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Species Survival Commission

Yellow bellied Wease, Phu Khieo Wildlife Sanctuary, Thailand (Photo: J. Cheah)

phoenixzoo
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The views expressed in this publication are those of the authors and do not necessarily reflect those of IUCN, nor the IUCN SSC Small Carnivore Specialist Group. The aim of this publication is to offer the members of the IUCN SSC Small Carnivore Specialist Group, and those who are concerned with small carnivores in families of Ailuridae, Eupleridae, Herpestidae, Mephitidae, Mustelidae, Nandiniidae, Prionodontidae, Procyonidae and Viverridae, original papers, news items, abstracts, and titles of recent literature. Prospective authors (who need not be members of the specialist group) should submit material to the Editors-in-chief.

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José F. González-Maya
Divya Mudappa
J. Sebastián Jiménez-Alvarado
Cover photo:
Jack Cheah

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EDITORIAL

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Editorial:
Small Carnivore Conservation and its contribution to the knowledge of rare small carnivores

Rarity in mammals is associated with different factors including local population density, geographical range, and variety of habitats occupied by a species (Yu & Dobson 2000). For small carnivores, which generally are cryptic and nocturnal, several species are considered "rare", mostly due to their ecological requirements and limited availability of reliable records. In other cases, some widely distributed species are considered "rare" in the limits of their distributional ranges. Although risk of extinction is generally increased by the rarity of a species, some additional factors on the biology of each species and habitats are required (Arita *et al*. 1990).

Most small carnivores are difficult to spot, influencing the amount of information known for most species, and therefore, limiting our capability to establish their distributional ranges, abundances, and more recently their conservation status. Less than ten species of small carnivores have been included in analyses of rarity, although carnivores in general exhibited relatively higher degrees of rarity in comparison with other mammalian orders (Arita *et al.* 1990).

In South America, for instance, the Patagonian Weasel *Lyncodon patagonicus* and the Colombian Weasel *Mustela felipei* are included among the rarest small carnivores of this continent due the scarcity of records (Prevosti *et al.* 2009, Ramírez-Chaves *et al*. 2012, Formoso *et al.* 2016, Ramírez-Chaves & Torres-Martínez 2016). In Asia, species such as Otter Civet *Cynogale bennettii* and Malabar Civet *Viverria civettina*, are also considered among the rarest carnivores, often undermining appropriate conservation planning for the species or region (Cheyne *et al.* 2010, Ross *et al.* 2015, Evans *et al.* this volume). Last but not least, for Africa most small carnivores are considered poorly known (Do Linh San *et al.* 2013), where species such as Pousargues's Mongoose *Dologale dybowskii* is highlighted as the least known African small carnivore (Stuart & Stuart 2013, Do Linh San *et al.* 2013).

In recent years, new records on small carnivore species considered rare have been published, mostly due the integration of traditional sampling efforts with new techniques, such as camera trapping. This information is helping to clarify the current status of species considered elusive to researchers for decades, and provides additional information on the biology of some species (e.g. Suzuki *et al.* this volume). It is important to highlight that when rare or elusive species are recorded or even rediscovered, findings should be supported by strong evidence such as photographs, DNA samples, fragments of bones or skins, etc., so reliable information becomes available for such rare species (McKelvey *et al*. 2012).

SCC has strongly contributed to the publication of these records in areas as remote as the tropical forests or dry ecosystems in the Middle East (Baradarani *et al*. this volume) the Andes (Cardona *et al*. this volume), and Borneo (Evans *et al*. this volume). SCC aims to play a leading role in facilitating the diffusion of information that is used in risk assessments (including for the IUCN Red List of Threatened Species) and provides the basis for long-term monitoring efforts. In this issue, SCC presents information on eight species, most of them considered rare or elusive, thus highlighting the importance SCC has played for almost 27 years in advancing small carnivore research globally. With 577 articles published to date, SCC aims to continue improving and growing as one of the most reliable sources of information for small carnivores, and the Editorial team works continually to expand the reach and scope of the journal in order to not only support the continued work of the IUCN SSC Small Carnivore Specialist Group but broader improving and supporting small carnivore conservation globally.

We expect that for the coming years, and based on our new format and editorial process (González-Maya & Schipper 2015), our journal will expand and growth, and we invite researchers globally to contribute their small carnivore research to our journal, as we believe SCC to be an important tool for advancing the conservation and knowledge of this important group globally.

