

Otter Civet *Cynogale bennettii* and other small carnivores recorded in the Bukit Tigapuluh Landscape, Sumatra, Indonesia

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Abstract

The Bukit Tigapuluh Landscape in Central Sumatra, Indonesia, is an important habitat for various wildlife species, including small carnivores belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae. An extensive camera-trap survey conducted between March 2013 and March 2014, and totalling 7068 camera-trap nights, in the southern part of the landscape detected 12 small carnivore species, including the first records of the Endangered Otter Civet *Cynogale bennettii* for the landscape.

Keywords: Viverridae, Mustelidae, Herpestidae, Prionodontidae, tropical lowland forest, wildlife conservation, camera-trapping

Introduction

The Indonesian island of Sumatra is home to a variety of small carnivore species. Most representatives of this group are elusive animals that are difficult to observe directly. Camera-trapping is among the most popular techniques to overcome detection problems and has been widely used to monitor wildlife populations in Sumatra and elsewhere (Linkie *et al.* 2008, Rowcliffe & Carbone 2008, Evans *et al.* 2016, Ancrenaz *et al.* 2012, Sunarto *et al.* 2013, McCarthy & Fuller 2014, Trolliet *et al.* 2014). However, by-catch records for non-target species are rarely published (Scotson *et al.* 2017). In contrast to neighbouring Borneo, where there has been considerable effort to clarify the conservation status of small carnivores (e.g. Wilting *et al.* 2016), very little up-to-date information is available from Sumatra (e.g. Holden 2006, McCarthy & Fuller 2014, Jennings *et al.* 2015), with several recent contributions covering only individual records of particular significance (e.g. Eaton 2009, Holden & Meijaard 2012, Ross *et al.* 2012, Puspardini & Sibarani 2014).

This survey contributes to closing the knowledge gap for small carnivores in Central Sumatra by presenting new records for species belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae, based on an extensive camera-trap survey

conducted between March 2013 and March 2014 in the Bukit Tigapuluh Landscape, Jambi, Indonesia.

Materials and methods

Survey site

The Bukit Tigapuluh Landscape is located roughly in the geographical centre of the Indonesian island of Sumatra, at the border between Riau and Jambi provinces. The tropical climate is marked by high rainfall (average precipitation 2577 mm/year, max. 347 mm/month, min. 83 mm/month) and temperatures ranging between 20 and 33 °C; the altitude ranges between 15 m and 843 m asl (Pratje & Sitompul 2009). In addition to a 1440 km² national park, the area includes a variety of land-use types and management units. These include forest concessions that are predominantly rubber tree *Hevea brasiliensis* and pulpwood *Acacia* and *Eucalyptus* monoculture plantations, as well as an ecosystem restoration concession (Menteri Kehutanan 2004), agriculture concessions (predominantly oil palm *Elaeis guineensis*), inactive logging concessions and community land. The study at hand was conducted in the southernmost part of the landscape in Jambi Province (Fig. 1). This area functions as an important buffer zone for the Bukit Tigapuluh National Park and as important habitat for conservation flagship species such as Asian Elephant *Elephas maximus* (Mossbrucker *et al.* 2015, 2016), Tiger *Panthera tigris* (Mossbrucker 2014), and re-introduced Sumatran Orangutans *Pongo abelii* that are released at a station located just south of the national park (Kelle 2012).

Data collection and processing

A camera-trap survey was conducted by well-trained Frankfurt Zoological Society field rangers as part of a wildlife monitoring programme implemented in cooperation with the Jambi Department of Conservation of Natural Resources and Ecosystem (Konservasi Sumber Daya Alam dan Ekosistem) under a general Memorandum of Understanding with the Indonesian Ministry of Forestry. The survey area was divided into four survey blocks of roughly 250 km² each (Fig. 1). In each of the four blocks 30 camera-trap stations were operated over a period of three months, starting in the westernmost block in March 2013 and completing the survey in the easternmost block in March 2014. Camera-traps (Bushnell® Trophy Cam™ HD) were set in pairs in the centre area of the blocks with approximately 3 km spacing in between individual trapping locations (referred to as camera-trap stations). Camera-trap pairs were set close to the ground (approximately 20–30 cm above ground level, 90° to the trail, with the cameras slightly angled away from each other or a few metres apart to prevent overexposure of images) for target animal size ranging from Leopard Cat *Prionailurus bengalensis* to Tiger *Panthera tigris*, with a pre-set delay interval of 10 seconds between motion-activated triggers. Locations for the stations were chosen on the basis of signs of animal activity, with priority given to active wildlife trails that showed tracks of

