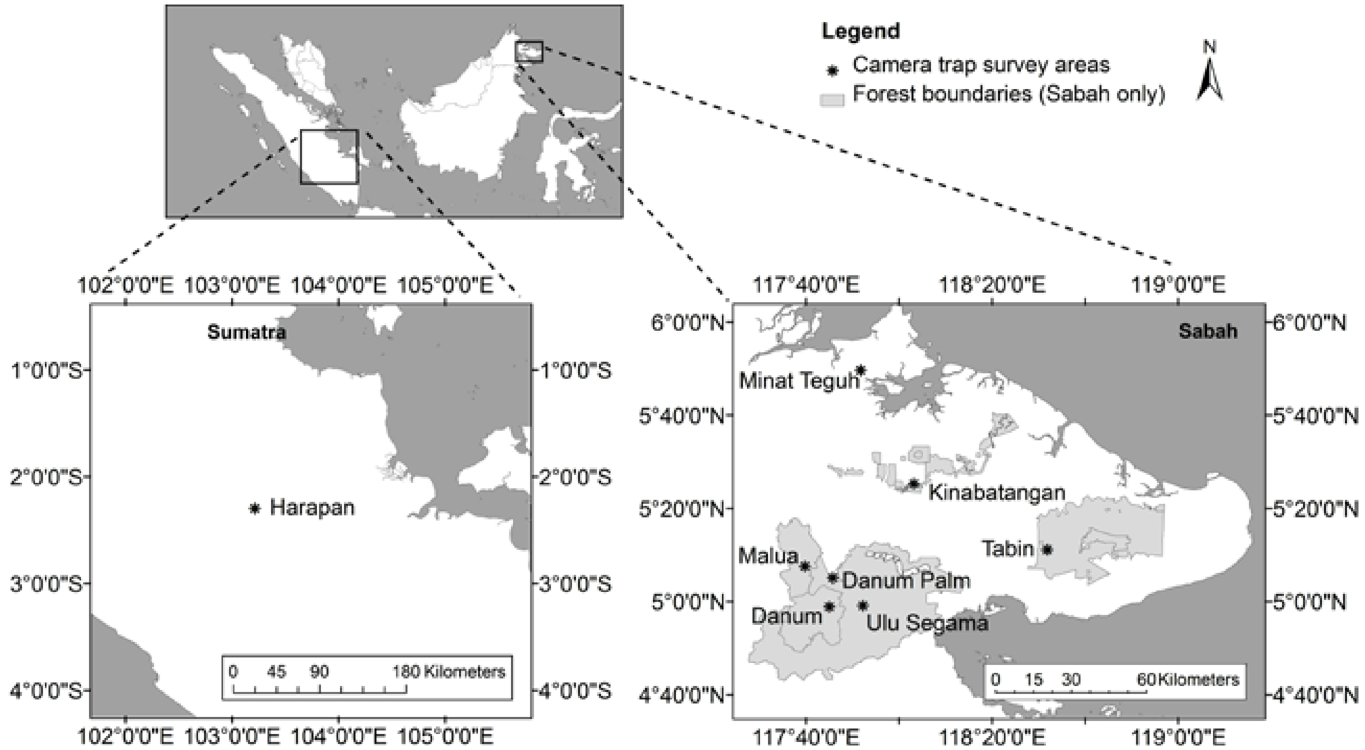

Fig. 1. Locations of the camera-trap survey areas in Borneo and Sumatra.

Table 1. Locations, dates and times for each of the five photo captures of reddish-orange mongooses *Herpestes* in Sabah, Malaysia, showing the total number of photographs recorded per independent occasion.

Study area	Location	Date	Time	Total n° photos
Ulu Segama F.R.	4°57'03.1"N, 117°53'20.9"E	19 Sep 2007	15h52	1
Danum Palm Estate	5°04'58.6"N, 117°45'32.7"E	1 Apr 2009	17h34	1
Danum Palm Estate	5°05'03.3"N, 117°46'29.0"E	23 Apr 2009	07h34	1
Danum Palm Estate	5°04'31.5"N, 117°45'19.7"E	7 May 2009	09h44	4
Danum Palm Estate	5°04'31.5"N, 117°45'19.7"E	22 Jun 2009	13h53	2

grey-brown coloration dorsally and on the upper parts of their rear legs. Two such animals are shown, from Danum Palm Estate (5°04'20.4"N, 117°46'23.5"E; measured altitude 243 m) on 14 May 2009 at 18h04 (Fig. 5a) and from Danum Palm Estate (5°04'31.5"N, 117°45'19.7"E; measured altitude 263 m) on 26 March 2009 at 07h32 (Fig. 5b). This observed colour variation does not appear to be related to habitat; animals of typical pelage, reddish-orange ones and intermediates were all detected in both forest and oil palm habitat.

Careful examination of the colour of the plants and other background in each relevant photograph indicates that these reddish-orange animals' tones are real, and not simply the effects of lighting, or a malfunction of the camera which would cause the entire photograph to be peculiarly coloured. In addition, the same type of digital camera-trap (Snapshot Sniper P41, Snapshot Sniper LLC, OK, U.S.A.), which incorporates a relatively high quality Sony P41 digital camera, was used in all Sabah surveys where these animals were recorded, thus reducing potential colour bias resulting from the use of different photographic equipment. Due to this variation in typical Collared Mongoose pelage tone, and because the reddish-orange animals' structure and pelage pattern do not differ notably from those of typical Collared Mongoose, it seems likely that they represent variation in that species' pelage.

A single orange mongoose has also been camera-trapped recently on Sumatra, Indonesia. A total of 2,059 trap-nights in the Harapan Rainforest in 2010 generated only four detections of mongooses. Three were typically coloured Short-tailed Mongooses but the other shows striking orange-coloured pelage and was taken in mixed lowland secondary forest with bamboo, near a river, on 29 December 2010 at 16h02 (Fig. 6; 2°18'04.1"S, 103°12'54.4"E; 70 m measured altitude). This animal is also similar to Collared Mongoose in its proportions, notably in the long tail length relative to head and body, but on the single photograph available, the neck pattern is difficult to determine. There are few records of Collared Mongoose from Sumatra. Those in Jentink (1894; one animal) and Robinson & Kloss (1919; two animals) may be the only previously published ones; a recent trawl for records traced no others from the island (Jennings & Veron 2011). An anonymous reviewer of the present text (*in litt*. 2012) pointed out that all these three specimens also are strikingly orange in colour. This Harapan animal's proportions cannot be that of Short-tailed Mongoose, the sole mongoose widely and commonly recorded on Sumatra. The only other mongoose species collected on Sumatra is Small Asian Mongoose *H. javanicus*, which may not be native there and is known by few records (Jennings & Veron 2011: 324): in relative proportion of head-and-body to tail length, it could arguably be the species camera-trapped at Harapan Rainforest. Thus, while this Harapan orange mongoose is also plausibly a Collared Mongoose, particularly given the striking orange-red coloration of all three Sumatran specimens about which we have information, it is best left presently unidentified.

A recent review of the taxonomy of Asian *Herpestes* mongooses, including examination of Collared Mongoose specimens held at the Rijksmuseum voor Natuurlijke Historie (National Museum of Natural History, 'Naturalis'), Leiden, Netherlands (RMNH) and the Natural History Museum, London, U.K. (Patou *et al*. 2009), did not discuss such wide intraspecific variation in pelage colour in any Sundaic mongoose, nor do the standard synthetic works covering these species such as Payne *et al*. (1985) and Corbet & Hill (1992). However, after examination of a Collared Mongoose specimen from Sumatra (RMNH 20803), Patou *et al*. (2009: 77) concluded that it was "clearly a red morph of *H. semitorquatus*": this is the only published statement we have traced referring to this coloration in the species. In their description of *Mungos* [= *Herpestes*] *semitorquatus unicolor*, based on two specimens including that later examined by Patou *et al*. (2009), Robinson & Kloss (1919: 302) surprisingly did not note the taxon as being redder than the nominate (Bornean) form, focussing their attention on its lack of hair banding, and describing its overall colour as "Sanford's Brown to Hazel".

We have not examined museum specimens and cannot therefore compare their pelage with the photographs here documented. However, this coloration in Bornean mongooses has been observed at least twice before, even if never preserved: Davies & Payne (1982: 153) wrote that a "viverrid [mongooses were then often seen as members of the Viverridae] which could not be identified as any known Sabah species (bigger and more red than the Malay Weasel) was seen in October 1980 active at 12:15 hours. This anomalous animal is perhaps [Hose's Mongoose] *Herpestes hosei*". J. Payne (*in litt*. 2012) observed this animal on the east side of the Crocker Range, north-west of Tenom town, at about 1,700 feet above sea level in hill dipterocarp forest. Davies & Payne (1982: 152) also noted that "in 1966, Mr Tony Lamb . . . was given a reddish mongoose collected at Tangusu Bay between Segama Estuary and Tambisan". That would be extreme lowland dipterocarp forest, maybe below 50 feet a.s.l., and was probably a logging area at the time, near swamp forest (J. Payne *in litt*. 2012). It seems highly likely that these animals were mongooses of the same type as here photographed; there is no need to invoke *H. hosei*, which is now generally considered a synonym of *H. brachyurus* (e.g. Corbet & Hill 1992, Patou *et al*. 2009).

Pending specimen confirmation, the assignment of these reddish-orange animals to Collared Mongoose is provisional. While it might seem surprising that such distinct phenotypic variation should remain undocumented for so long on Borneo, Collared Mongoose is so poorly known overall that it is listed as Data Deficient by *The IUCN Red List of Threatened Species* (IUCN 2011). It has never been the subject of any field study and it is only through the increasing use of camera-traps throughout its range that this apparently rare coloration has been recorded recently.

These mongooses pose a hitherto unappreciated identification risk with Malay Weasel. Although orange-red Collared Mongoose specimens collected a century ago are held in museum collections, the lack of explicit mention of them in standard identification sources is problematic given that most people making field identifications base these on the literature, and do not habitually visit skin collections to check all their identifications. Malay Weasel has conventionally been considered almost unmistakeable in the field, having been seen as the only bright-orange small carnivore in its range (Borneo, Sumatra and the Thai–Malay peninsula, but not Java; Duckworth *et al*. 2006); for example Duckworth *et al*. (2006: 3), reviewing records of the species, wrote that "being morphologically extremely distinctive (South-east Asia has no other white-headed bright orange mammal, let alone an obviously weasel-shaped one), sight records from observers of known general reliability were considered acceptable.". The present photographs clearly demonstrate that Malay Weasel is one of two orange small carnivores in the Sundaic subregion, at least on Borneo and Sumatra. Thus, its field identification needs considerably more care than was hitherto believed. Specifically, the Malay Weasel records compiled by Duckworth *et al*. (2006) should now be seen as provisional except where supported by specimens or publicly available photographs. It seems, however, unlikely that many past Malay Weasel records do in fact refer to orange mongooses, given the paucity of specimens of such mongooses in zoological collections (contrasting with the dozens of Malay Weasels) and the low proportion of orange specimens among the camera-trap photographs from these nine survey areas in Sabah. Nevertheless, there is now an added need to publish records of Malay Weasel that explicitly rule out mongooses from the identification.

For observers familiar with both genera, and with a good view (in life or on a photograph) of the animal, there should be little difficulty in distinguishing Malay Weasels from orange mongooses because the animals are so different in morphology. Under less optimal views, or for less experienced people, the risk is real. For example, the Sumatran animal here figured was originally placed on the project's web-site (Harapan Rainforest 2011) as a Malay Weasel (this has now been corrected) where it was seen and cited as a valid record of Malay Weasel in a manuscript about Sundaic small carnivores (J. W. Duckworth *in litt*. 2012).

Malay Weasels seem always to have a pale head and the tail often has a pale tip (Brongersma & Junge 1942), features not apparently shown by orange mongooses. However, Malay Weasel is extremely variable in pelage: Brongersma & Junge (1942: 157) wrote that "when the two extremes of the series [that they examined] . . . are placed side by side, one would hardly believe that they belong to the same species". Although all the specimens they studied had heads somewhat to markedly paler than the body (in extreme cases, whitish), it cannot be excluded that Malay Weasels with heads looking almost concolorous with their body under field conditions might occur. Fig. 7 exemplifies variation in the pelage of Malay Weasel, showing an animal with typical bright orange-coloured body and one with markedly browner pelage. These latter animals require particular care in identification as, similarly, do orange mongooses.

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Captions to figures (on back cover):

Fig. 2. Bright reddish-orange mongoose, apparently Collared Mongoose *Herpestes semitorquatus*. Photograph taken at Danum Palm Estate, Sabah, Malaysia, 7 May 2009.

Fig. 3. Collared Mongooses *Herpestes semitorquatus* showing typical mahogany-brown pelage. Photograph (a) taken in Ulu Segama Forest Reserve, Sabah, Malaysia, on 20 July 2007, (b) taken in Danum Palm Estate, Sabah, Malaysia, on 30 April 2009.

Fig. 4. Short-tailed Mongoose *Herpestes brachyurus*. Photograph taken in Danum Palm Estate, Sabah, Malaysia, 21 May 2009. Note body colour and overall grizzling of pelage.