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Héctor E. RAMÍREZ-CHAVES[1], José F. GONZÁLEZ-MAYA[1,2] & Jan SCHIPPER[1,2]

1 Editors, Small Carnivore Conservation

2 Co-chairs - IUCN SSC Small Carnivore Specialist Group

hera.chaves@gmail.com

http://www.smallcarnivoreconservation.org

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SHORT COMMUNICATION

New locality records of Pine Marten *Martes martes* from Iran

Kambiz BARADARANI[1], Ehsan M. MOQANAKI[2*], Mohammad Ali ADIBI[3] & Ali MOUSAVI[4]

http://www.smallcarnivoreconservation.org
ISSN 1019-5041

1. Kaveh Blvd., Dowlat, Tehran 1931863153, Iran
2. Tehran 1584844313, Iran
3. Iran Department of Environment, Semnan Provincial Office, Semnan, Iran
4. Payame Noor University, Nur, Mazandaran, Iran

Correspondence:
Ehsan M. Moqanaki
ehsan.moqanaki @gmail.com

Associate editor:
Francesco Maria Angelici

Abstract.

Pine Marten *Martes martes* is a relatively common small carnivore across most of its Eurasian range, but few verifiable occurrence data on this species are available from southwestern Asia. In Baradarani & Moqanaki (2014), we provided a baseline review of the current distribution and conservation status of Pine Marten in Iran, together with two new confirmed records of presence after a period of about 50 years. Here, we report five new specimens from Mazandaran and Golestan provinces, within the Caspian region of Iran. Pine Marten appears to be amongst the rarest of mammalian carnivore species in Iran however, more specimens may have gone undetected because of misidentification with the broadly-distributed and supposedly more abundant Stone Marten *Martes foina*.

Keywords: distribution range, Hyrcanian deciduous forest, Alborz Mountains, Caspian Sea region, museum specimen, *Martes martes*, Iran.

The Pine Marten *Martes martes* ranges across the western Palaearctic from Fennoscandia eastward throughout most of Europe to western Siberia (Kranz *et al.* 2008). Contrary to the species' wide distribution range and relatively high abundance in northern and western Europe (Kranz *et al.* 2008), southwestern Asian populations of Pine Marten are often small and isolated in highly fragmented mosaic habitats. Iran is one of the latter range countries.

We previously reviewed the historical records of Pine Marten in Iran, and updated the species' distribution range with new locality records over the last 50 years (Baradarani & Moqanaki 2014). We showed that although there are no verifiable records of Pine Marten occurrence in north-western and western Iran across the Caucasus Landscape and Zagros Mountains, respectively, it is likely that this species is present throughout the remnant Hyrcanian deciduous forests in northern Iran (Figure 1). We stressed that because of poor knowledge and/or misidentification with the supposedly much more abundant Stone Marten *M. foina* (Ziaie 2008) among local biologists and wildlife authorities, confirmation of Pine Marten presence is difficult to ascertain in Iran. We therefore recommended a survey of natural history collections and local biologists to determine the actual geographical range of Pine Marten in Iran. Here, we report such range clarification attempts by providing new locality records of this species from northern Iran via contact with local taxidermists and visiting private collections.

Figure 1. Map showing confirmed presence records of Pine Marten *Martes martes* from Iran (black circle; after Baradarani & Moqanaki 2014) and the new locality records we reported here (star). The shaded dark grey area shows the Hyrcanian forests along the southern Caspian Sea coast in northern Iran.

Following our previous publication, the first author (KB) initiated contact with regional taxidermists about the presence of Pine Marten specimens within their stock. In September 2015, another author (AM) informed KB that a local taxidermist from Chalus County, Mazandaran province, had contacted him about a Pine Marten specimen approximately one year ago. The local taxidermist had informed AM about a somewhat weird "samour" (a Farsi equivalent of marten, but is commonly used by the public for calling several members of Iranian Mustelidae; Ziaie 2008) with a yellow neck-patch, which the local taxidermist had considered unusual given his previous experience with "samour" specimens. AM consequently inspected the specimen and identified it as a Pine Marten. As the Pine Marten specimen was in poor condition, AM and the local taxidermist decided not to proceed with preparing it for taxidermy and only stored it in a freezer.

We inspected the specimen again in October 2015 (Figure 2). The local taxidermist only let us measure and weigh the Pine Marten. The specimen was a female weighing ca. 570 g, and morphometric measurements were: body length= 36.5 cm, tail length= 26 cm, and shoulder height= 14 cm. The local taxidermist explained that a villager from Hachiroud (36°40′N, 51°21′E), a small town in Kelarestaq-e Gharbi Rural District of Chalus County (Figure 1), had delivered this specimen to him in autumn 2013. Hachiroud is a collection of several villages that stretch around 4 km in length between the Caspian Sea coast to the north (-15 m asL) and a large area of little disturbed Hyrcanian deciduous forest in the south (<60 m asl). The town itself is dominated with mosaics of human development, agriculture lands and riverine vegetation communities. However, the villager's property was believed to be close to the edge of the forest. The villager had claimed that he shot this "samour" after experiencing several occasions of chicken predation by an unknown predator. The villager had been raising some domestic chickens in a yarding system inside his property, as is common practice in many parts of the Caspian region of Iran. Chickens were kept in a simple handmade coop made from chicken wire and a few concrete blocks to secure it on the ground. Within a short, but undetermined period of time, the villager experienced several occasions of chicken predation inside the coop. No chicken was removed from the coop, nor was the coop damaged. In one night, he heard unusual disturbance from the chicken coop. As he was alerted about the predation, he quickly grabbed his hunting firearm and rushed to the coop. He could detect an invader inside the coop and shot it. The villager had claimed that he had no idea about the creature, and later found out that the predator had been a "samour".