tigers and/or tiger prey. Recently burnt areas and other wasteland were not included in the survey, and neither lures nor baits were used. All camera-trap stations were visited monthly to collect memory cards, exchange batteries and maintain the stations. The location of each station was recorded using handheld GPS units (Garmin GPSMAP® 60CSx), and for all locations elevation information was obtained based on Shuttle Radar Topography Mission data (digital elevation model with a resolution of 1 arc-second, courtesy of the U.S. Geological Survey). All pictures were cross-checked by a minimum of three different qualified persons independently in order to minimise misidentifications, and all records were entered into a standardised Microsoft Excel database, using a lag time of one hour in between records for each individual species at each individual camera-trap station (i.e., discarding pictures of the same species taken within a period of one hour following the first photo) to result in ‘notionally independent records’.

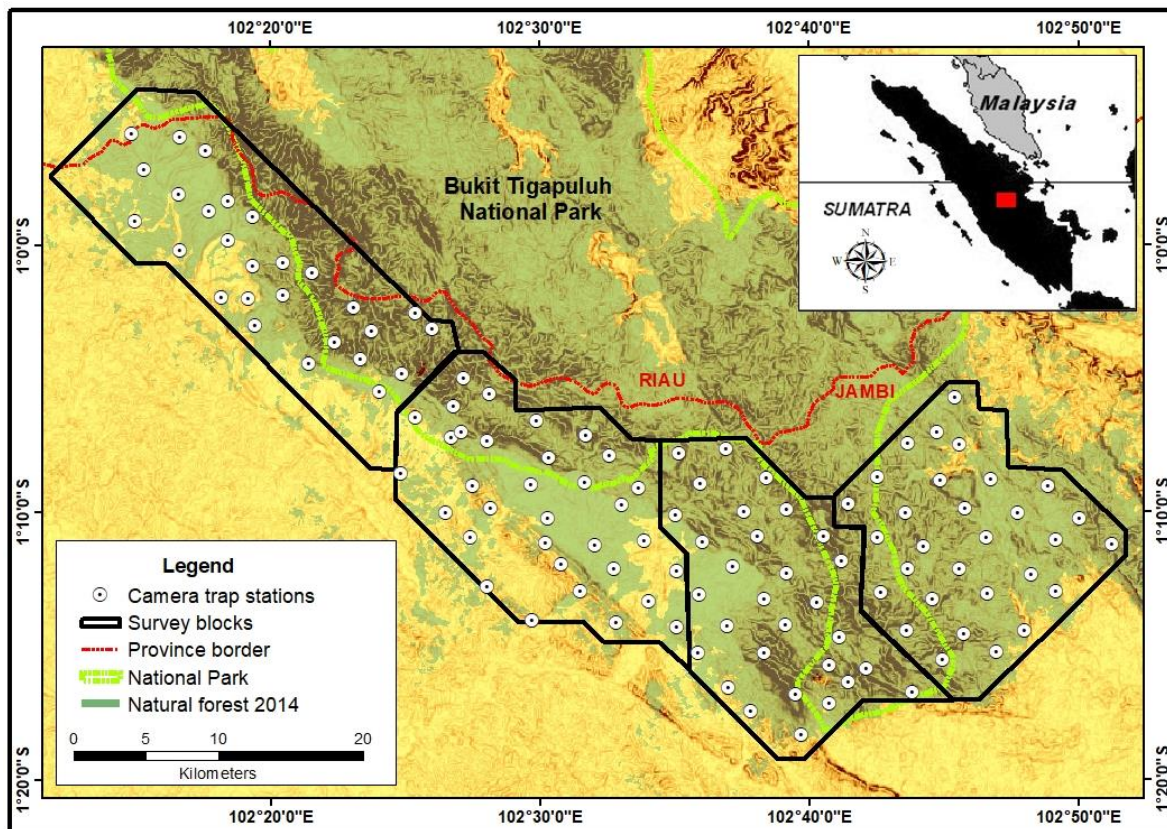


Fig. 1. Survey area showing 120 camera-trap stations (white dots) in four survey blocks (black outlines) in the Bukit Tigapuluh Landscape, Sumatra, Indonesia. (Map data sources forest cover: Frankfurt Zoological Society based on Landsat imagery; administrative boundaries: Frankfurt Zoological Society and Badan Koordinasi Survei dan Pemetaan Nasional, Indonesia; digital elevation model: Shuttle Radar Topography Mission data, courtesy of the U.S. Geological Survey.)