Fig. 5. Apparent Collared Mongooses *Herpestes semitorquatus* showing pelage tone brighter than typical mahogany-brown pelage. Photograph (a) from Danum Palm Estate, Sabah, Malaysia, on 14 May 2009, (b) also from Danum Palm Estate, on 26 March 2009.

Fig. 6. Mongoose, potentially Collared Mongoose *Herpestes semitorquatus*, showing rich orange pelage; Harapan Rainforest, Sumatra, Indonesia, 29 December 2010 (Elva Gemita / Harapan Rainforest).

Fig. 7. Malay Weasel *Mustela nudipes*, (a) of typical coloration: note the various clear structural differences from mongooses *Herpestes* and the pale head. Photograph taken in Crocker Range National Park, Sabah, Malaysia, 4 November 2011. (b) showing a browner coloration, highlighting the potential for confusion with other species when identification is based on colour alone. Photograph taken in Crocker Range National Park, Sabah, Malaysia, on 1 February 2012.

For details of the above pictures, refer Ross *et al.* page 11.

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Distribution of Sunda Stink-badger *Mydaus javanensis* in Sarawak, Malaysia

Belden GIMAN and Alex JUKIE

Abstract

The Sunda Stink-badger (Teledu) *Mydaus javanensis* is one of the least studied mammals in the island of Borneo. Standard sources imply that it occurs throughout Sarawak, but this stance is not supported by the few, and geographically restricted records here traced in a review of records from the state. Historical specimens and recent sightings, in the context of survey effort across the state, suggest that Sunda Stink-badger does not occur south of Miri Division, and may even be erratic in occurrence outside the northernmost part of the state.

Keywords: Borneo, Miri Division, legal protection, protected area

Taburan Teledu *Mydaus javanensis* di Sarawak, Malaysia

Abstrak

Teledu atau lebih dikenali dengan nama saintifiknya *Mydaus javanensis* merupakan salah satu daripada spesies haiwan karnivora kecil yang jarang dan hampir tidak pernah dikaji secara terperinci di kepulauan Borneo khasnya. Berdasarkan sumber-sumber yang lazimnya didapati sebelum ini, menegaskan bahawa haiwan ini telah dikenalpasti dan dikesan meliputi hutan negeri Sarawak, tetapi kebenaran ini tidak dapat disokong kebenarannya oleh sesetengah pihak secara kajian saintifik, disebabkan oleh kawasan taburan geografi haiwan ini yang terhad dan rekod-rekod lampau yang tidak mencukupi untuk menyokong fakta sedemikian. Berdasarkan specimen-spesimen lama ditambah lagi dengan pemerhatian dan pemantauan yang telah dan sedang dijalankan untuk baru-baru ini terutamanya meliputi kawasan negeri Sarawak telah mengesahkan bahawa haiwan ini tidak menghuni kawasan di bahagian selatan bahagian Miri sehingga ke bahagian Kuching dan berkemungkinan juga mempunyai taburan yang tidak sekata terutamanya di kawasan utara negeri Sarawak.

Kata kunci: Borneo, Miri sehingga ke bahagian Kuching, kawalan undang-undang, kawasan terkawal

Introduction

The state of Sarawak, in the northwest part of the island of Borneo, covers approximately 24,450 km^2 of various habitats mostly forests (Bennett & Gumal 2001). It is the largest state in Malaysia. Of the approximately 24 species of the order Carnivora on Borneo, the Sunda Stink-badger (Teledu, or Malay Badger) *Mydaus javanensis* is among the most distinctive by sight and smell.

> "Many many times . . . the mydaus has discovered its proximity to us by its extremely disagreeable and peculiar odour. So powerful indeed is this that natives, attempting to catch these animals, often fall down insensible if struck by the discharge from their anal battery. Even at the distance of half a mile and more the stink, as I must call it, permeates the atmosphere so thickly that it is plainly discernible by taste" (Forbes 1879).

The species occurs only on Java, Sumatra, the North Natunas, and some neighbouring small islands, as well as Borneo (Corbet & Hill 1992, Meijaard 2003). Its only congener is the Palawan Stink-badger *Mydaus marchei* of Palawan and associated islands in the Philippines: these two species are the only species of skunks (Mephitidae) outside the Americas (Dragoo & Honeycutt 1997). Although Payne *et al*. (1985) felt that the species had a patchy distribution in Borneo, various subsequent secondary sources (e.g. Corbet & Hill 1992, Hwang & Larivière 2003, Long *et al*. 2008, Dragoo 2009) map, state or imply that Stink-badgers occur throughout Sarawak, which covers nearly 17% of the land area of Borneo. This suggestion is here tested by assembling Stink-badger records from across the state, followed by discussion of the species's habitat use and local conservation status.

Data sources

Records were sought from all available sources: the authors' notes; publications (formal and 'grey'; see Corlett 2011); in international museum holdings and their printed catalogues (e.g. Kool & Yakup Nawi 2005); and in correspondence with colleagues. Of particular relevance, many of the most intensive recent mammal surveys within the border of Sarawak were made by the Sarawak Forestry Corporation. Areas surveyed included several national parks (NPs), using camera-trap, line transect and night spotlighting surveys. None of the surveys reviewed had specifically targeted Stink-badger, but camera-trapping and spotlighting seem well able to detect the species where present (e.g. Wilting *et al*. 2010, though see Holden 2006). Most surveys aimed mainly to document in general terms the area's mammalian community.

Past and current distribution of Sunda Stink-badger in Sarawak

The first Stink-badger record from Sarawak was the collection of the two skins held by local people near Gunung (= Mount) Murud documented by Moulton (1921). Medway's (1977) comprehensive review traced few records from the state, and for the past 30 years or so, the only reliable Stink-badger records traced from Sarawak comprise incidental sightings and road-kills. All Sarawak records traced are given in Table 1 and portrayed in Fig. 1.

These records suggest that, in contrast to the portrayal in general sources (see above), Sunda Stink-badger is highly localised in Sarawak. Records come only from the Kelabit highlands and northwards to the border with Sabah. The only two records of road kills involving Stink-badgers were both from northern Sarawak (in Lawas), despite there probably being many more miles driven by people likely to notice and report road-kill wildlife in and around Kuching than in the state's north. Similarly, patterns of relevant survey effort across Sarawak warrant evaluation to consider whether the restriction of Stink-badger records in Sarawak to the north is likely to be a true reflection of the species's distribution, rather than a false impression from uneven survey effort.

Various surveys, particularly in protected areas, including Similajau NP (Duckworth 1997), Lambir Hills NP (Mohd Azlan & Lading 2006), Niah NP (Anwarali Khan *et al*. 2008)

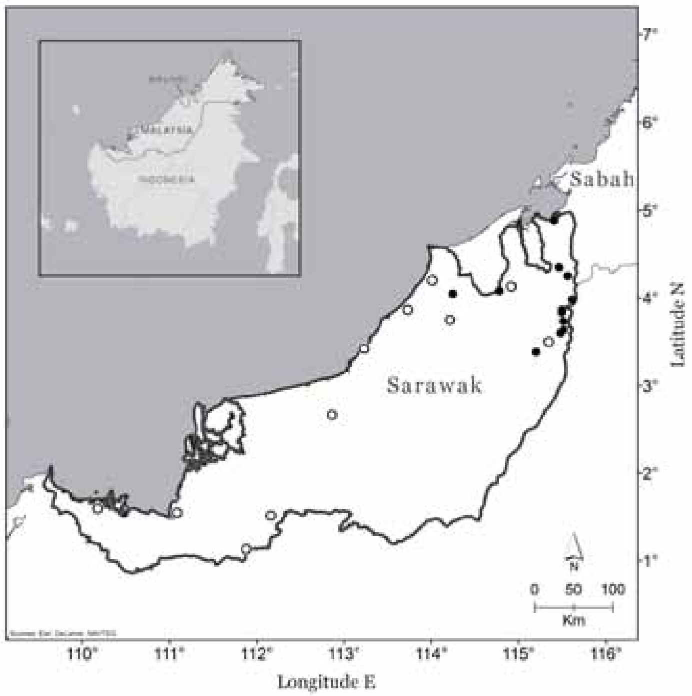

Fig. 1. Sarawak, Malaysian Borneo, showing Sunda Stink-badger *Mydaus javanensis* records (black dots) and other survey areas (open circles) mentioned in the text.

Table 1. Sunda Stink-badger *Mydaus javanensis* records from Sarawak.

Site name	Lat/long; altitude	Date; time of day	Habitat	Type of record	Observer or reference	Other notes
Kuala Lawas (Sri Tanjong resort)	4°57'22"N, 115°24'16"E; sea level	14 July 2010; 19h00	Muddy / sandy area adjacent to mangrove and peat-swamp forest	Field sighting	Oswald Braken Tisen *in litt*. 2011	Stuck between refrigerator and kitchen wall
Merarap camp to Long Semadoh Nasab (Lawas)	Roughly 4°21'N, 115°28'E; within 500–650 m	23 December 2007; n/a	Mixed hill dipterocarp forest	Roadkill	B. Giman	On logging road
Long Semadoh Nasab (Lawas)	Roughly 4°15'N, 115°34'E; within 450–550 m	2009; within 18h00–19h00	Not known	Field sighting	Balang (local villager)	Found near their settlement
Gn. Mulu NP, park entrance area	4°05'N, 114°47'E; 15 m	5 November 2002; about 04h30	Not known	Field sighting	V. Dinets *in litt*. 2011	
Ba Kelalan (Lawas)	Roughly 3°59'N, 115°37'E; within 750–850 m	2003; n/a	Mixed hill dipterocarp forest	Roadkill	Balang (local villager)	On logging road
Gn. Murud	About 3°50'N, 115°30'E; within 1,000–2,000 m	Before 1922	Not known	Three native skins	Moulton 1921, 1922	Location based on local report
Pa Umur, Kelabit uplands	3°44'N, 115°31'E; 3,500'	Within 1945–1949	Not known	Two specimens	Davis 1958	
Pah Trap and Pa Main, Kelabit uplands	Roughly 3°38'N, 115°31'E; ?1,000 m	About 1924	"Open forest country"	Ten specimens	Lönnberg & Mjöberg 1925	Considered it common in the area
Pa Main, Kelabit uplands	3°38'N, 115°31'E; 3,300'	Within 1945–1949	Not known	Specimen	Davis 1958	

Records are listed from north to south.

and Maludam NP (Azlan 2004; J. Hon verbally 2011), all on or near the central-west coast of Sarawak; Loagan Bunut NP (Mohd Azlan *et al*. 2006) in central north-east Sarawak; Gunung Gading NP (A. McKenzie verbally 2011) in south-west Sarawak; Batang Ai NP (Meredith 1995; R. Scott verbally 2011) and part of Lanjak–Entimau Wildlife Sanctuary (E. Lading verbally 2011), both in central-southern Sarawak; and Kubah NP in southern Sarawak (Azlan *et al*. 2007; Mohd Tajuddin verbally 2011), all found no sign of Stink-badgers. Stuebing's (1995) surveys in central Sarawak's mixed dipterocarp forest, ongoing camera-trapping and spotlighting in this part of the state by Grand Perfect Conservation Department of the 4,900 km^2 Sarawak Planted Forest Project within Bintulu Division, comprising mixed old secondary forest and *Acacia mangium* monoculture plantations (of various ages) interspersed with natural forests (Belden *et al*. 2007a, 2007b, McShea *et al*. 2009, authors' own data), and surveys in nearby Anap–Muput Forest Management Unit (in Hon *et al*. 2008) also discovered no Stink-badgers.

Although no individual survey lasted long enough to expect it to detect all carnivore species in the survey area, in combination their lack of Stink-badger records is strong evidence for the species's absence from most of Sarawak. Also relevant is that Hose (1893), who had wide collecting experience in central Sarawak, evidently never encountered the animal, having to refer to A. Everett as an authority for including it in his list of the mammals of Borneo.

Moreover, several surveys within the species's Sarawakian range did not find it. In Pulong Tau National Park (the most northern part of Sarawak), neither a recent camera-trapping survey (P. Dagang verbally 2011), nor a nine-day intensive survey in 1998 focused on Sumatran Rhinoceros *Dicerorhinus sumatrensis* (Anonymous 1998) found Stink-badger, although the latter may not have used methods likely to find the species. Small mammal surveys conducted by University Malaysia Sarawak (UNIMAS) at Gunung Murud and Kelabit Uplands of Bario (Rahman *et al*. 1998, Faisal *et al*. 2007, Tuen *et al*. 2007, Wiantoro *et al*. 2009), did not record this species. Intensive camera-trapping in the mix of logged-over and unlogged forests of the upper Baram (Miri Division) recorded 14 species of small carnivores (Mathai *et al*. 2010), but did not photograph Stink-badger, nor did local people apparently know of the species. This area lies just south of the cluster of records from the Kelabit uplands and Gn. Murud, suggesting, given the high effort of this survey, that this part of the upper Baram may be just outside the species's southern limit in Sarawak. Surveys for the 1982 management and development plan for Gunung Mulu NP did not find the species, despite recording eight other carnivores (Cranbrook 1982), and despite a subsequent record there (Table 1).

This localised distribution in Sarawak contrasts with its status in Sabah, where it is widespread and locally common (e.g. Medway 1977, Matsubayashi *et al*. 2007, Wilting *et al*. 2010). The reasons for this difference cannot presently be determined.