Figure 2. Carcass of Pine Marten killed in Hachiroud, Chalus County of Mazandaran province in autumn 2013 (Photo: K. Baradarani).

In the second incident, in August 2015 the third author (AMM), who is managing a taxidermy supply, received mutilated carcasses of an adult female Pine Marten (Figure 3) with one sub-adult cub from an unidentified location in vicinity of Sari (Figure 1), Mazandaran province, via the Provincial Office of Iran Department of Environment. These Pine Martens were killed in traps that were set by local people as a retaliatory response to the predation of their domestic fowl by mesocarnivores. The adult Pine Marten was 1010 g, with measured body and tail length of 60 and 30 cm, respectively. The cub was neither sexed nor measured because of the extremely poor condition of the carcass.

Figure 3. The female Pine Marten killed in a trap in vicinity of Sari, Mazandaran province, in August 2015 (Photo: M. A. Adibi).

During our semi-directive interviews with local taxidermists, we were also shown photos of two previously not reported museum specimens of Pine Marten collected from Golestan Province, which are now in the possession of two private collections. The first specimen was claimed to belong to the royal collection of Abdorreza Pahlavi, a former prince of Iran prior to the 1979 revolution. The second specimen was an adult male which was killed in a trap in an unidentified village in vicinity of Gorgan (Figure 1) in October 2013. We could not verify the exact geographic locations of these specimens.

The new localities we reported here include the first verifiable presence record of Pine Marten from the west of Mazandaran province (Baradarani & Moqanaki 2014; Figure 1), supporting the extension of Pine Marten range throughout the Alborz Mountains along the Caspian Sea coast. Surveys of taxidermists and local informants such as hunters have proven to be very useful for assessing the distributional range of rare and elusive carnivores of Iran (*e.g.*, Moqanaki *et al.* 2010). As long as no biological surveys are directed towards small carnivores in Iran, the collection of sporadic occurrence data and key informant surveys (Huntington 2000), as we reported here, are cost-effective methods to at least partially overcome the lack of a comprehensive review of the current distribution and conservation status of small carnivores in Iran.

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SHORT COMMUNICATION

A Yellow-bellied Weasel *Mustela kathiah* sighting at Phu Khieo Wildlife Sanctuary, north-eastern Thailand

Jack CHEAH[1]

http://www.smallcarnivoreconservation.org
ISSN 1019-5041

[1.] Amphur Soeng Sang, Nakhorn Ratchasima, 30330, Thailand.

Correspondence:
Jack Cheah
jack2964@gmail.com

Associate editor:
Daniel Willcox

Abstract.

Yellow-bellied Weasel *Mustela kathiah* is a rarely recorded small carnivore species. On 22 March 2016 a Yellow-bellied Weasel was directly observed in Phu Khieo Wildlife Sanctuary in north-eastern Thailand. This is outside of the species' known distribution in Thailand. The weasel was observed and photographed from a hide that had been set up for bird photography.

Keywords: weasel, evergreen forest, photography hide

The Yellow-bellied Weasel *Mustela kathiah* occurs in a wide range across the Himalayas, southern China and mainland South-east Asia. A number of recent records have extended its known range considerably, with the first records for Thailand and Cambodia coming only in 2000 and 2013 respectively (Supparatvikorn *et al*. 2012, Phan *et al*. 2014). These late discoveries are assumed to represent earlier overlooking of the species rather than a genuine expansion of the species's range, or of its rarity (Supparatvikorn *et al*. 2012, Chutipong *et al*. 2014, Phan *et al*. 2014).

Phu Khieo Wildlife Sanctuary is in north-eastern Thailand between 16°05' and 16°35'N and 101°20' and 101°55'E. The sanctuary ranges in altitude from 250 to 1310 m asl and has a total area of 1,573 km². The main habitat types at the wildlife sanctuary are mixed deciduous forest with smaller areas of semi-evergreen forest below 800 m asl and hill evergreen forest at higher elevations (BirdLife International 2016). The dry season occurs during November to March, and the wet season occurs during April to October (Prasanai *et al*. 2012).

On 22 March 2016 at approximately 08h00, I attended a permanent photography hide set up and maintained by the Phu Khieo Wildlife Sanctuary, primarily for bird watching. The hide is located at 16°23'13"N 101°34'02"E at an elevation of approximately 880 m asl, and is approximately 600 m asl from the sanctuary's headquarters, which is located in the centre of the sanctuary. The hide is set amid near-intact evergreen forest and is open for public use. The hide has a piped water supply that has been used to create a small, approximately 2 m², artificial waterhole at the base of a tree to attract birds and other wildlife.