Results and discussion

A total of 6480 notionally independent records of mammals (excluding humans [793 records] and domestic dogs [8 records]) were obtained over the course of 12 months. With very few exceptions (four camera-traps had to be moved to new stations when fields were opened), camera-trap stations were recording data for 46 to 66 days, with an average of 60 days per station. The survey detected a total of 35 medium-sized and large-bodied wild mammal species, including rare and/or cryptic species such as Sumatran Orangutan, Asian Elephant, Tiger, Sunda Clouded Leopard *Neofelis diardi*, Sun Bear *Helarctos malayanus*, Asian Tapir *Tapirus indicus*, Dhole *Cuon alpinus*, Marbled Cat *Pardofelis marmorata* and Asiatic Golden Cat *Catopuma temminckii*.

Small carnivores were frequently detected, with a total of 406 notionally independent records for 12 species belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae (Table 1). Most records were obtained during night time (18h00–06h00 Western Indonesian Time [WIB]), but several species were also frequently or even exclusively recorded during daytime hours (06h00–18h00 WIB).

Table 1. Notionally independent species records for small carnivores belonging to the families Viverridae, Mustelidae, Herpestidae and Prionodontidae collected during a camera-trap survey from March 2013 to March 2014 in the Bukit Tigapuluh Landscape, Sumatra, Indonesia, with IUCN Red List conservation status (IUCN 2019) and recorded altitude ranges for each species.

Species name (conservation status ¹)	No. of stations ²	No. of records ³	Day-/night- time records ⁴	Altitude (m asl)
<i>Herpestes brachyurus</i> , Short-tailed Mongoose (NT)	16	31	28/3	90 - 373
<i>Herpestes semitorquatus</i> , Collared Mongoose (NT)	1	1	1/0	122
<i>Aonyx cinereus</i> , Asian Small-clawed Otter (VU)	3	3	2/1	128 - 180
<i>Martes flavigula</i> , Yellow-throated Marten (LC)	20	25	25/0	108 - 572
<i>Mydaus javanensis</i> , Sunda Stink-badger (LC)	4	10	1/9	116 - 445
<i>Prionodon linsang</i> , Banded Linsang (LC)	22	40	0/40	147 - 730
<i>Arctictis binturong</i> , Binturong (VU)	4	6	3/3	176 - 376
<i>Cynogale bennettii</i> , Otter Civet (EN)	2	3	0/3	271 - 524
<i>Hemigalus derbyanus</i> , Banded Palm Civet (NT)	39	71	2/69	104 - 572
<i>Paguma larvata</i> , Masked Palm Civet (LC)	5	6	1/5	107 - 673
<i>Paradoxurus hermaphrodites</i> , Common Palm Civet (LC)	35	59	1/58	98 - 730
<i>Viverra zangalla</i> , Malay Civet (LC)	54	151	9/142	75 - 471
Total	205	406	73/333	75 - 730

¹ Least Concern (LC); Vulnerable (VU); Near Threatened (NT); Endangered (EN). ² Number of camera-trap stations that recorded the species. ³ Number of notionally independent records. Notionally independent records of a given species are photographs of the same species at the same camera-trap station, separated by a minimum of one hour. ⁴ Number of notionally independent records recorded during day (06h00 – 18h00 Western Indonesian Time [WIB]) and night-time (18h00 – 06h00 WIB) hours.

In general, species that may prefer habitat close to rivers and streams, such as Oriental Small-clawed Otter *Aonyx cinereus* (Wright *et al.* 2015), Otter Civet *Cynogale bennettii* (Ross *et al.* 2015) and Collared Mongoose *Herpestes semitorquatus* (Mathai *et al.* 2015), were rarely recorded in this survey. This is probably because camera-traps were placed predominantly some distance from water to prevent damage from flooding. Nevertheless, the endangered Otter Civet (Fig. 2) was detected at two, Collared Mongoose (Fig. 2) at one and Oriental Small-clawed Otter at three camera-trap stations. To our knowledge, these represent the first records for these species in Bukit Tigapuluh Landscape (see Veron *et al.* 2006, Holden & Meijaard 2012, Ross *et al.* 2012, Pusparini & Sibarani 2014 for additional records from Sumatra).

Fifty percent of all detected small carnivores are either listed on The IUCN Red List of Threatened Species as Near Threatened (Banded Civet *Hemigalus derbyanus*, Collared Mongoose and Short-tailed Mongoose *Herpestes brachyurus*), Vulnerable (Oriental Small-clawed Otter and Binturong *Arctictis binturong*) or Endangered (Otter Civet) (IUCN 2019). Our findings underline the importance of the Bukit Tigapuluh Landscape, particularly the surveyed southern part, for the conservation of small carnivores and other threatened mammals.