Natural history notes

Other than the brief notes and speculations in Payne *et al*. (1985), no published information was traced specific to Stink-badger ecology, habitat preferences and social behaviour in Borneo. Nor did any source seek to explain its patchy distribution throughout Borneo generally and in Sarawak particularly. All historical Sarawak records come from the mid-montane zone, but a recent record from Kuala Lawas in the far north was from sea-level (Table 1). The altitudinal range occupied may vary across this species's range, and indeed in neighbouring Sabah it seems to be predominantly lowland (Payne *et al*. 1985). Some historical sources mentioned that Sunda Stink-badger inhabits caves (Forbes 1879, Moulton 1921 [who based his assessment on local reports]), but Banks (1931) considered it to dwell in holes in the ground dug by itself or by porcupines (Hystricidae). This latter statement may have been based on Lönnberg & Mjöberg (1925), who stated that it burrowed in the ground amid open forest in the Kelabit Uplands.

The historical authors' comments on the animal's defence are not exaggerated. Two people (C. Kri and Mohd Ali of Sarawak Forestry Corporation) tried to free an animal stuck in a kitchen at Kuala Lawas in 2010 (O. B. Tisen *in litt*. 2011; see Table 1), but had to abandon the attempt when the Stink-badger sprayed the area. The animal managed to free itself and disappeared into the forest, but a very distasteful smell lasted for the whole evening. Some occupants of Sri Tanjung were overpowered by the smell, resulting in severe vomiting. The workers cleaned the location with the most powerful detergent available (Clorox), but a year later, the smell still lingered on (O. B. Tisen *in litt*. 2011).

Threats

The localised distribution of Sunda Stink-badger in Sarawak seems to be a natural pattern of long standing, not the result of a recent decline. Too little is known about its population, present or past, to determine if numbers have decreased (or indeed increased) recently. There is no clear recent information on threats to Stink-badgers in Sarawak, but Lönnberg & Mjöberg (1925: 512) noted that "in most of the Kalabit's [= Kelabit] houses flat badger skins, very much stretched in order to make large 'sitting mats', were found", reflecting the source of the three specimens Moulton (1921, 1922) discussed. Banks (1931: 62) added that "the Kalabit dogs find the entrance to these [Stink-badgers'] earths and the smallest dogs will eagerly enter and bay the quarry underground while the men dig furiously down from above with the aid of sharpened sticks . . . Kalabits . . . eat the animal and value its skin for sale to down country people, who mix the shavings with water and drink them as a cure for fever or rheumatism".

The species seems generally tolerant of habitat degradation, fragmentation and even conversion to non-forest (e.g. Payne *et al*. 1985), suggesting that it is unlikely to be threatened by recent habitat changes in Sarawak. Although the species is listed globally as Least Concern by *The IUCN Red List of Threatened Species* (Long *et al*. 2008), this does not imply that it is not of conservation concern in certain parts of its range, such as Sarawak. Equally, a localised distribution does not necessarily imply a conservation need. Only further study and assessment in the state, including the publication of all records of the species, would clarify its conservation status and needs, if any.

Legal protection status of Sunda Stink-badger in Sarawak

In Sarawak, Sunda Stink-badger, unlike civets, mustelids and mongooses, is not protected in the Wildlife Protection Ordinance, 1998 (State of Sarawak 1998a, 1998b). This reflects the generally low interest in this species in the state. It is protected in two of the other parts of Borneo, Sabah through the Wildlife Conservation Enactment 1997 (Sabah Government 1997) and Indonesia (Wildlife Protection Ordinance 1931, 1979). Given its small range in Sarawak, it would seem to be as much, or more, in need of legal protection there, too.

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Using canine width to determine age in the Black-footed Ferret *Mustela nigripes*

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Abstract

The Black-footed Ferret *Mustela nigripes*, a carnivore indigenous to North America's Great Plains, provides an example of species management that uses intensive population monitoring. Age class determination, however, is difficult because juveniles are adult-size at the time of dispersal in the wild. Our objective was to evaluate the use of body mass and canine width in aging Black-footed Ferrets. We measured known-aged captive-bred individuals and validated the findings in an intensively monitored free-ranging population. Body mass could not be used to distinguish between juvenile and adult wild females, but could be used in wild and captive males, and in captive females. Canine width can be used to distinguish between juvenile and adult animals within sex. Canine width was similar between wild and captive individuals; therefore, results were grouped. For males, mean (± SE) canine width was smaller for juveniles (n = 40, 3.38 ± 0.04 mm, 95% confidence interval [CI] = 3.31–3.45 mm) than for adults (n = 33, 4.13 ± 0.06 mm, 95% CI = 4.01–4.24 mm). Similarly for females, canine width was smaller for juveniles (n = 49, 3.18 ± 0.04 mm, 95% CI = 3.11–3.25 mm) than for adults (n = 47, 3.66 ± 0.03 mm, 95% CI = 3.60–3.73 mm). Canine width changes with age apparently through recession of the gum-line and exposure of the tooth root. Therefore, visualisation of the canine tooth root may be a reliable indication of adulthood. Body mass may be inconsistent in the wild because of high variation in food availability. Canine width can allow age determination in the field, which will assist with the assessment of population dynamics of free-ranging Black-footed Ferrets and the success of recovery efforts.

Keywords: aging technique, body mass, Endangered, morphometry, Mustelidae, population management

Introduction

Monitoring is an essential component of successful wildlife management, yet effective surveillance can be challenging. For populations that are rare or otherwise at risk of extinction, detailed population information often helps management decisions (Kleiman 1989, Armstrong & Seddon 2008). In particular, a population's age structure provides clues about population growth and stability; yet this information can be challenging to collect (Bingham & Purchase 2003).

Animals can be aged with techniques that use cementum layers, tooth wear, gum recession and radiographs of the tooth's pulp cavity. Cementum, the calcified tissue that surrounds the dentine, is deposited seasonally, forming layers that vary based on nutritional intake (Morris 1978, Wittwer-Backofen *et al.* 2004). These layers have been used to age various carnivores, including canids (Arctic Fox *Alopex lagopus*, Bradley & Prins 1981; Red Fox *Vulpes vulpes*, Cavallini & Santini 1995) and mustelids (Sea Otter *Enhydra lutris*, Ryazanov & Klevazal 1991; Eurasian Otter *Lutra lutra*, Hauer *et al.* 2002). The technique's major disadvantages are: 1) a tooth must be removed from the animal (Johnson *et al.* 1987); 2) interpreting layers can be subject to observer bias (Bodkin *et al.* 1997); and 3) juveniles may be difficult to distinguish from adults (e.g. Fisher *Martes pennanti*, Strickland *et al.* 1982). Tooth wear can be used as an index of age in wild animals such as the Puma *Puma concolor* (Gay & Best 1996), wild Reindeer *Rangifer tarandus* (Klevazal & Sokolov 2004) and Eurasian Wild Pig *Sus scrofa* (Nahlik & Sandor 2003), but varying abrasiveness of diets could wear down teeth at different rates. Gum-line recession has been used to age the Puma (Laundre *et al.* 2000). Radiographs of teeth, which show the narrowing of the pulp cavity with age, have been used to age carnivores, including Eurasian Pine Marten *Martes martes*, Stone Marten *M. foina*, American Marten *M. americana* and Fisher (Johnson *et al.* 1987, Helldin 1997, Bingham & Purchase 2003). Measurements of the pulp width have been used to age carnivore carcasses, but the modified technique for live specimens requires a portable x-ray machine for fieldwork, and radiographic images can often be blurred by the mandibular bone, which may cause errors in the interpretation of radiographs (Helldin 1997).

In sexually dimorphic species, like mustelids, body weight and skeletal measures may be used to distinguish between the sexes (Moors 1984). Canine width has been used successfully to sex Sea Otter (Dayan *et al.* 1989a, Ryazanov & Maminov 1996), Virginia Opossum *Didelphis virginiana* (Patterson & Mead 2009), Bobcat *Lynx rufus* (Williams *et al.* 2011), European Badger *Meles meles* (Johnson & Macdonald 2001), American Marten (Belant *et al.* 2011), Pine Marten in Ireland, Stoat *Mustela erminea*, American Mink *M. vison* (Dayan & Simberloff 1994), Long-tailed Weasel *M. frenata* and Least Weasel *M. nivalis* (Dayan *et al.* 1989b); however, most often canine teeth are removed from the animal to do this, which may be too invasive, especially for carnivores. Recently, field methods have been established to age Galapagos Sea-lions *Zalophus wollebaeki* using both canine measurements and body mass (Jeglinski *et al.* 2010).

Wild populations at elevated risk of extirpation are often intensively monitored, yet managers must balance collection of the maximum amount of information using techniques not overly intrusive. The Black-footed Ferret *Mustela nigripes* provides an example of intensively monitored populations of conservation concern (Biggins *et al.* 1997). This species is endemic to North America, with its former range including the Great Plains from Canada to northern Mexico. Black-footed Ferrets are obligate predators of prairie-dogs *Cynomys* and, currently, about 830 Black-footed Ferrets live in the wild in a maximum of four self-sustaining populations (Gober 2009, Jachowski & Lockhart 2009). More recently, some of the reintroduction sites are requiring intensive disease management (Matchett *et al.*

2010). Site managers monitor Black-footed Ferret populations intensively, to determine population size and trends and to estimate the number of captive individuals needed to maintain a viable population (Biggins *et al.* 1993).

Black-footed Ferret monitoring involves spotlight surveys in the fall during juvenile dispersal (Biggins *et al.* 2006). Animals are captured and unmarked animals are tagged with passive integrative transponder chips (Avid Identification Systems, INC., Norco, CA, U.S.A.; see Fagerstone & Johns 1987, Stoneberg 1996). Age determination is difficult because Black-footed Ferrets are adult-sized by 95–100 days of age (Vargas & Anderson 1996) and during fall surveys, juveniles are approximately four months of age (Miller *et al.* 1996). For a species at risk of extinction, like the Black-footed Ferret, an accurate method of age determination would assist managers in estimating recruitment into the population, success of the reintroduction site, and ultimately, success of the recovery effort. Demographic data can: 1) predict the ability of animal populations to withstand perturbation, 2) suggest which segment of the population is most vulnerable to catastrophic events, and 3) suggest which segments contribute the most to population growth (Bingham & Purchase 2003). Accurate aging of individuals may provide reintroduction site managers with a useful tool to assess the age distribution of the wild populations.

Black-footed Ferrets are short-lived carnivores with an average generation length of < 2.3 years in the wild (Wisely *et al.* 2003); therefore, it is important to monitor juvenile survival and recruitment, reflecting this age class's role in the population growth rate (Grenier *et al.* 2007). Because both body weight and canine width have been successful at distinguishing between sexes in mustelids, our goal was to determine if these techniques could be applied to age Black-footed Ferrets. Specifically, our objective was to determine if measurements of body mass and canine width vary between sex, age class (juvenile versus adult) and site-types (captive versus wild) in known-aged Black-footed Ferrets.

Methods

Captive Black-footed Ferrets

The captive-born Black-footed Ferrets (n = 82) used in this study were part of a breeding and reintroduction programme and were anaesthetised for routine health examinations in the fall from 2002 to 2004. These Black-footed Ferrets were maintained at one breeding facility, the Smithsonian Conservation Biology Institute near Front Royal, Virginia, U.S.A. Individuals were maintained in enclosures 3.6 m wide × 6.0 m long × 4.0 m high, with a mulch substrate and nest-boxes filled with Alpha Dry® substrate (Shepherd Specialty Paper, Watertown, TN, U.S.A.). Lighting was provided both naturally (by skylights) and artificially (via fluorescent illumination) with a minimum of 25 foot-candles at the cage/enclosure base, regulated by automatic timers set to turn on artificial lights 15 min before sunrise and turn them off 15 min after sunset. Black-footed Ferrets were fed a Toronto Carnivore Diet (Milliken Meat Products; Scarborough, Ontario, Canada). Fresh water was provided *ad libitum*.

Wild-born Black-footed Ferrets

Wild Black-footed Ferrets (n = 87) were all wild-born and were being trapped during fall 2002 monitoring surveys at the Conata Basin reintroduction site within the Buffalo Gap National Grasslands (43°46'N, 102°14'W) in south-west South Dakota, U.S.A. The Conata Basin encompasses 22,267 ha of mixed grass prairie with more than 5,290 ha of Black-tailed Prairie-dogs *Cynomys ludovicianus* in three sub-complexes: Agate (1,483 ha), Sage Creek (3,142 ha) and Heck Table (665 ha). Black-footed Ferret reintroduction occurred in 1996–1999. Sixty or more litters were documented annually from 2000 to 2008 and the site is considered self-sustaining (Jachowski & Lockhart 2009) but requires intensive disease management (dusting for fleas to reduce the incidence of Sylvatic plague *Yersinia pestis*). Trapping and immobilisation protocols followed Sheets (1972) and Kreeger (1998). Briefly, animals were cage-trapped at night and returned to the same location following examination and recovery from anaesthesia (usually within 1 hr of capture). Trapping and handling techniques followed guidelines of the Animal Care and Use Committee (1998) of the American Society of Mammalogists.