At 10h40 I heard rustling of ground-cover to the left of the hide and a single Yellow-bellied Weasel *Mustela kathiah* came into view and moved cautiously towards the waterhole. The Yellow-bellied Weasel remained at the waterhole for almost a minute and during this time I was able to take a total of nine photographs of the single animal (Figure 1). The animal left the site after it seemed to become aware of my presence in the hide, apparently alerted by the noise of my camera's shutter. I remained in the hide until 17h10 but the animal did not reappear. Phu Khieo Wildlife Sanctuary is outside the known range for the Yellow-bellied Weasel in Thailand, where it was previously known from only the northern highlands and western mountains (see Chutipong *et al*. 2014). The habitat the Yellow-bellied Weasel was recorded in, is consistent with records from other sites in Thailand (Chutipong *et al*. 2014), as well as other range countries, such as Cambodia (Phan *et al*. 2014) and Vietnam (Roberton 2007).

Figure 1. Yellow-bellied Weasel *Mustela kathiah* photographed with a hand-held camera at Phu Khieo Wildlife Sanctuary, Thailand, on 22 March 2016 (J. Cheah). The somewhat similar-looking Stripe-backed Weasel *M. strigidorsa* can be excluded by the broad pale belly patch (right image) and lack of mid-dorsal pale stripe (left image).

Phu Khieo Wildlife Sanctuary is one of the most intensively surveyed areas in Thailand for forest mammals (see Chutipong *et al*. 2014). This Yellow-bellied Weasel record is a good example of how easy it is to overlook this, and other, weasel species through conventional mammal survey techniques, such as camera-trapping. At the same photography hide, in the same month as this sighting, a Stripe-backed weasel *Mustela strigidorsa* was observed and photographed (Khao Yai News 2016); wildlife enthusiasts and photographers could play an important role in documenting weasel sightings in South-east Asia.

Weasel species are difficult to distinguish between in the field and any records should preferably be validated with photographs; Stripe-backed Weasel and Yellow-bellied Weasel co-occur at a number of sites in mainland South-east Asia and are very similar looking species. For some guidance on species identification, see descriptions and photographs given in Streicher *et al.* (2010) for Stripe-backed Weasel and Supparatvikorn *et al*. (2012) for Yellow-bellied Weasel. Though neither of these species are likely to be threatened in Thailand or in the region, proper documentation of incidental records and subsequent publication, would greatly improve understanding of weasel distribution and conservation status in mainland South-east Asia, and could be done with relative ease. The publication of records, such as the Yellow-bellied Weasel observation documented in this paper, are strongly encouraged.

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SHORT COMMUNICATION

New Olingo records (genus *Bassaricyon*) from the Colombian Andes

Diana CARDONA[1], Fabio Leonardo MEZA-JOYA[1,2*] & Javier COLMENARES[2,3]

http://www.smallcarnivoreconservation.org
ISSN 1019-5041

1. Colombia Endémica, Asociación para el estudio y la conservación de los recursos naturales, Bucaramanga, Colombia.
2. Grupo de Estudios en Biodiversidad, Universidad Industrial de Santander, Bucaramanga, Colombia.
3. Laboratorio de Macroecología, Escuela de Biología, Universidad Industrial de Santander, Bucaramanga, Colombia.

Correspondence:
Fabio Leonardo Meza-Joya
fabio.meza@correo.uis.edu.co

Associate editor:
José F. González-Maya

Abstract. Knowledge of geographic distribution and taxonomic status of *Bassaricyon* species in Colombia is still incipient. In this note, we gather information about the current known localities and present new field records for two olingo species (*Bassaricyon alleni* and *Bassaricyon neblina osborni*) from the Andes in Colombia. These records extend the geographic range of these species and highlight the need for further studies to clarify its taxonomy, distribution, and conservation status.

Keywords: Andes, *Bassaricyon*, conservation status, geographic range, taxonomic status.

The olingos (genus *Bassaricyon* Allen 1876) are an enigmatic group of small to medium-sized arboreal procyonids that occur from low to high altitudes in tropical or subtropical forests (≤ 2,750 m asl) of Central America and northern South America (Glatston 1994, Kays 2000, Prange & Prange 2009, Sampaio *et al.* 2010, Helgen *et al.* 2013). Most species are described as solitary, arboreal, and nocturnal animals that feed mostly on fruits and nectar (Glatston 1994, Kays 2000, González-Maya & Belant 2010, Sampaio *et al.* 2010, Helgen *et al.* 2013).

