

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 kategori terancam (kucing hutan *Prionailurus planiceps*, kucing merah *Pardofelis badia*, musang air *Cynogale bennettii*) dan enam jenis kategori 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, Gimán *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 km²) 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 km²). 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

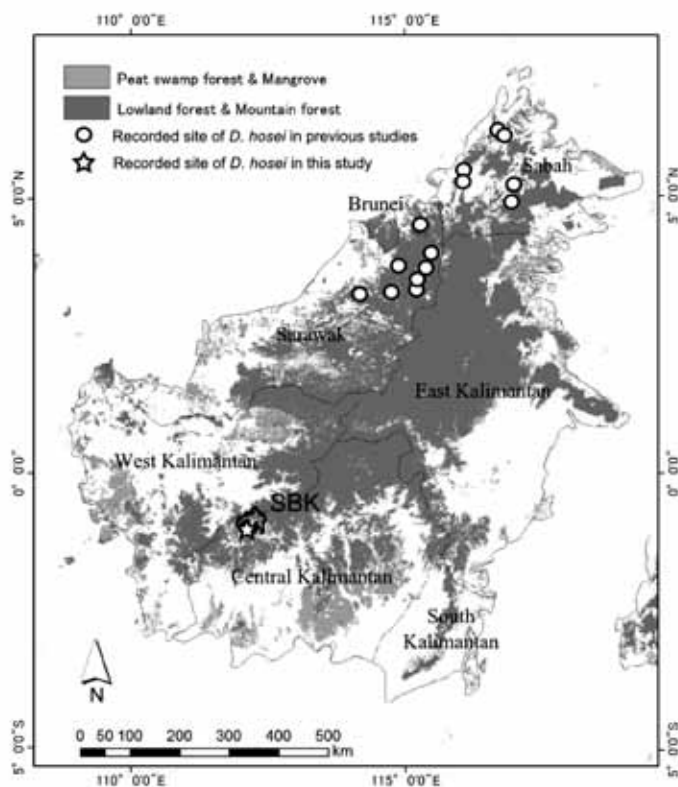


Fig. 1. Borneo, showing recorded sites of Hose's Civet *Diplogale hosei* (sources are detailed in the text) and the area of remaining natural forest (Miettinen *et al.* 2011).

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 laevis*, 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

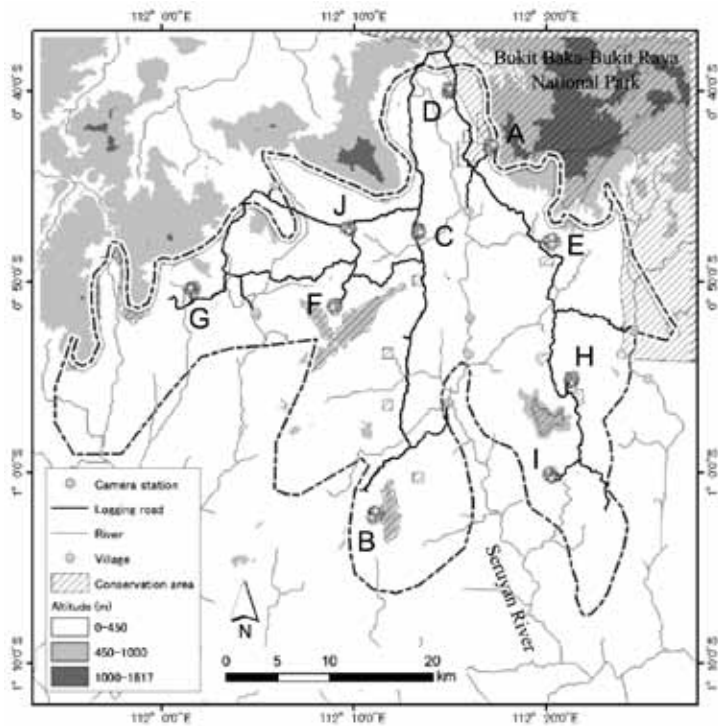


Fig. 2. Ten plots in the Katingan-Seruyan Block of Sari Bumi Kusuma Corporation, Central Kalimantan, Indonesia. Ten camera set points were randomly selected in each plot.

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 m², 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	Forest condition
		mean (range)	
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 zibethus* (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, Mat-subayashi *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 <i>Hemigalus derbyanus</i>	VU	55	11	6	2		47	8	1		8	138
Sun Bear <i>Helarctos malayanus</i>	VU	1	8	3	11	1	12	1	2	8	2	49
Common Palm Civet <i>Paradoxurus hermaphroditus</i>		1					9	4	3	3	1	21
Banded Linsang <i>Prionodon linsang</i>		4		1	3	1	3	1	4	1	2	20
Malay Civet <i>Viverra zangalla</i>			12	2				1		1	3	19
Collared Mongoose <i>Herpestes semitorquatus</i>	DD	10	1				1	2			1	15
Yellow-throated Marten <i>Martes flavigula</i>					1		4		2	1	3	11
Short-tailed Mongoose <i>Herpestes brachyurus</i>			6		2			2				10
Masked Palm Civet <i>Paguma larvata</i>		2	3						1			6
Leopard Cat <i>Prionailurus bengalensis</i>		1					1			2	1	5
Flat-headed Cat <i>Prionailurus planiceps</i>	EN			1						1		2
Hose's Civet <i>Diplogale hosei</i>	VU		2									2
Bay Cat <i>Pardofelis badia</i>	EN						1					1
Binturong <i>Arctictis binturong</i>	VU						1					1
Sunda Clouded Leopard <i>Neofelis diardi</i>	VU						1					1
Marbled Cat <i>Pardofelis marmorata</i>	VU										1	1
Otter Civet <i>Cynogale bennettii</i>	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 unicorn* 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 biodiversity. 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 range¹.

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♀
Sahebmarā 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 Patiatāla (exact location not known)	Not known
IIM wetland, Joka (22°26'N, 88°17'E)	Not known

¹All 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

²Sex could be determined only for animals handled by ZSI and NEWS.

³No details are given, and the photograph purportedly 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.