Animal handling

We measured the body mass and canine width on live, anaesthetised captive-born (n = 82; 31 males and 51 females) and wild-born (n = 87; 42 males and 45 females) Black-footed Ferrets. Each animal was handled to induce and maintain anaesthesia by inhalation of isoflurane gas (Kreeger 1998). Body mass was measured on a digital scale in grams (± 0.1 g). Maxillary canine width was measured on the right side by RMS using digital calipers (± 0.02 mm, Mitutuyo Corporation, Aurora, IL, U.S.A.) for all animals in this study. Canine width was measured as the width from the anterior to posterior edge of the tooth at the gum-line. Measurements were excluded when morphological structures were missing or damaged. Measurements were taken along with other body measurements and procedures; therefore, measurements were not repeated, thereby minimising duration of animal handling.

Data analysis

Data were analysed using Sigma Stat version 3.0 (SPSS Inc., Chicago, IL, U.S.A.). A Kolmogorov–Smirnov test was used to test for normality and the Levene median test for equal variance assumption testing. We used a two-way analysis of variance (ANOVA) to test for differences among age classes (juvenile versus adult animals); data also were partitioned by sex because Black-footed Ferrets are sexually dimorphic (Anderson *et al.* 1986). *A posteriori* comparisons of means between age classes were performed using the Tukey test. For non-normal data, Kruskal–Wallis one-way ANOVA was used with Dunn's pairwise multiple comparison procedure. Values are presented as mean ± 1 standard error (SE). For all analyses, $P < 0.05$ was considered significant.

We classified animals less than six months old as juveniles and those of six months and older as adults. We knew exact birth dates for captive Black-footed Ferrets, but not for wild animals. At the time of the fall survey (16–23 September 2002), the estimated age of wild-born juveniles was 105 ± 30 days, based on a 1 June date of birth (Biggins *et al.* 2006). Vargas & Anderson (1996) reported that females and males reached 95% of their adult body mass by 105 and 126 days of age, respectively, and permanent canines for both sexes were fully erupted around 63 days of age. With intensive fall surveying efforts, biologists in Conata Basin captured 203 Black-footed Ferrets from fall 2002 to fall 2003 (TML, unpublished data). The ages of wild-born Black-footed Ferrets are well documented because all trapped animals are tagged with transponder chips. Live-trapping of Black-footed Ferrets typically begins in early September when juveniles begin dispersal (Miller *et al.* 1996).

Results

Comparison of body mass between age, sex and site-type
Overall, mean body mass was less ($F_{1,152}$ = 27.03; P < 0.001) for females (n = 93, 739.2 ± 12.0 g, range = 372–988 g) than for males (n = 63, 931.1 ± 25.6 g, range = 386–1,454 g). Wild-born male Black-footed Ferrets were heavier ($F_{1,59}$ = 10.22; P = 0.002) than captive males (Table 1). Wild male juveniles weighed less (H_1 = 13.39; P < 0.001) than adults. For captive males, juveniles weighed less (H_1 = 7.23; P = 0.007; Table 1) than adults. For females, captive individuals were heavier (H_1 = 8.69; P = 0.003; Table 1) than wild ones. Within captive females, juveniles weighed less (H_1 = 4.99; P = 0.025) than adults; however, body mass of both age classes of wild females seemed similar (P > 0.05; Table 1).

Comparison of canine width between age, sex and site-type
Overall, males (n = 73, 3.72 ± 0.05 mm, range = 2.99–4.63 mm) had wider (H_1 = 11.66; P < 0.001) canine teeth than females (n = 96, 3.42 ± 0.03 mm, range = 2.74–4.23 mm). Within sex, site-type (wild vs. captive) did not seem to influence canine width (P > 0.05); therefore, these data were combined. For males, juveniles (n = 40, mean, 3.38 ± 0.04 mm; range = 2.99–3.82 mm, 95% CI = 3.31–3.45 mm) had a smaller canine width ($F_{1,69}$ = 109.56; P < 0.001) than adults (n = 33, mean, 4.13 ± 0.06 mm; range = 3.47–4.63 mm, 95% CI = 4.01–4.24 mm). For females, juveniles (n = 49, mean, 3.18 ± 0.04 mm; range = 2.74–3.60 mm, 95% CI = 3.11–3.25 mm) had a smaller canine width ($F_{1,92}$ = 106.41; P < 0.001) than adults (n = 47, mean, 3.66 ± 0.03 mm; range = 3.12–4.23 mm, 95% CI = 3.60–3.73 mm). Additionally, one distinguishing difference between juvenile and adult Black-footed Ferrets in both sexes was the recession of the gum-line exposing more of the canine tooth root in adults, which may be the reason for the widening of the canine with age and may be used to confirm age classes (Fig. 1).

Discussion

Aging Black-footed Ferrets can be difficult due to a rapid growth rate (adult size by about four months of age; Vargas & Anderson 1996) and weight fluctuations that can occur during the year depending on food availability. This study presents a method for classifying age of Black-footed Ferrets using canine width and recession of the gum-line exposing the tooth root. For both male and female Black-footed Ferrets, the width of the canine can distinguish between most juveniles and adults and was not influenced by site-type; however, there was some overlap between age classes. Therefore, the use of canine width as an aging technique may need to be corroborated with the obvious exposure of canine tooth root and/or other biological indicators, such as mammary development in females. Additionally, body mass may not be an accurate age classification technique in wild and captive Black-footed Ferrets. The large variation and overlap among age classes in body mass was probably due to variable food availability and nutrition. Additionally, in captivity, births may be more spread out across the spring months due to housing conditions.

Table 1. Mean (± SE) and range body mass (g) of male and female Black-footed Ferrets *Mustela nigripes* in different age classes and site-types.

Sex	Age class*	Site-type	Mean (g)	Range (g)
Male	Juvenile (*n* = 24)	Wild	928.2 ± 36.3	659–1,454
	Adult (*n* = 13)	Wild	1,103.9± 31.7	965–1,330
	Juvenile (*n* = 16)	Captive	762.4 ± 49.6	386–998
	Adult (*n* = 10)	Captive	983.4 ± 48.4	722–1,223
Female	Juvenile (*n* = 26)	Wild	730.8 ± 15.7	520–874
	Adult (*n* = 19)	Wild	715.1 ± 12.6	592–797
	Juvenile (*n* = 22)	Captive	684.5 ± 38.8	372–933
	Adult (*n* = 26)	Captive	811.6 ± 12.7	716–988

*Number of individuals within age class in parentheses

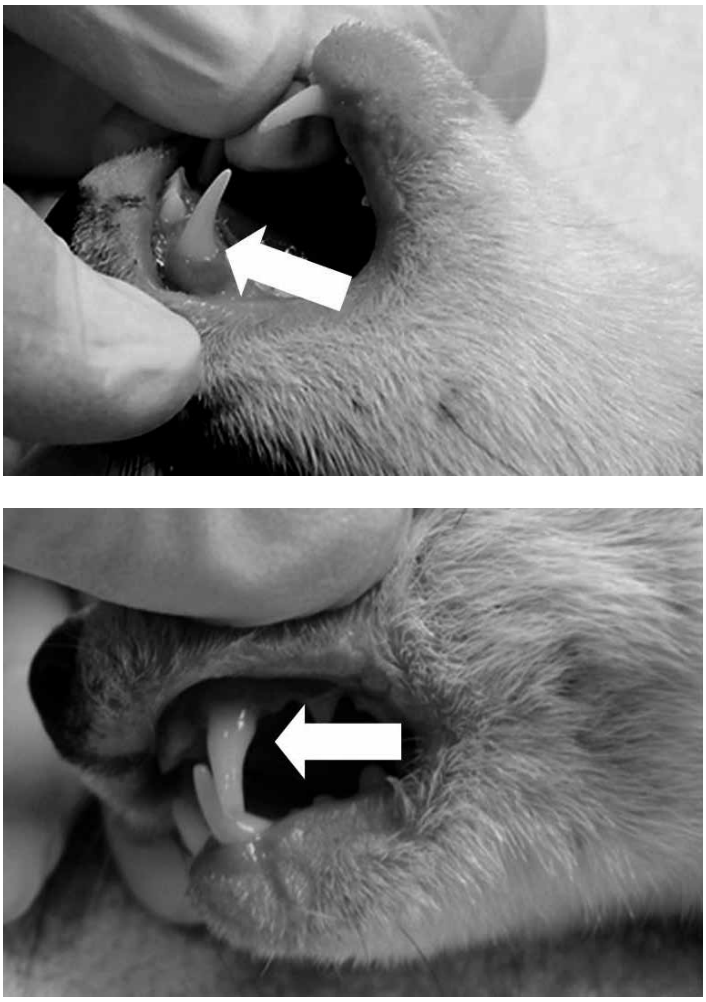

Fig. 1. Juvenile (top; photo: Michael Forsberg) and adult (bottom; photo: Travis Livieri) Black-footed Ferret *Mustela nigripes* teeth. Arrows point to the receding gum-line in the adult exposing the tooth root, which can be used to distinguish between the age categories.

Our body mass data were consistent with previous assessments of sexual dimorphism in Black-footed Ferrets: Anderson *et al.* (1986) studied Black-footed Ferret museum specimens and determined females on average were 68% of males' body weight, whilst Vargas & Anderson (1996) studied captive, live Black-footed Ferrets and found males weighing approximately 25–30% more than females. We determined that there was a greater body mass dimorphism in wild animals (females were 73% of males' weight) than in captives (females were 89% of males' weight). Many mustelids are highly sexually dimorphic in body size (Moors 1980, 1984). This size difference may have evolved for sexual selection (Thom *et al.* 2004) or for niche separation (Darwin 1871), suggesting larger males would have the ability to catch larger prey and reducing intra-specific competition for food (Dayan *et al.* 1989a, Hedrick & Temeles 1989, Dayan & Simberloff 1996). Additionally, females are smaller, thus, reducing energy requirements which may allow for more energy to be used for reproduction (Moors 1980). Reduced sexual dimorphism in Black-footed Ferrets may be an effect of the captive environment (Wisely *et al.* 2005). In American Mink, captivity was determined to lessen sexual selection, reduce resource competition and select the larger specimens of both sexes for breeding within ranch populations (Lynch & Hayden 1995).

Previous studies have used morphometric features to sex animals. Anderson *et al.* (1986) were able to sex Black-footed Ferrets accurately using skull measurements 89.4% of the time. Our results demonstrate that the canine width of live, anaesthetised Black-footed Ferrets is also sexually dimorphic. Overall, male canines tended to be about 9.2% larger than female canines. Site-type did not influence canine width, consistent with previous studies (Wisely *et al.* 2005). Our study was designed to differentiate between adults and juveniles during fall monitoring surveys. Differences may change if measurements are taken at other times of year. In males, 21% adults (7 of 33) overlapped with juveniles and 38% (18 of 47) adult females overlapped with juveniles. For animals within the range of overlap, secondary attributes, such as mammary development and/or lactation in females, may help. A definite distinction between the age classes was the gum-line recession, exposing the canine tooth root. This root exposure caused the increasing width of the canine tooth; thus, it can be used to confirm the width measurements.

Conclusion

Determining the age of wild-born animals is important for identifying age-specific estimates of population parameters. Using canine width to age individuals has the potential to be applied to similar wild species, particularly if a captive population is available to validate parameters. Animals maintained in zoological institutions could be used as models for the wild counterparts, although mean canine width with an estimate of precision (e.g. 95% confidence intervals) would need to be established for both wild and captive populations. These results highlight the importance of validating data to determine the reliability of extending inferences from captive to wild populations. As the Black-footed Ferret recovery enters its thirtieth year after the rediscovery of the species (1981) and the twentieth year of returning it to the wild (1991), understanding the population dynamics and what factors are affecting population growth will lead to improved success of the programme.

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[†] Deceased

Small carnivore records from the Oddar Meanchay* sector of Kulen–Promtep Wildlife Sanctuary, northern Cambodia

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Abstract

Here are presented the first published records of four small carnivore species within Kulen–Promtep Wildlife Sanctuary, northern Cambodia. Some records are at a presumed salt-lick, including the first published record of a Crab-eating Mongoose *Herpestes urva* at a salt-lick. The records were generated through camera-trapping from 16 January to 25 August 2011, by the Frontier–Cambodia Forest Research Project.