Olingos are poorly-known mammals relatively new to science (the genus was first described by Allen 1876) relative to other carnivore forms (Helgen *et al.* 2013). The genus is underrepresented in museum collections and most records come from anecdotal reports, presumably because they are overlooked easily or mistaken with similar nocturnal arboreal mammals such as *Potos flavus* or even *Aotus* spp. (Emmons 1984, Kays 2000, Prange & Prange 2009, Sampaio *et al.* 2010, 2011, Helgen *et al.* 2013).

Despite recent efforts to clarify the taxonomic status, diversity, and distribution in this genus (*e.g.*, Helgen *et al.* 2013), knowledge of the geographic distribution of *Bassaricyon* species in Colombia is still incipient. In fact, before Helgen *et al.* (2013) all forms of olingos in the country were treated as *B. gabbii*. Here, we present new field records of two species of olingos from the Colombian Andes, including the first confirmed record of the Eastern Lowland Olingo (*Bassaricyon alleni*) in Santander department on the western slope of the Cordillera Oriental and an additional record for the Olinguito

(*Bassaricyon neblina osborni*) from the eastern slope of the Cordillera Occidental in Antioquia department.

The Eastern Lowland Olingo, Bassaricyon alleni

The Eastern Lowland Olingo is a medium-sized olingo that differs externally from other similar species by having a more strikingly black-tipped dorsal pelage (Helgen *et al.* 2013). This species is known from forested areas in eastern and central Guyana, western Venezuela, eastern Colombia, eastern Ecuador, eastern Peru, north-western and central Bolivia, and western Brazil (Helgen *et al.* 2013, Sampaio 2013). Because of its wide distributional range, which probably includes several protected areas, the species is listed as Least Concern according to the IUCN Red List of Threatened Species (Helgen *et al.* 2016, Helgen *et al.* 2013). Based on museum specimens, the species elevational distribution ranges from sea level up to 2,000 m asl, most records coming from areas below 1,000 m asl (Helgen *et al.* 2013). Although Colombian specimens of *B. alleni* have been deposited in several museum collections (American Museum of Natural History - AMNH, National Museum of Natural History - USNM, British Museum of Natural History - BMNH) previously (mislabelled mostly as *B. gabbii*), the species was only recently included in the list of mammals of Colombia by Ramírez-Chaves & Suárez-Castro (2014) and Ramírez-Chaves *et al.* (2016).

In Colombia, the species has been reported in forested areas below 1,900 m asl (record from Serranía de los Churumbelos by Donegan & Salaman 1999), in the Andean, Caribbean and Llanos regions; with records in the political administrative departments of Cauca (Donegan & Salaman 1999, as "*Bassaricyon* sp" but designated as *B. alleni* by Helgen *et al.* 2013), Meta (Thomas 1927, Helgen *et al.* 2013, AMNH 142223), Cundinamarca (Helgen *et al.* 2013, AMNH 70532), Norte de Santander (Helgen *et al.* 2013, USNM 281485), and "Cesar department" in territories belonging today to La Guajira department (Helgen *et al.* 2013, USNM 281482, 281483, 281484).

The new records of *B. alleni* presented here (Figure 1) come from the north-western slopes of the Eastern Andes Slope (*Cordillera Oriental*) of Colombia in the Serranía de los Yariguíes, San Vicente de Chucurí municipality, Santander department (6°47′2.4″ N, 73°28′4.8″ W, 1,450 m asl); ca. 176 km south-southwest from San Calixto municipality (Norte de Santander), the closest known locality (Figure 3A). During faunal surveys in April 2012, two presumably adult individuals, were first observed and photographed on a tree (ca. 5 m high) in the border of the forest at 19h00. Later, we observed at least one additional adult individual in the forest moving through the canopy, but then we lost sight of the animal.

Additional sightings of individuals have been recorded periodically since 2012 from the same locality. Recently, in January 2015, an adult male (based on its prominent testes) was followed for about 4 hours (between 20h00 and 00h00) while it was jumping through the canopy. In June 2015 we witnessed a noisy fight between two presumably male individuals. The individuals here reported were recorded in a disturbed cloud forest patch (Figure 1C), surrounded almost completely by cattle grazing grasslands. The forest fragment has a dense canopy (up to 30 m height) dominated by *Erythrina* sp (Fabaceae), *Nectandra* sp (Lauraceae), and *Cordia* sp (Boraginaceae) trees.

From existent records, specimens referred to as *Bassaricyon* sp from the north-western slope of the Cordillera Oriental in the Serranía de los Yariguíes, Cerro Manchurrias, El Carmen de Chucurí municipality, Santander department (6°41′1.5″ N, 73°26′27.7″ W, 1824 m asl; A.J. Lozano, com. pers.), may correspond to *B. alleni*. Specimens at the mammal collection of the Universidad Nacional de Colombia (identified as "*Bassaricyon gabbii*") from Meta (ICN-M-105, 106, 2075), Santander (ICN-M-168), and Putumayo (ICN-M-3725), and a record from Vaupes (ICN-M-184, designated as "*Bassaricyon* sp"), were already identified to *B. alleni* (Suárez-Castro & Ramírez-Chaves 2015), likely the only olingo found east of the Andes.