Fig. 2. Otter Civet *Cynogale bennettii* (top; photographed 7 July 2013) and Collared Mongoose *Herpestes semitorquatus* (bottom; photographed 18 August 2013) recorded by camera-traps in the Bukit Tigapuluh Landscape, Jambi, Sumatra.

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Appendix 1. Information on location, altitude, and small carnivore species recorded for each camera-trap station set from March 2013 to March 2014 in the Bukit Tigapuluh Landscape, Sumatra, Indonesia.

No.	Latitude	Longitude	asl (m)	Recorded species ¹	No.	Latitude	Longitude	asl (m)	Recorded species ¹
1	-1.185154064	102.6007251	193	MAFL, PAHE	61	-1.166572875	102.4417656	133	PAHE
2	-1.200356423	102.6192933	119	HEDE, VITA	62	-1.142262134	102.4139422	109	PAHE
3	-1.181839193	102.6350796	231	MAFL, PAHE, PRLI	63	-1.182494096	102.4568729	90	HEBR, VITA
4	-1.166157643	102.6268035	279	PRLI	64	-1.164031604	102.4699192	143	VITA
5	-1.144989345	102.6402563	334	HEDE, MAFL, VITA	65	-1.198896773	102.5134947	131	VITA
6	-1.164616108	102.6532446	340		66	-1.18576363	102.5036284	166	PAHE
7	-1.168109908	102.584359	135	HEBR, PAHE, VITA	67	-1.21290017	102.4677105	122	
8	-1.149032113	102.5996421	225		68	-1.233886638	102.4954573	141	PAHE
9	-1.129659071	102.5866005	344	PRLI, VITA	69	-1.215701416	102.5250909	75	VITA
10	-1.127233548	102.6156546	376	ARBI, MAFL	70	-1.235471805	102.5472007	139	VITA
11	-1.204941463	102.6526808	308		71	-1.170091978	102.505133	108	HEBR, MAFL, VITA
12	-1.181819438	102.6756472	673	PALA, PRLI	72	-1.149384088	102.494492	128	AOCI, HEDE, PAHE, VITA
13	-1.197052239	102.6871574	524	CYBE, MAFL	73	-1.238345075	102.5851055	119	HEDE, PAHE, VITA
14	-1.222738743	102.6712835	256	HEBR, PRLI	74	-1.201674018	102.5458662	104	HEBR, HEDE, PAHE, VITA
15	-1.220803059	102.6390606	182	PAHE	75	-1.222275326	102.5673381	98	PAHE
16	-1.236986359	102.6519883	181	HEDE, VITA	76	-1.109310369	102.4984056	245	

No.	Latitude	Longitude	asl (m)	Recorded species ¹	No.	Latitude	Longitude	asl (m)	Recorded species ¹
17	-1.25443926	102.6391117	409	HEDE, PRLI, VITA	77	-1.132898349	102.5056144	355	PALA, PRLI
18	-1.218172564	102.5984421	122	HEDE, HESE, PAHE, VITA	78	-1.118456378	102.5289476	386	PRLI
19	-1.237722504	102.6161171	107	HEDE, PAHE, PALA, VITA	79	-1.131592674	102.5429007	308	
20	-1.253958418	102.5977363	139	HEBR, HEDE, PAHE, VITA	80	-1.148084662	102.5278539	135	HEDE, MAFL, PAHE, VITA
21	-1.279191288	102.7306027	197	HEDE, MAFL	81	-1.151774197	102.5610686	187	HEDE, VITA
22	-1.272511679	102.6913045	269	PAHE	82	-1.16197022	102.5506876	121	HEBR, PAHE, VITA
23	-1.261770685	102.6794135	445	MAFL, MYJA, PRLI	83	-1.186830533	102.5340254	88	VITA
24	-1.244682071	102.6858144	450	MAFL	84	-1.184119168	102.5648125	122	HEDE, PAHE, VITA
25	-1.280003018	102.658614	471	PAHE, PRLI, VITA	85	-1.203281905	102.5849392	124	
26	-1.28551827	102.6794282	197	HEBR	86	-1.119902717	102.4453449	119	HEDE, PAHE, VITA
27	-1.26432193	102.7018562	387	HEDE, VITA	87	-1.107347442	102.4232665	139	
28	-1.305254138	102.6621566	157	HEDE, PAHE, VITA	88	-1.14982179	102.4582043	201	
29	-1.275625468	102.6169539	134	HEDE, VITA	89	-1.121784258	102.4678101	221	HEDE
30	-1.290725316	102.6308698	128	PAHE, VITA	90	-1.116274905	102.4517055	151	PAHE
31	-1.253426659	102.7827205	176	ARBI, MYJA, PAHE, VITA	91	-1.092934476	102.4687146	378	VITA