Keywords: camera-trap, Common Palm Civet, Crab-eating Mongoose, ferret badger, salt-lick, *Viverra*, *Viverricula*

កំណត់ត្រាពពួកសត្វស៊ីសាច់ជាអាហារប្រភេទតូចៗ នៅក្នុងដែនជម្រកសត្វព្រៃ គូលែន- ព្រហ្មទេព ភូមិសាស្ត្រ ខេត្តឧត្តរមានជ័យ ភាគខាងជើងប្រទេសកម្ពុជា

អត្ថបទសង្ខេប

នេះគឺជាឯកសារបោះពុម្ពផ្សាយលើកទី១ ស្តីអំពីកំណត់ត្រាពពួកសត្វស៊ីសាច់ជាអាហារប្រភេទតូចៗ ចំនួន **បួនប្រភេទ** ដែលមានវត្តមាននៅក្នុងដែនជម្រកសត្វព្រៃគូលែន-ព្រហ្មទេព ភាគខាងជើងប្រទេសកម្ពុជា។ កំណត់ត្រាមួយចំនួនត្រូវបានគេស្រាវជ្រាវរកឃើញនៅតាមតំបន់ដីប្រាបរួមមានរូបភាពប្រភេទស្ការធំ (*Herpestes urva*) ដែលបានកត់ត្រានៅតំបន់ដីប្រាប។ វត្តមានប្រភេទសត្វទាំងនេះ ត្រូវបានស្រាវជ្រាវរកឃើញដោយគម្រោងស្រាវជ្រាវព្រៃឈើ *Frontier-Cambodia* តាមរយៈការដាក់ម៉ាស៊ីនថតរូបភាពស្វ័យប្រវត្តិចាប់ពីថ្ងៃទី១៦ ខែមករា រហូតដល់ថ្ងៃទី២៥ ខែសីហា ឆ្នាំ២០១១។

ពាក្យគន្លឹះ៖ ម៉ាស៊ីនថតរូបភាពស្វ័យប្រវត្តិ សំពោចក្រអូប ស្ការធំ ឆ្លក ដីប្រាប អំបូរសត្វសំពោចធំៗ អំបូរសត្វសំពោចតូចៗ។

Introduction

The current status of small carnivores within Cambodia is poorly understood, because few records have been published historically or recently (Holden & Neang 2009). Furthermore, published records of small carnivore presence at salt-licks, spatially limited areas that animals visit to ingest soil (geophagy), drink water or hunt (Klaus & Schmidg 1998), are rarer still.

The function of geophagy and drinking the water at salt-licks is much debated, with several hypotheses proposed for the behaviour. The most common is the provision of sodium as the primary role (Kreulen 1985, Moe 1993, Abraham 1999, Rick *et al*. 2003, Ayotte *et al.* 2008, Dudley *et al*. 2011). Geophagy is common in mammals and has been observed in every continent except Antarctica (Klaus & Schmidg 1998, Brightsmith 2004). Most known geophagous mammals are herbivores or frugivores; carnivores are seen at licks much less frequently, presumably because they gain sodium from their diet (Matsubayashi *et al.* 2006).

Blake *et al*. (2011) recorded two members of the Procyonidae, Crab-eating Raccoon *Procyon cancrivorus* and South American Coati *Nasua nasua*, at a salt-lick in Ecuador. Matsubayashi *et al.* (2006) recorded a total of eleven small carnivore species at salt-licks in the inland forests of Borneo, and suggested the hunting of geophagic prey as their main reason for visiting licks. Because chances of being predated upon at the lick for the smaller carnivores themselves are high (Moe 1993), coupled with the risks of disease and parasite transfer (Henshaw & Ayeni 1971), the costs of visiting must be outweighed by the benefits (Klaus *et al.* 1998).

Frontier, a non-profit conservation and development non-governmental organisation, has been working within the western portion of Kulen–Promtep Wildlife Sanctuary in Oddar Meanchey* province since January 2011, and is the first body to survey that area for mammals. The eastern portion, that in Preah Vihear province, has been surveyed fairly intensively since 1999, with confirmed records of Fishing Cat *Prionailurus viverrinus* (Rainey & Kong 2010) and of several important bird species such as Sarus Crane *Grus antigone* (Handschuh *et al*. 2010) and Green Peafowl *Pavo muticus* (Goes 2009).

Study site

Kulen–Promtep Wildlife Sanctuary, covering an area of 4,099 km^2 and spanning three provinces, is Cambodia's largest protected area. It was set up in 1993 to protect the Kouprey *Bos sauveli,* currently listed by *The IUCN Red List of Threatened Species* as Critically Endangered and which has not been seen reliably since the 1960s (Timmins *et al*. 2008). The sanctuary encompasses a range of habitats including lowland evergreen and deciduous dipterocarp forest as well as the second largest swamp in the country, and is home to a variety of large mammal species, with confirmed records from 2011 camera-trapping in the Oddar Meanchey sector including Asian Golden Cat *Pardofelis temminckii* (Edwards in press), Gaur *Bos gaurus*, Leopard Cat *Prionailurus bengalensis*, Red Muntjac *Muntiacus muntjak* and Eurasian Wild Pig *Sus scrofa* (Edwards in prep.).

A single presumed salt-lick was shown to us by locals, who told us animals such as primates and porcupines (Hystricidae) went there to practise geophagy. The camera-traps did capture groups of East Asian Porcupines *Hystrix brachyura* apparently engaged in geophagy at the site. The salt-lick consisted of a small patch of bare ground where two holes had been made by animals; the holes would fill up with water following heavy rain. The total area of the salt-lick comprised around 5 m^2, surrounded by lowland evergreen forest, approximately 1 km from a small resin-tappers' camp, and a small, permanent river lay approximately 3 km from the salt-lick.

* Note added in proof: The survey location is in an area of inconsistent provincial assignment, but on the best available information it seems to be, at the time of survey, in Oddar Meanchay province, not Siem Reap province.

Methods

Five Bushnell CamTrakker camera-traps were placed at five locations (Table 1) within an area dominated by evergreen forest, all 4–8 km from the nearest village, from January to August 2011, with an average altitude of 100 m. Co-ordinates were derived from a GPS unit set to the India–Thai datum. Two camera-trap locations, in the dry riverbeds, were in areas heavily used by resin-tappers. Camera-traps were placed where large mammals were presumed most likely to travel within the dense forest, such as dry riverbeds. They were set to be active throughout the 24-hour cycle and at the highest sensitivity and resolution, taking three photographs per firing (a second apart), with the minimum gap between successive firings being set to ten seconds. Camera-traps were chained to trees approximately 1 m from ground level and aimed as near parallel to the ground as possible. No baits or lures were used.

Results

The survey from 16 January to 25 August 2011 captured wild mammal images from 1,801 firings, from 679 operational trap-nights. In total, images from 291 firings, representing 45 independent events (firings spaced 30 minutes or more apart), contained small carnivores (Table 1). The images captured comprised four species of small carnivore: Common Palm Civet *Paradoxurus hermaphroditus*, Yellow-throated Marten *Martes flavigula*, unidentified ferret badger *Melogale* and Crab-eating Mongoose *Herpestes urva* (Fig. 1). All species present were validated by independent examination of the photos (by J. W. Duckworth).

Common Palm Civets were the most commonly recorded small carnivore, comprising 76% of independent events, and were captured in every location, always at night (18h01–06h00). Common Palm Civet was photographed at the salt-lick in groups ranging from one to five individuals (Fig. 2). When in such groups animals tended to spend much time (periods of up to 39 minutes) in and around the holes at the salt-lick, although whether they were practising geophagy, drinking water in the holes, or engaged in something else cannot be determined. The two records of apparently solo animals at the lick both spent less than two minutes there and did not go near the holes, and in every other location only individual animals were seen.

Yellow-throated Marten was only recorded twice, at 14h17 on 8 February at a small stream and at 04h09 on 23 August at the salt-lick. The latter animal did not apparently approach the holes, and stayed less than three minutes. Crab-eating Mongoose, like Yellow-throated Marten, spent under two minutes at the lick and seemed to be passing, rather than visiting, the lick. All images of it were by day (06h01–18h00), and each recorded only a single animal. Ferret badger, the only small carnivore photographed but not recorded at the salt-lick, was only recorded once: at 21h22 on 31 January 2011.

Table 1. Locations of camera-traps in Kulen–Promtep Wildlife Sanctuary, northern Cambodia, in 2011, with number of independent events for each species at each.

Camera-trap location and recorded altitude	Site Description	Species recorded (number of independent events)
14°04'07.037"N, 104°11'41.608"E; 96 m	Dry river bed	Common Palm Civet (5), Crab-eating Mongoose (5)
14°04'02.922"N, 104°11'47.091"E; 104 m	Dry river bed	Common Palm Civet (20), Crab-eating Mongoose (1), ferret badger (1)
14°03'05.187"N, 104°11'29.966"E; 92 m	Small stream	Common Palm Civet (1), Crab-eating Mongoose (1), Yellow-throated Marten (1)
14°04'20.056"N, 104°09'09.183"E; 99 m	Small stream	Common Palm Civet (1)
14°03'32.782"N, 104°10'10.87"E; 101 m	Salt-lick	Common Palm Civet (7), Crab-eating Mongoose (1), Yellow-throated Marten (1)

Fig. 1. Crab-eating Mongoose *Herpestes urva* in a dry river bed, Kulen–Promtep Wildlife Sanctuary, Cambodia, 2011. © Frontier.

Fig. 2. Group of Common Palm Civets *Paradoxurus hermaphroditus* at a salt-lick, Kulen–Promtep Wildlife Sanctuary, Cambodia, 2011. © Frontier.

Discussion

The camera-trap data presented here, to the best of my knowledge, represent the first published records of four small carnivore species within Kulen–Promtep WS, although all (and various other small carnivore species) have also been recorded by surveys in the Preah Vihear portion of the sanctuary during recent years (H. J. Rainey *in litt.* 2012); the western portion of Kulen–Promtep WS has never been surveyed before for mammals. They are the first published records of three of those species at presumed salt-licks within Cambodia (although all three have been photographed at salt-licks within the Preah Vihear sector; H. J. Rainey *in litt.* 2012), and apparently the first published record of Crab-eating Mongoose at a salt-lick anywhere. Other mongoose species have been recorded at salt-licks: Matsubayashi *et al.* (2006) recorded Short-tailed Mongoose *H. brachyurus* and Collared Mongoose *H. semitorquatus* at salt-licks in Borneo. We recorded a mongoose at the salt-lick only once (and perhaps not using the lick's special features in any meaningful sense); Matsubayashi *et al.* (2006) also found mongooses to be infrequent salt-lick visitors. Common Palm Civet is highly frugivorous (e.g. Su Su & Sale 2007) so, although it is in the order Carnivora, it is not surprising to find it regularly using a salt-lick, contrasting with the generally low lick use of strict carnivores (Matsubayashi *et al.* 2006).

A status review of small carnivores in Laos, including similar lowland habitats (Duckworth 1997) found the five most regularly recorded small carnivore species to be Yellow-throated Marten, Common Palm Civet, Crab-eating Mongoose, Large Indian Civet *Viverra zibetha* and Small-toothed Palm Civet *Arctogalidia trivirgata*. This list is similar to the species list in our study. That we recorded no Small-toothed Palm Civet may simply reflect that this species is highly arboreal: it is best surveyed by spotlighting (Walston & Duckworth 2003). By contrast, there are few recent ferret badger records from Cambodia or Laos (and very few identified to species), although the reasons for this are unclear (Schank *et al.* 2009, Robichaud 2010).

Perhaps the most surprising, and somewhat concerning, result of this survey is the absence of records of *Viverra* spp. or of the allied Small Indian Civet *Viverricula indica*: these ground-dwelling species are readily camera-trapped when present. There was no evidence of specific hunting pressure on small carnivores within the area at the time of survey, but evidence of hunting was seen in the survey area in the form of snares and traps, and through frequent observations of locals taking their catches, namely rats (Muridae) and Northern Treeshrews *Tupaia belangeri* (never small carnivores), home. Any earlier pressure specifically on small carnivores is unknown: perhaps previously high hunting pressure caused a current lack or rarity of *Viverra* and *Viverricula* in the area. Other surveys in Cambodia have camera-trapped them: Large-spotted Civet *V. megaspila* was found in Botum Sakor National Park (Royan 2010), and Gray *et al.* (2010) found it the most frequently recorded small carnivore species within Mondulkiri Protected Forest. Large-spotted Civet, Large Indian Civet *V. zibetha* and Small Indian Civet all inhabit the Preah Vihear Protected Forest (Schank *et al* 2009), only some 80 km east of our Kulen–Promtep WS camera-trap area. Within the Phnom Samkos Wildlife Sanctuary and the Central Cardamoms Protected Forest, Large Indian, Small Indian and Large-spotted Civets were all camera-trapped, the former two regularly (Holden & Neang 2009).

A camera-trap survey in six of the REDD Community Forests in Oddar Meanchey province (the closest being Sangkrous Preychheu, bordering Kulen–Promtep WS on the western side) also found no records of *Viverra* or *Viverricula* (Elliot *et al.* 2011). This survey had fewer trap-nights (just one or two at each location) and found three of the same four small carnivore species as during this survey (and Small Asian Mongoose *Herpestes javanicus*, but no ferret badgers). Only further survey could clarify the reasons for this strange gap in records of *Viverra* and *Viverricula* in Oddar Meanchey province.

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Announcement

International Badger Symposium, Edmonton, Alberta, Canada, 1-4 October 2013

Alpha Wildlife Research & Management will be hosting the first *International Badger Symposium* in October 2013. The symposium aims to bring together researchers, conservationists and managers working on the following species: American Badger *Taxidea taxus,* European Badger *Meles meles*, Ferret Badgers *Melogale spp.*, Stink Badgers *Mydaus spp.*, Hog Badger *Arctonyx collaris*, Honey Badger *Mellivora capensis*. To present original research findings, conservation programs, or reviews on symposium topics, please submit abstracts before **15 September 2012.**

For further details consult the symposium website: http://www.alphawildlife.ca/2013badgersymposium and/or contact Gilbert Proulx (e-mail: gproulx@alphawildlife.ca). Selected papers for oral presentations or posters will be published as a peer-reviewed book by Alpha Wildlife Publications.