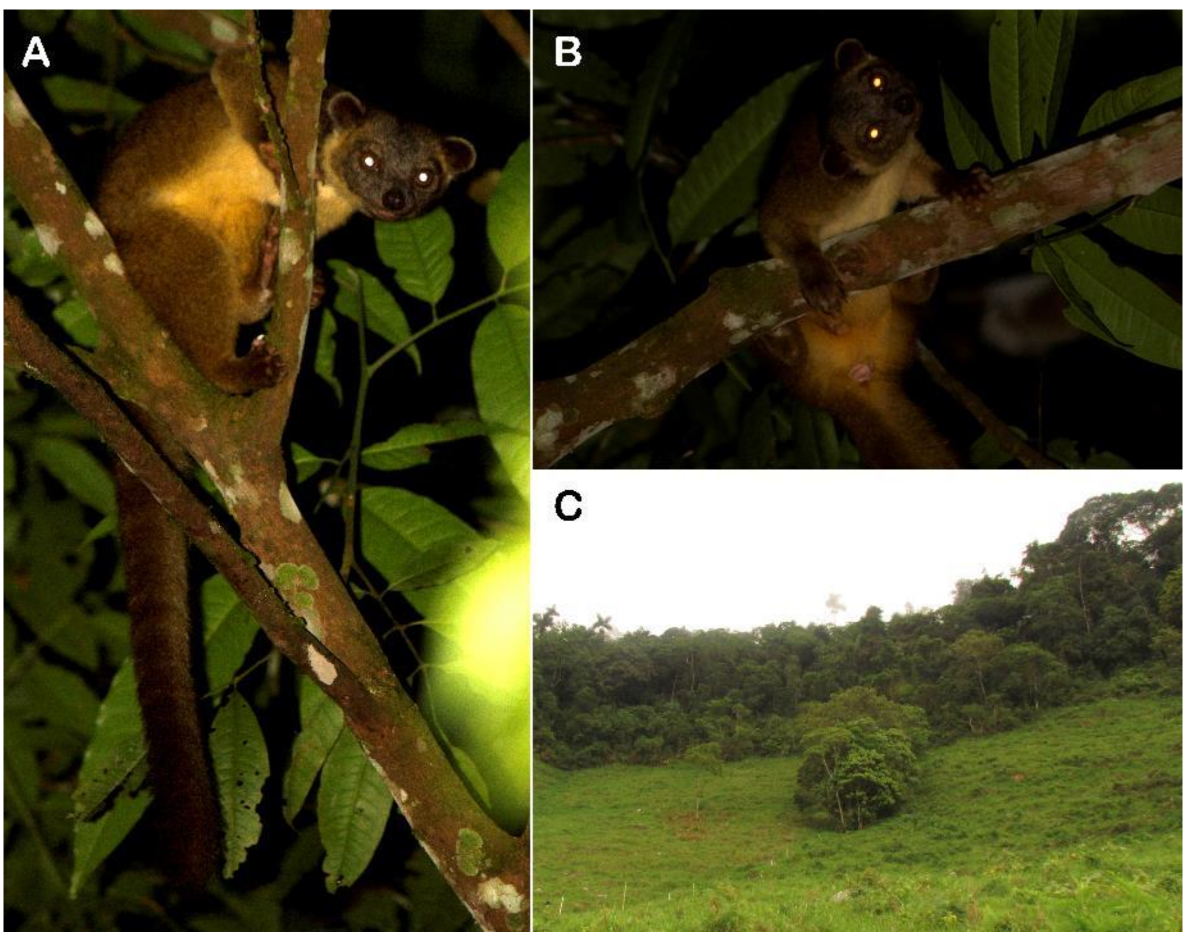

Figure 1. (A-B) Adult individuals of *Bassaricyon alleni* from Serranía de los Yariguíes, Santander, Colombia and (C) general view of the habitat where *B. alleni* was recorded (Photos F.L. Meza-Joya).

The Olinguito, Bassaricyon neblina osborni

Bassaricyon neblina is a complex of four subspecies currently recognized (*B. n. osborni*, *B. n. neblina*, *B. n. hershkovitzi*, and *B. n. ruber*) differing externally from other olingos according to body size, coloration, length, density of dorsal pelage and the presence of a shorter and bushier tail without distinctive bands (Helgen *et al.* 2013). The species was recently assessed as Near Threatened by the IUCN Red List of Threatened Species given inferred declines of its populations due to the extensive deforestation historically occurring within its range (Helgen *et al.* 2016).