No.	Latitude	Longitude	asl (m)	Recorded species ¹	No.	Latitude	Longitude	asl (m)	Recorded species ¹
32	-1.202283837	102.7595715	188	HEBR, MAFL, VITA	92	-1.083159737	102.4529907	488	MAFL, PRLI
33	-1.216517776	102.711382	373	HEBR, HEDE, VITA	93	-1.100733868	102.4467891	328	MAFL, PRLI
34	-1.182606733	102.709039	308	VITA	94	-0.978715528	102.2954373	151	HEDE, PAHE
35	-1.201895956	102.7279921	329	VITA	95	-0.968126814	102.2765204	158	AOCI, HEDE
36	-1.188135537	102.7372904	271	CYBE, MAFL, VITA	96	-1.003146238	102.2777488	139	PAHE
37	-1.242307687	102.7623496	218	ARBI, HEBR, MAFL	97	-0.985130193	102.2495195	164	
38	-1.22106467	102.7429666	284		98	-0.953117308	102.2551205	167	PRLI
39	-1.240460104	102.726837	436	PAHE, VITA	99	-0.932702456	102.2774279	180	AOCI
40	-1.258939506	102.749159	374	HEDE, MYJA	100	-0.941200939	102.2936622	242	
41	-1.095126928	102.7569246	234	VITA	101	-0.930392742	102.2475523	160	HEDE
42	-1.145788337	102.7793851	185	HEDE, MAFL, PAHE, VITA	102	-1.091303311	102.4006259	122	VITA
43	-1.164362677	102.7632934	177	PAHE, VITA	103	-1.080479318	102.4151363	239	MAFL
44	-1.124600482	102.7597136	186	VITA	104	-1.070696156	102.3892401	299	HEDE
45	-1.147128541	102.7477418	246		105	-1.052196428	102.4333606	407	MAFL, PALA, PRLI
46	-1.161691696	102.6912821	420	HEDE	106	-1.042381701	102.4232312	403	PALA
47	-1.166927718	102.7267003	301		107	-1.053358548	102.396357	572	HEDE
48	-1.14459365	102.7091955	266	ARBI, HEDE	108	-1.03899717	102.38528	730	PAHE, PRLI
49	-1.123988156	102.7279556	261	VITA	109	-1.060288792	102.3729792	485	HEDE
50	-1.116896446	102.7457892	251	HEBR, VITA	110	-1.073533195	102.3569319	160	HEDE, PRLI
51	-1.186629493	102.8545513	255	HEDE, MAFL	111	-0.972715692	102.3076881	184	HEDE
52	-1.183682053	102.8198732	192	VITA	112	-0.982289109	102.3225393	225	PAHE

No.	Latitude	Longitude	asl (m)	Recorded species ¹	No.	Latitude	Longitude	asl (m)	Recorded species ¹
53	-1.150453453	102.8145904	325	HEDE, PAHE, PRLI	113	-0.996890172	102.307525	133	VITA
54	-1.170972931	102.8341287	294	HEBR, PRLI, VITA	114	-1.013043075	102.3223797	210	
55	-1.205701408	102.8040563	117	HEBR, VITA	115	-1.010600606	102.341344	270	PRLI
56	-1.215866738	102.8196771	120	HEDE	116	-1.017104396	102.3593315	493	PRLI
57	-1.182698164	102.7765359	161	HEBR, PAHE	117	-1.031296588	102.3415065	278	
58	-1.167353865	102.7959399	140	HEBR, VITA	118	-1.033555602	102.319732	163	HEDE, PAHE, VITA
59	-1.217440775	102.7768582	157		119	-1.049690958	102.324055	147	HEDE, PRLI, VITA
60	-1.240739118	102.7997343	116	MYJA, VITA	120	-1.032592289	102.3028358	147	

¹ AOCI = *Aonyx cinereus*, ARBI = *Arctictis binturong*, CYBE = *Cynogale bennettii*, HEDE = *Hemigalus derbyanus*, HEBR = *Herpestes brachyurus*, HESE = *Herpestes semitorquatus*, MAFA = *Martes flavigula*, MYJA = *Mydaus javanensis*, PALA = *Paguma larvata*, PAHE = *Paradoxurus hermaphrodites*, PRLI = *Prionodon linsang*, VITA = *Viverra zanglonga*.