Symposium topics:
- Evolutionary history
- Phylogenetic relationships
- Distribution and status
- Population structure and spacing
- Reproductive Biology
- Man-caused and natural mortality
- Parasites and Diseases
- Habitat Ecology
- Food Habits
- Translocation
- Interspecific Relationships
- Man-Badger Relationships
- Research & Management Techniques
- Conservation Programs

Sightings of Common Palm Civets *Paradoxurus hermaphroditus* and of other civet species at Phnom Samkos Wildlife Sanctuary and Veun Sai–Siem Pang Conservation Area, Cambodia

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Abstract

Night surveys are still sparse in Cambodia and therefore only limited data are available on the distribution, density and ecology of nocturnal mammals. In 20 km of nocturnal line transects in Phnom Samkos Wildlife Sanctuary (southwest Cambodia) in 2009, and 17.2 km in Veun Sai–Siem Pang Conservation Area (northeast Cambodia) in 2011, we encountered 14 Common Palm Civets *Paradoxurus hermaphroditus*, seven in each site. Mean linear encounter rate for Common Palm Civet was 0.35 animals/km (SE ± 0.17) in Phnom Samkos Wildlife Sanctuary and 0.39 animals/km (SE ± 0.21) in Veun Sai–Siem Pang Conservation Area. Other small carnivore species sighted during the surveys comprised Small-toothed Palm Civet *Arctogalidia trivirgata* and *Viverra/Viverricula* sp. Although there is no evidence that civets are commonly hunted for use in traditional medicine, they are caught opportunistically for local consumption. Further surveys in Cambodia could clarify trends in nocturnal mammal populations.

Keywords: anthropogenic pressure, night surveys, nocturnal mammals, traditional medicine

ការអង្កេតប្រភេទសត្វសំពោចក្រអូប និងប្រភេទសត្វសំពោចផ្សេងៗទៀត នៅក្នុងដែនជម្រកសត្វព្រៃភ្នំសំកុស និងតំបន់អភិរក្សវ៉ឺនសៃ-សៀមប៉ាង ក្នុងប្រទេសកម្ពុជា

សង្ខេប

ការអង្កេតពេលយប់នៅតែមានភាពខ្វះចន្លោះនៅក្នុងប្រទេសកម្ពុជា ដែល ជាលទ្ធផលការប្រមូលទិន្នន័យ ទៅលើ របាយ ដង់ស៊ីតេ និងលក្ខណៈជីវសាស្ត្រនៃថនិកសត្វរាត្រីចរនៅមានកំរិតនៅឡើយ ។ នៅក្នុងឆ្នាំ ២០០៩ ក្រុមស្រាវជ្រាវបានជ្រើសរើសវិធីសាស្ត្រដើរត្រង់ស៊ិក (Transects) ពេលយប់ នៅដែនជម្រកសត្វព្រៃភ្នំសំកុស(ភាគនារតីនៃប្រទេសកម្ពុជា)បានចំងាយ ២០គីឡូម៉ែត្រ និងក្នុងឆ្នាំ ២០១១ នៅតំបន់អភិរក្សវ៉ឺនសៃ-សៀមប៉ាង(ភាគឥសាន្តនៃប្រភេទកម្ពុជា)បានចំងាយ១៧,២ គីឡូម៉ែត្រ ។ ក្រុមស្រាវជ្រាវបានជួបប្រទះសំពោចក្រអូប *Paradoxurus hermaphroditus* ចំនួន១៤ក្បាលនៅតំបន់ទាំងពីរ (ចំនួន៧ក្បាលក្នុងតំបន់និមួយៗ) ។ ជាមធ្យមការជួបប្រទះសំពោចក្រអូបនៅក្នុងការអង្កេតគឺមានចំនួន០,៣៥ ក្បាលក្នុងមួយគីឡូម៉ែត្រការ៉េ (SE ± 0.17) ក្នុងដែនជម្រកសត្វព្រៃភ្នំសំកុស និងចំនួន ០,៣៩ក្បាល ក្នុងមួយគីឡូម៉ែត្រការ៉េ (SE ± 0.21) ក្នុងតំបន់អភិរក្សវ៉ឺនសៃ-សៀមប៉ាង។ ក្រៅពីនេះមានប្រភេទមំសាសីមួយចំនួនទៀតបានជួបប្រទះផងដែរនៅក្នុងការសិក្សានេះ មានដូចជា សំពោចអុចខ្នង *Arctogalidia trivirgata* និង *Viverra/Viverricula* sp. ។ ទោះបីជាគ្មានការបញ្ជាក់ថាសំពោចជាទូទៅត្រូវបានគេប្រមាញ់សម្រាប់ប្រើធ្វើឱសថបូរាណក៏ដោយ ក៏ប្រភេទនេះជាទូទៅត្រូវបានគេ ប្រមាញ់សម្រាប់ធ្វើជាម្ហូបអាហារ ។ ជាចុងក្រោយក្រុមស្រាវជ្រាវ បានផ្តល់អនុសាសន៍អោយមានការសិក្សាថនិកសត្វរាត្រីចរបន្ថែមទៀតដើម្បីតាមដាន និងត្រួតពិនិត្យការប្រែប្រួលនៃចំនួនរបស់វា ។

ពាក្យគន្លឹះ: សំពាធ ការសិក្សាពេលយប់ ថនិកសត្វរាត្រីចរ និងឱសថបូរាណ

Introduction

Human activities in the Indo-Burma biodiversity hotspot are leading to major declines in mammal populations (Myers *et al.* 2000, Ceballos & Ehrlich 2002). With a tumultuous history of civil conflict over the last half-century, Cambodia withstood some of these declines, and stands out as retaining some of the largest tracts of forest in the region (Claridge *et al.* 2005). With a move to liberal democracy, forest loss has now increased dramatically, and the impact on biodiversity has become severe. Demands for timber, for non-timber forest products, for animals in traditional medicines and for wild meat both locally and for illegal export, raise concern for fast-disappearing habitats and unsustainable exploitation of forest products (Platt *et al.* 2004, Ashwell & Walston 2008, Grismer *et al.* 2008).

The status of many nocturnal mammal species is still poorly understood in Cambodia, given the general focus on diurnal and sign-based mammal surveys (e.g. Momberg & Weiler 1999, Long & Swan 2000, Walston *et al.* 2001). Most research including nocturnal mammals in Cambodia has simply recorded species presence (e.g. Walston & Duckworth 2003, Holden & Neang 2009, Schank *et al.* 2009) with only a handful attempting to quantify abundance (Gray *et al.* 2010, Streicher 2010, Coudrat *et al.* 2011, Gray & Phan 2011, Starr *et al.* 2011). Population sizes of nocturnal mammals in Cambodia and threat levels to them are therefore mostly speculative.

One often largely overlooked family is the Viverridae (civets). Seven civet species are reported from Cambodia (with their threat status on *The IUCN Red List of Threatened Species*; IUCN 2011): the Vulnerable (VU) Binturong *Arctictis binturong*, VU Large-spotted Civet *Viverra megaspila*, Near Threatened (NT) Large Indian Civet *V. zibetha*, Least Concern (LC) Common Palm Civet *Paradoxurus hermaphroditus*, LC Masked Palm Civet *Paguma larvata*, LC Small Indian Civet *Viverricula indica* and LC Small-toothed Palm Civet *Arctogalidia trivirgata*.

The nocturnal, arboreal lorises *Nycticebus* are heavily hunted and traded in Cambodia for use in Khmer, Chinese and Vietnamese traditional medicine (Starr *et al.* 2010). Arboreal civets are likely to be hunted through the same processes, and although they may not be specifically targeted, populations are plausibly being affected. This note presents sightings of Common Palm Civets and other civet species in two sites in Cambodia.

Study areas

The Phnom Samkos Wildlife Sanctuary (= Phnom Samkos WS), in the Cardamom Mountains of southwest Cambodia (Fig. 1), encompasses 3,338 km^2 of protected forest (Daltry & Momberg

2000). LDR surveyed specifically in the lowland Samkos Basin close to the base camp at 12°21'N, 103°07'E, an area characterised by dry dipterocarp forest with occasional patches of semi-evergreen and evergreen forest. The Veun Sai–Siem Pang Conservation Area (= Veun Sai–Siem Pang CA) covers 550 km^2 in north-eastern Cambodia which, while the target of conservation activities, is not currently a legally designated protected area (Fig. 1). TI surveyed in the southernmost part of Veun Sai–Siem Pang CA (base camp: 14°01'N, 106°44'E) where broadleaf evergreen forest, semi-evergreen forest and mixed deciduous forest dominated by *Lagerstroemia* species are the prevalent forest types. Currently available habitat maps are insufficient to assess relative proportions of forest type along transects accurately at this scale. Both sites are subject to considerable illegal logging, hunting, fires (including burning for shifting cultivation), and often unsustainable collection of non-timber products by the local population.

Methods

The records presented here were collected during population surveys of lorises. All nocturnal mammals seen were systematically recorded, with particular attention to civets, which are potential predators of lorises. Phnom Samkos WS was surveyed from April to July 2009 and Veun Sai–Siem Pang CA from April to June 2011, timings dictated by external constraints. The 17 transects (Table 1) were a minimum of 500 m apart. Transect preparation minimised cutting of vegetation (sufficient to allow passage for one person at a time) and other changes to microhabitat that might affect the distribution of animals. In Phnom Samkos WS transects were placed in three separate areas of the Samkos basin accessible by three small trails. The transects were all cut following the bearing of 220° running parallel to each other. In Veun Sai–Siem Pang CA, randomised transect positioning was prevented by the patchy habitat, so transects were positioned not to cross farm land and other large open areas assumed to be inappropriate habitat for lorises.

Transects were marked every 50 m with flagging tape and allowed to rest for at least 30 hrs before the first survey on that transect (as recommended by Peres 1999). Transect lengths measured with a laser range finder (Bushnell® Sport 450) were confirmed with GPS reference points (Garmin: eTrexVista®HCx and GPSMAP®60CSx). Checking compass bearings approximately every 50 m ensured transect linearity. Surveys took place between 19h00 and 04h00. Most surveys were conducted simultaneously by two observers, but twice in Veun Sai–Siem Pang CA the team consisted of three, and once six, people. Observers walked randomly selected transects, determined by picking the number out of a hat. Each transect was walked at least twice, excepting two in Veun Sai–Siem Pang CA walked only once. Twice in Veun Sai–Siem Pang CA, transects were not completed due to heavy storms and were repeated on a different night; the uncompleted transects are included here because animals were seen during their early part. Observers walked 0.5–1 km/hr maintaining 10 m distance between each other, scanning all levels of vegetation and, in Veun Sai–Siem Pang CA, stopping for 5–10 min every 100 m to maximise probability of detection. The 4.5V head torches with red filter (Petzl®) for detection and identification of animals mostly used were not bright enough in open parts in Veun Sai–Siem Pang CA to penetrate the entire search volume effectively; here, locally purchased torches with white light were used for initial detection and identification of animals followed by closer observations using red light.

Species status at each site is expressed as the linear encounter rate per kilometer, which is calculated as the number of animals seen divided by distance walked. Linear encounter rates were calculated per individual transect-line and averaged to give a final figure for each site; this gives each transect-line equal weighting no matter how often it was walked. The encounter-rate approach is fraught with methodological difficulties, most significantly the assumption that viewing distance (i.e. detection function) is uniform along and between transects. These estimates are for general reference, and as a potential basis for monitoring in Veun Sai–Siem Pang CA if transects be repeated at a later stage.

Results

In total 37.2 km were surveyed along transects: 20 km in Phnom Samkos WS and 17.2 km in Veun Sai–Siem Pang CA (Table 1). We confidently identified Common Palm Civets (seven each in Phnom Samkos WS and on transects in Veun Sai–Siem Pang CA), mainly as a solitary animal but once as a duo. In Veun Sai–Siem Pang CA five further Common Palm Civets were seen off-transects. Most Common Palm Civets were in evergreen forest, but two records in Phnom Samkos WS were in dry dipterocarp forest. While evergreen forest was the

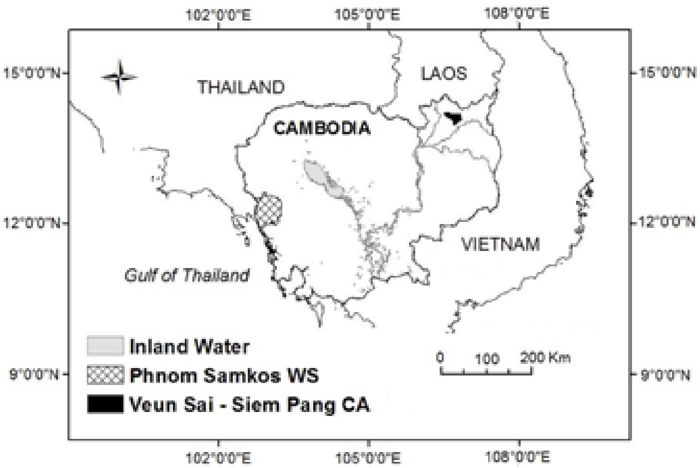

Fig. 1. Locations of the Phnom Samkos Wildlife Sanctuary and Veun Sai–Siem Pang Conservation Area within Cambodia.