B. n. osborni is the largest subspecies of the group and is recognized by its short rostrum, dorsal pelage of moderate length, and its general pattern of coloration (Helgen *et al.* 2013). This subspecies occurs in humid montane rainforests, from 1,500 to 2,750 m asl, on the Eastern slopes of the Western Andes Range (Cordillera Occidental) and on both slopes of the Central Andean Range (Cordillera Central) of Colombia (Helgen *et al.* 2013). *B. n. osborni* has been recorded in the political administrative departments of Caldas ("Cauca department" in Helgen *et al.* 2013, based on the political division of Colombia at 1898, AMNH-14185), Antioquia (Helgen *et al.* 2013, AMNH-42351), Valle del Cauca (Poglayen-Neuwall 1976, Saavedra-Rodríguez & Velandia-Perilla 2011, as "B*assaricyon gabbii*" but designated as *B. n. osborni* by Helgen *et al.* 2013, UV-13700), and Cauca (Helgen *et al.* 2013, AMNH-32608, 32609, FMNH-85818, FMNH-88476, FMNH-89220, FMNH-90052).

One new confirmed record of *B. n. osborni* (Figure 2A, 2B) was obtained through *ad-libitum* surveys in September 2013, on the north-eastern slope of the Cordillera Occidental, Vereda Sedeño Alto, Tamesis municipality, Antioquia department (5°34′31.2″ N, 75°41′56.7″ W, 2,216 m asl, Figure 3B). This area is located within the "Distrito de Manejo Integrado Cuchilla Jardín-Támesis", a regional reserve of Antioquia department that expands through 31,759 ha of cloud forest habitats. The forest fragment where de olinguito was observed is dominated by *Hedyosmum* sp (Chloranthaceae), *Croton* sp (Euphorbiaceae), and *Inga* sp (Fabaceae); and is surrounded by a modified matrix of cattle grazing grasslands (Figure 2C).

This record extends the distributional range of the species ca. 190 km north from the closest record in the Cordillera Occidental and 22.9 km from the nearest record in the Cordillera Central (Figure 3B). The specimen deposited in the mammal collection of the Universidad del Valle and previously identified as *B. gabbii* (Saavedra-Rodríguez & Velandia-Perilla 2011, UV-3774), could correspond to *B. n. osborni* or *B. medius medius*. The taxonomic status of these specimens requires confirmation, because the geographic boundaries of these species are unclear and both are presumably sympatric (Helgen *et al.* 2013).

Figure 2. (A-B)Adult individuals of *Bassaricyon neblina osborni* from Distrito de Manejo Integrado Cuchilla Jardín-Támesis, Tamesis, Antioquia department and (C) general view of cloud forest where *B. n. osborni* was recorded (Photos A-B: C. Ortiz, Photo C: D.M. Cardona).

Research priorities for olingo species include studies to clarify the taxonomic status of Colombian species, and specimens (González-Maya *et al.* 2011), and the improvement of our understanding of the distributional range of the genus in the country. Additional studies are needed to evaluate the level of genetic divergence between different populations of olingos. Further studies about demography, ecology, and natural history of the genus remain a priority for a better understanding of its conservation status.