Table 1. Night transects walked at Phnom Samkos Wildlife Sanctuary in 2009 and Veun Sai–Siem Pang Conservation Area in 2011, Cambodia.

	Phnom Samkos WS	Veun Sai–Siem Pang CA
Number of transects	10	7
Individual transect length	1 km	1.1–1.6 km
Total transect length	10 km	9.2 km
Total distance walked	20 km	17.2 km
Total survey effort	25 hours	29 hours

predominantly surveyed habitat in Veun Sai–Siem Pang CA, in Phnom Samkos WS about 60% of surveyed transect was in dry dipterocarp forest. In Phnom Samkos WS Common Palm Civets were encountered mostly in trees, but twice on the ground. In Veun Sai–Siem Pang CA, they were detected at heights of 6–22 m above the ground (mean 12.6 m ±1.67). Behaviours at first contact included being alert/watching the observers; resting; playing socially and feeding on fruit.

Physical characteristics and behaviour of a civet seen further off the transect in Phnom Samkos WS corresponded to those described by Duckworth (1997) and Walston & Duckworth (2003) for Small-toothed Palm Civet *Arctogalidia trivirgata*. Initially, we assumed that the animal was a Masked Palm Civet *Paguma larvata* based on conversation with our local guide and his pointing to this species in *A field guide to the mammals of Southeast Asia* (Francis 2008). The animal was in lowland evergreen forest, making considerable noise as it moved around high in a tree. On 17 May 2011 in Veun Sai–Siem Pang CA in evergreen forest, facing each other on the thick branches of two neighbouring trees at 12 and 14 m above ground respectively, we saw a duo of civets with distinct black-and-white banded tails and neck-markings. They were not safely identifiable beyond *Viverra/Viverricula*. Both genera are almost invariably seen singly and on the ground, at least in the Mekong countries (J. W. Duckworth *in litt*. 2012), suggesting that perhaps they were in some reproductive association.

Mean linear encounter rates for Common Palm Civet were 0.35 animals/km (SE ± 0.17) in Phnom Samkos WS and 0.39 animals/km (SE ± 0.21) in Veun Sai–Siem Pang CA. These figures do not necessarily indicate a proportionate difference in density, because sighting distances along and between transects were not uniform.

Discussion

In the two study areas only three of Cambodia's seven civet species were found, echoing previous spotlighting studies: Streicher (2010), in Veun Sai–Siem Pang CA, also only confidently identified *P. hermaphroditus* although both *Viverra zibetha* and *V. megaspila* were subsequently camera-trapped at the site (BR pers. obs.). Starr (2012), in Mondulkiri Province for two years, only encountered *P. hermaphroditus* and possibly *Paguma larvata*. We certainly encountered *P. hermaphroditus* 'commonly' at both sites, but many civets' general *Red List* categorisation as LC is based on minimal field data: many nocturnal studies do not attempt to quantify their abundance.

Because detection varies between species, habitat types, observers and environmental conditions (Anderson 2001), for comparable results, survey methods should be standardised (Struhsaker 1981, Peres 1999). Density calculations are best achieved using DISTANCE software, which incorporates the probability of detection function (Buckland *et al.* 1993). This study's intended use of DISTANCE sampling for civet densities was prevented by the low number of encounters: 60–80 independent sightings, and never less than 40 are required (Buckland *et al*. 1993, 2001). Such sample sizes are frequently impossible to generate in nocturnal transect surveys of small carnivores in tropical forest (e.g. Mathai *et al*. in prep.).

Iseborn (2011) interviewed villagers from two ethnic groups, the Kavet and Lao, regarding their knowledge and attitudes towards animals living in the Veun Sai–Siem Pang CA (42 hunters and 20 non-hunters, aged 17–67 years). Civets were never placed by hunters in the top ten desired prey species, nor were they mentioned in the context of traditional medicine use. Other relatively obscure nocturnal animals, including pangolins *Manis*, various lizards and snakes, and lorises, were preferred by hunters, reflecting their higher economic value. Despite this, non-target species were said usually to be caught when observed, suggesting that opportunistic offtake of civets may be high.

Apart from a Leopard Cat *Prionailurus bengalensis* in a tree in the dipterocarp forest in Phnom Samkos WS, no other small carnivore species were encountered directly. Only a few other nocturnal species were seen from transects (Phnom Samkos WS first, Veun Sai–Siem Pang CA second): Bengal Slow Loris *Nycticebus bengalensis* (n = 9, 0), Pygmy Loris *N. pygmaeus* (n = 0, 5), Indian Giant Flying Squirrel *Petaurista philippensis* (n = 3, 1), Lesser Chevrotain *Tragulus kanchil* (n = 15, 7) and Red Muntjac *Muntiacus muntjak* (n = 1, 0). In Phnom Samkos WS, muntjacs were frequently seen and heard out of survey time.

Hunting remains a chief threat to wildlife in Cambodia. Not only were head-torches, which facilitate nocturnal hunting, readily available at markets and small shops around both sites, but also traditional snares were seen in hunter's houses, and many people could be observed with domestic dogs *Canis familiaris*, with which they also hunted. Future nocturnal surveys in Cambodia should attempt to quantify civet abundance. The paucity of quantitative data from the region and the strong evidence of hunting urge more research to clarify nocturnal mammal conservation status in Cambodia. Further explorations into local ecological knowledge might clarify why at least some nocturnal mammal taxa in the country seem to occur at consistently low densities.

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Notes on live ferret badger *Melogale* trade in Java

Mia KIM

Abstract

A ferret badger *Melogale* was photographed for sale at Jatinegara animal market, Jakarta, Java, Indonesia, on 16 July 2011. This trade observation is supported by internet evidence of recent Javan trade in the genus, and raises a number of unforeseen questions concerning the conservation status of the Javan Ferret Badger *M. orientalis*, which is endemic to Java and Bali. Further investigation is needed to determine the species being traded in Indonesia, and to identify potential conservation needs, because intervention options rapidly decrease the longer such trade continues.

Keywords: hybridisation risk, Jatinegara animal market, *Melogale moschata*, *Melogale orientalis*, pet trade

Perdagangan Teledu *Melogale* di Pulau Jawa

Abstrak

Teledu *Melogale* terfoto dijual di pasar burung Jatinegara, Jakarta, Jawa, Indonesia, pada tanggal 16 Juli 2011. Adanya perdagangan marga *Melogale* ini didukung dengan bukti perdagangan terbaru di internet, dan menimbulkan keprihatinan akan status konservasi teledu jawa *Melogale orientalis*, satwa endemik Jawa dan Bali. Penelitian lebih lanjut diperlukan untuk mengetahui spesies *Melogale* apa saja yang diperdagangkan, dan untuk menentukan kebutuhan konservasinya, karena opsi intervensi konservasi akan semakin sedikit dengan makin lamanya perdagangan berlanjut.

Kata kunci: ancamana hibridisasi, pasar burung Jatinegara, *Melogale moschata*, *Melogale orientalis*, perdagangan hewan peliharaan

The four* species of ferret badgers *Melogale* resemble each other closely in external appearance, and inhabit mainland and insular South-east Asia and adjacent parts of South Asia and China (Corbet & Hill 1992). Their conservation status is poorly known, and all four species are recorded as Data Deficient on *The IUCN Red List of Threatened Species* (IUCN 2011) with the exception of the Small-toothed Ferret Badger *M. moschata*, which is listed as Least Concern. Conventional mammal surveys tend to generate few records of ferret badgers (e.g. Than Zaw *et al*. 2008, Robichaud 2010, Wong *et al*. 2011), and the still-frequent reports that extend the known range of this genus suggest that their actual range may yet be underestimated (e.g. Bali: Riffel 1991; Bangladesh: Islam *et al*. 2008; Cambodia: Schank *et al*. 2009; central Lao PDR: Robichaud 2010).

The only ferret badger known from Indonesia is the Javan Ferret Badger *M. orientalis*, of Java and Bali (Riffel 1991), although the Bornean Ferret Badger *M. everetti*, known only from Sabah, Malaysian Borneo, may yet be found in the highlands of Indonesian Borneo (Wong *et al*. 2011). The limited information available on the conservation status of Javan Ferret Badger suggests that it may occur both within and outside tall forest ecosystems, including some areas of heavy human use (e.g. Schreiber *et al*. 1989, Riffel 1991, Duckworth *et al*. 2008); however, the possibility remains that the paucity of data available reflects genuine scarcity and thus perhaps a threatened status for this species. Therefore, any information about the Javan Ferret Badger may help clarify its conservation status and identify potential conservation needs.

During a casual visit to the large, longstanding Jatinegara animal market, Jakarta, Java, on 16 July 2011, an apparently immature, single, caged ferret badger was photographed (Fig. 1). The animal's calm disposition suggested that it had not been taken from the wild as an adult. It may have been hand-raised having been taken as a wild cub (as frequently occurs with

Fig. 1. Ferret badger *Melogale* sp. for sale, Jatinegara animal market, Jakarta, Java, Indonesia, 16 July 2011 (M. Kim).

*After this observation a fifth species of ferret badger, Cuc Phuong Ferret Badger *Melogale cucphuongensis*, was proposed by Nadler *et al.* (2011).

civets in Java; C. R. Shepherd *in litt.* 2011) or, perhaps, was captive-bred. The vendor seemed unhappy about the animal being photographed and would not enter into discussion; this was not surprising as wildlife traders in this market operate largely outside the law (C. R. Shepherd *in litt.* 2011). This chance trade observation is supported by internet advertisements offering young ferret badgers in Java for sale as pets during 2010–2011 and ranging from 300,000 to 450,000 IDR (about USD 35–52; e.g.: http://tokolaris.info/baby-biul-javan-ferret-badger/ ; http://indopetshop.info/jual-baby-javan-ferret-badger-biul-imuut/ ; http://www.reptilx.com/rxforum/viewtopic.php?f=13&t=3695 ; http://www.kaskus.us/showthread.php?p=371134412). Wildlife traders are extremely opportunistic and will sell anything they acquire, and these observations suggest the possibility that the trade might be at volumes significant to conservation. However, while two observers report never seeing a ferret badger in trade on Java, despite repeated visits to wildlife markets over many years in Indonesia (C. R. Shepherd *in litt.* 2011, N. W. Brickle *in litt.* 2011), a third (G. Semiadi *in litt.* 2011), has noted a low level of their trade in Jakarta and Surabaya, Java. Thus far, reports of ferret badgers for food or as pets in Indonesia have been unusual, with demand arising only from highly specialised wildlife-pet keepers. At present, there are no registered trade breeders or sellers (those with permits issued by the Department of Forestry) for ferret badgers (G. Semiadi *in litt.* 2011).

Because the four ferret badger species are quite similar in external appearance, the photographed captive animal cannot be objectively identified to species. Given the quantity and diversity of native wild vertebrate species found in the trade markets of Indonesia (e.g. Shepherd *et al.* 2004), the Javan Ferret Badger is an obvious plausible identity. Another possibility, if demand were sufficiently high, is the importation of the Small-toothed Ferret Badger *M. moschata* which is farmed and sold in large numbers in China (Lau *et al.* 2010). However, while numerous species of non-native birds and reptiles have been observed on trade in Indonesia, there are no known reports of non-native small carnivores to date (C. R. Shepherd *in litt.* 2011). Systematic surveys, such as have been carried out in pet markets in Medan, Sumatra (e.g. Shepherd *et al.* 2004, Shepherd 2008), would be helpful to understand the extent and diversity of small carnivore trade; such data are sparse for wildlife trade in Jakarta (e.g. Shepherd & Nijman 2007; C. R. Shepherd *in litt.* 2011).

These findings warrant fresh consideration of the potential conservation threats to the Javan Ferret Badger. If the native Javan Ferret Badger is at present being traded exclusively, hunting pressure may be higher than previously appreciated. If non-native Small-toothed Ferret Badgers were being traded, the native Javan Ferret Badger may face greater conservation risks from hybridisation, competitive exclusion and/or introduction of foreign disease through the inevitable escape or release of these animals. As a precedent among the Mustelidae, the introduction of farmed American Mink *Neovison vison* to Europe has driven major declines in the phenotypically similar native European Mink *Mustela lutreola*, which is now at high risk of extinction (e.g. Sidorovich *et al.* 1999). And locally, in Java, a free-living Masked Palm Civet *Paguma larvata* (not a native of Java) was observed in Cibodas Botanic Gardens adjacent to the Gunuing Gede Pangrango National Park (Brooks & Dutson 1994). This was either Sumatran or Bornean in origin, based upon the published morphological description, and because significant trade exists between the islands of Indonesia and large quantities of wildlife have been documented on trade in Java from Sumatra (C. R. Shepherd *in litt.* 2011), it is likely that this civet was a trade escape or release. Unfortunately, there is too little information to date to assess these threats authoritatively towards the Javan Ferret Badger.

Box 1. Morphological characteristics reported to distinguish the Javan Ferret Badger *Melogale orientalis* from the Small-toothed Ferret Badger *Melogale moschata*.

1. Dentition – the Javan Ferret Badger has massive teeth (similar to the Large-toothed Ferret Badger *M. personata* of mainland Asia), compared with the smaller dentition of the Small-toothed Ferret Badger (Long 1992);
2. The tail as a percentage of head-and-body length – this is 45–50%, with the tail darker and nearly always white-tipped for the Javan, compared with 40–45% in the Small-toothed which has lighter tail sometimes lacking a contrasting white tip (Corbet & Hill 1992); and
3. Lengthy pale ventral patch – distinctly narrows at the chest in the Javan but does not in the Small-toothed (Corbet & Hill 1992).

Note: while the tail and coat characteristics are often suggestive rather than diagnostic at the individual animal level, they are more readily obtainable for live animals in trade than either the dentition or genetics.

The actual threat that this trade represents to the Javan Ferret Badger remains unknown. Actions to determine the species's conservation needs are recommended, as intervention options rapidly dwindle the longer such trade continues. Several topics warrant investigation: 1) identification of the species of ferret badger being traded through genetic analysis and morphological examination (Box 1); 2) determination of the source of the animals being traded (e.g. whether cubs are wild-caught and hand-reared vs. captive-bred animals); and 3) evaluation of both the magnitude and target market of the trade.

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Notes on the flexibility of foraging behaviour in Tayras *Eira barbara*

Fernando G. SOLEY

Abstract

Based on direct field observations, images from camera traps, and analysis of faeces, I describe aspects of diet and foraging behaviour of Tayras *Eira barbara* in July 2004 and during September–December 2006 at La Selva Biological Station, Costa Rica. Tayra diet consisted primarily of *Musa* (introduced plantains and bananas) and Cacao *Theobroma cacao* fruits. Tayras visited an abandoned plantain plantation during day and night and were observed foraging individually or in pairs. Tayras cached unripe plantains and retrieved them once ripened. Tayras exhibit versatility of foraging behaviours and visited disturbed sites.

Keywords: camera-traps, Costa Rica, diet, disturbed sites, Mustelidae

Notas sobre la flexibilidad en el forrajeo del Tolomuco *Eira barbara*

Resumen

Algunos aspectos sobre el comportamiento de forrajeo del Tolomuco *Eira barbara* fueron estudiados en la Estación Biológica La Selva, Costa Rica, en Julio del 2004 y de Setiembre a Diciembre del 2006. Basándose en observaciones directas, cámaras trampa, y análisis de heces, la dieta de esta especie en La Selva, tiene un componente importante de frutos de *Musa* (plátanos y bananos que fueron introducidos al continente americano). Individuos que forrajeaban de manera solitaria o en parejas fueron observados durante el día y también en la noche en una plantación de plátano abandonada. Los Tolomucos almacenaron plátanos que no habian madurado y los recuperaron luego para consumirlos ya maduros. Algunos detalles sobre el forrajeo de tolomucos son mencionados en relación con el aprovisionamiento de frutos. Los tolomucos demuestran versatilidad en sus estrategias de forrajeo y en su habilidad de utilizar áreas perturbadas.

Palabras clave: áreas de disturbio, cámaras-trampa, Costa Rica, dieta, Mustelidae

Introduction

Mustelids are typically considered carnivorous, although several species consume much fruit (Zabala & Zuberogoitia 2003, Barrientos & Virgós 2006, Macdonald 2006). Most knowledge about the natural diet of Tayras *Eira barbara* comes from opportunistic observations, which suggest an omnivorous diet including invertebrates, small and medium-sized vertebrates, various fruits and honey (Janzen 1983, Presley 2000, Bezerra *et al*. 2009).

Once considered forest specialists (see Presley 2000), Tayras are now known also to frequent disturbed areas and human settlements near forests, and to forage in plantations and gardens, often damaging crops (Presley 2000, Guiracocha *et al.* 2001, Macdonald 2006, Soley & Alvarado-Díaz 2011). Besides eating ripe fruits, Tayras cache unripe plantains *Musa* × *paradisiaca* and Sapote *Pouteria sapota* fruits to eat them later, once ripened (Soley & Alvarado-Díaz 2011). Unripe fruits detached from the plant will only continue to ripen if picked at mature stages (Offem & Njoku 1993) and Tayras are able to select unripe plantains and Sapote fruits that are mature enough for caching. These fruits are cached out of sight (e.g. in bromeliads, cavities in trees or on the ground, and on top of tree stumps covered by tall grass), often in places likely to be less frequented by competitors, such as forestry plantations and pastures (Soley & Alvarado-Díaz 2011). These future-oriented behaviours raise important questions about cognitive abilities (i.e. mental processes) in mustelids and on how such abilities contribute to the natural history and ecology of this group. I here provide complementary data to an earlier study (Soley & Alvarado-Díaz 2011) and comment on Tayra foraging versatility in relation to their ecology.

Methods

Opportunistic observations of Tayra foraging behaviour were made at La Selva Biological Station, Costa Rica (10°26'N, 84°01'W), during July 2004 and September–December 2006. This protected area includes patches of primary and secondary forest, and abandoned pastures and plantations (McDade *et al.* 1994). Most observations occurred in a small (484 m^2) plantain plantation and in a forestry plantation lacking fruiting trees. The two plantations, separated by about 80 m, were surrounded by forest. These sites are described in detail by Raich *et al*. (2007) and Soley & Alvarado-Díaz (2011).

To study Tayra diet at La Selva, 11 faeces were collected (10 at the plantain plantation and one at the forestry plantation). Faeces were assigned to Tayra based on volume, shape and place of deposition. They are easily distinguishable from those of the other common medium-sized mammals at this site, White-nosed Coati *Nasua narica*, Common Opossum *Didelphis marsupialis* and Collared Peccary *Pecari tajacu.* To monitor Tayra visits, six motion-sensitive cameras were installed at the plantain plantation, facing the fruit bunch or the pseudostem of a plantain plant. Traps occasionally registered a Tayra visit repeatedly, by taking successive pictures, usually separated by 1-min intervals. Based on these successive pictures, the longest that a Tayra remained in a fruit bunch was 8 min. Thus, pictures separated by intervals greater than 20 min were considered independent visits.

Results

Seven of the 11 faeces contained seeds of Cacao *Theobroma cacao* and one also contained remains of an *Ameiva* lizard. The remianing four faeces were comprised entirely of digested *Musa* (plantain or banana) fruits.

During 31 days with 4–8 hours' observation each, Tayras were observed on 16 occasions (nine at the plantain plantation and seven at the forestry plantation). On 13 occasions they were observed foraging alone and on three occasions in twos. One duo was attempting to cache an unripe plantain at the forestry plantation, and another was retrieving a ripe plantain from a cache at the forestry plantation; both of these observations were described in Soley & Alvarado-Díaz (2011). Also, on 6 November 2006 two Tayras were observed together at the plantain plantation; one walked towards a plantain fruit bunch and picked up a plantain (of unknown ripeness) while the other appeared to wait about 8 m away, at the edge of the plantation. The Tayras left the plantation together (one carrying the plantain) and were again seen about 1 min later at the forestry plantation, but quickly disappeared.

All plants with fruit bunches (n = 42) had Tayra claw markings, even if fruits were unsuitable for eating or caching. Claw marks of the other clawed medium-sized mammals that were common at these plantations, White-nosed Coati and Common Opossum, differ markedly in size and shape from those of Tayra. A male Tayra was once observed inspecting three fruit bunches at the plantain plantation before leaving the site; all three bunches contained immature plantains, and the Tayra picked no fruit.

Pelage patterns of Tayras can be quite uniform, so it was often impossible to distinguish individuals from camera pictures. However, based on variations in facial profiles, fur coloration and scars, at least five individuals visited the fruit bunches in 2006. Two cameras at fruit bunches with unripe, mature fruit registered at least seven different visits in one day. The average daily number of visits per camera was 1.9 ± 1.6 (n = 11 cameras) and cameras registered pictures by both day and night. Three dens similar in appearance to the description of Tayra dens by Janzen (1983) were observed within 200 m of the plantation.

Discussion

All Tayra faeces examined had remains of Cacao or *Musa* fruits, so it appears that at La Selva during September to December, the diet of Tayras includes a strong fruit component (no faeces were found in July 2004). At this site, small abandoned plantations of Cacao, banana and plantain are intermixed with primary and secondary forests, so fruit availability might be greater than in surrounding areas. Similar conditions of mixed agricultural and forest ecosystems occur in other places in Costa Rica, and mammals including Tayras also frequent these sites (e.g. Talamanca, Guiracocha *et al.* 2001; Península de Osa, pers. obs.).

Although it is unknown how many Tayras were present at La Selva, it is likely that the species is common in this area because of the high abundance of food and number of observations reported. Ripe fruits are consumed by many species at La Selva, and Tayras may reduce competition for plantains by caching unripe fruits: unripe plantains at this site are not consumed by other species unless they fall to the ground (where they are consumed by peccaries; Soley & Alvarado-Díaz 2011). Occasionally whole plants with fruit bunches fell to the ground, a consequence of weakening of the pseudostem through claw-damage from repeated use by Tayras. These unripe fruit bunches were consumed by peccaries within two days.

The Tayra's wide distribution range encompasses many habitats (Presley 2000) and aspects of their foraging ecology may have played an important role in their success (Soley & Alvarado-Díaz 2011). Tayra juveniles have a tendency to explore (Poglayen-Neuwall 1978, Presley 2000) and Tayras have a diverse diet requiring flexible foraging behaviour (Janzen 1983, Presley 2001); they can be active at different times of day (Presley 2000, González-Maya *et al.* 2009, Delgado *et al.* 2011), and can forage singly or in small groups, on the ground or in trees (Timm *et al.* 1989, Presley 2000, Delgado *et al.* 2011). An attribute of foraging behaviour that might have provided Tayras with an ecological advantage is their ability to cache fruits in secure places to reduce consumption by competitors (Soley & Alvarado-Díaz 2011).

It is not known if other populations of Tayras cache unripe fruits. *Musa* was introduced into the Tayra's geographical range only about the 16th century (Bassler 1926). It is possible that Tayras transferred the skill of caching native, unripe Sapote fruits to caching unripe plantains or the other way around, but it remains unknown whether the same individuals cache both types of fruit (Soley & Alvarado-Díaz 2011). Other mustelids are also known for their foraging versatility (Goswami & Friscia 2010), which enables them to exploit food sources that would otherwise be potentially unavailable. For example, Fishers *Martes pennanti* attack and kill North American Porcupines *Erethizon dorsatum* in a very specific manner (Powell 1993), Wolverines *Gulo gulo* cache the remains of large prey items (Macdonald 2006), and Sea Otters *Enhydra lutris* use stones as anvils to open hard-shelled molluscs (Alcock 1972).

The transmission of highly specialised foraging skills via social learning (mother–offspring associations) has been demonstrated in mongooses (Müller & Cant 2010). Tayras raised in captivity apparently improve preying tactics based on trial and error, starting gradually with wounded prey brought by their mothers (Poglayen-Neuwall & Poglayen-Neuwall 1976, Poglayen-Neuwall 1978). Since Tayras frequently forage in pairs or small groups (Presley 2000, Delgado *et al.* 2011), even when caching fruit (Soley & Alvarado-Díaz 2011), it is likely that social learning has contributed to transmission of this behaviour.

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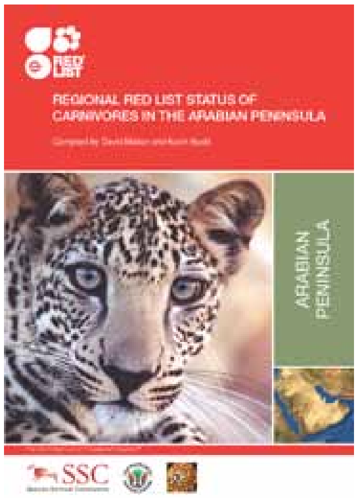
Regional Red List status of carnivores in the Arabian Peninsula by D. Mallon & K. Budd, K. (eds). IUCN, Cambridge, U.K., and Gland, Switzerland; and Environment and Protected Areas Authority, Sharjah, U.A.E. 2011, vi + 49 pp.

A Regional Red List workshop for the carnivores of the Arabian Peninsula took place over 8–10 February 2011. The workshop was organised and funded by the Environment and Protected Areas Authority, Government of Sharjah, and was hosted by the Breeding Centre for Endangered Arabian Wildlife. More than 30 people from within and outside the region participated.

Twenty species of carnivores have been reported within the Arabian Peninsula, of which seven fall under the remit of the IUCN/SSC Small Carnivore Specialist Group (Marbled Polecat *Vormela peregusna*, Eurasian Badger *Meles meles*, Ratel *Mellivora capensis*, Indian Grey Mongoose *Herpestes edwardsii*, White-tailed Mongoose *Ichneumia albicauda*, Bushy-tailed Mongoose *Bdeogale crassicauda* and Common Genet *Genetta genetta*). Of these, Arabian peninsula populations of Marbled Polecat, Eurasian Badger and Bushy-tailed Mongoose were deemed Not Applicable for regional assessment (the former two are of only marginal occurrence in the region, and the mongoose has not been confirmed to occur at all). Of the four small carnivore species assessed, Ratel was categorised as Regionally Near Threatened, White-tailed Mongoose and Common Genet as Regionally Least Concern, and Indian Grey Mongoose as Regionally Data Deficient. All four are considered Least Concern globally



For details of the above pictures, refer Ross *et al.* page 11.

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