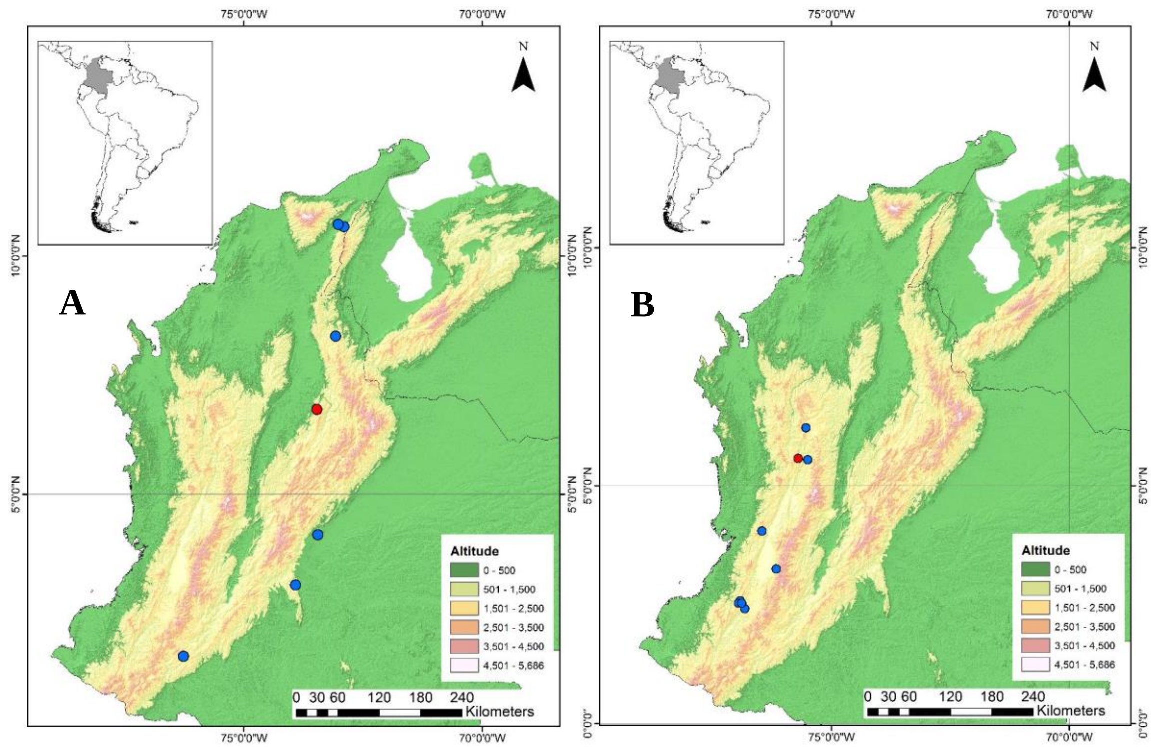

Figure 3. Distribution maps with confirmed records of the (A) Eastern Lowland Olingo, *Bassaricyon alleni* and (B) Olinguito, *Bassaricyon neblina osborni* from Colombia. Red circle indicates new records presented here.

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SHORT COMMUNICATION

Observations of intra- and inter-specific interactions of Small-toothed Palm Civets *Arctogalidia trivirgata* in the Danum Valley Conservation Area, Borneo

Miyabi NAKABAYASHI[1]

http://www.smallcarnivoreconservation.org
ISSN 1019-5041

[1] Wildlife Research Center of Kyoto University, 2-24 Tanaka-Sekiden-cho, Sakyo, Kyoto 606-8203, Japan.

Correspondence:
Miyabi Nakabayashi
miyabi.nakabayashi@gmail.com

Associate editor:
José F. González-Maya

Abstract.

I reported intra- and inter-specific interactions of Small-toothed Palm Civets *Arctogalidia trivirgata* in a lowland tropical rainforest in Borneo. They did not exhibit aggressive or escape behaviours toward conspecific co-feeding individuals, but did not tolerate co-feeding of other civet species in a fruiting tree. These observations suggest that there may be differences in Small-toothed Palm Civets' reactions to conspecifics including same-sex individuals and different civet species, indicating that they do not always tolerate co-feeding animals. The observations reported in this study are a first step to describe social structure of Small-toothed Palm Civets, and suggest the existence of loosely associated groups. Further field study is required to elucidate social structure of frugivorous/omnivorous carnivorans.

Keywords: Arctogalidia trivirgata, co-feeding, inter-specific interaction, social tructure

Small-toothed Palm Civets *Arctogalidia trivirgata* are small carnivorans usually weighing 2–2.5 kg as adults (Nowak 2005). They are widely distributed in South-East Asia and are one of the least known civet species because of their arboreal and nocturnal habits (Nowak 2005). They feed primarily on fruits, small animals, and flower nectar (Harrison 1961, Nowak 2005, Moore & Wihermanto 2014). While there are no published studies on the social structure of Small-toothed Palm Civets, several authors observed group feedings of 2−4 adults (Duckworth 1997, Borissenko *et al.* 2004, Duckworth & Nettelbeck 2007, Eaton *et al.* 2010, Moore 2011, Willcox *et al.* 2012, Murali *et al.* 2014), also with some observations of solitary feeding (Low 2010, Moore & Wihermanto 2014, Raman & Zakhuma 2014), suggesting social structure flexibility. This paper reports several observations of Small-toothed Palm Civets in terms of their intra- and inter-specific interactions in feeding trees in the Danum Valley Conservation Area.

The Danum Valley Conservation Area (4°57'N, 117°48'E) is a 438 km^2 protected area in North-Eastern Borneo. Approximately, 90% of the area is mature lowland evergreen dipterocarp forest between 180 and 900 m asl. (Marsh & Greer 1992, Newbery *et al.* 1999). The study was conducted in a 5 km^2 on the eastern boundary of the area, from July 2012 to February 2013. Mean annual rainfall was 2700 mm (1986–1992) and mean daily maximum, minimum, and mean temperatures were 30.9, 22.5, and 26.7°C, respectively (Marsh & Greer 1992).

Case 1. Co-feeding Small-toothed Palm Civets in fruiting fig trees

Around 00h00 on 20 July 2012, I observed four adult Small-toothed Palm Civets feeding in a fruiting *Ficus binnendijkii* tree. I could neither observe their sex or behaviours due to limited visibility nor hear growling or any other aggressive sounds.

At 15h42 on 11 February 2013, I observed a Small-toothed Palm Civet coming to a fruiting tree (*Ficus* sp.) to feed. At 16h38 and 16h43, two more Small-toothed Palm Civets moved to the same tree. They were all adult size and at least one individual was male. They did not demonstrate antagonistic behaviour even though they fed on the same branch. At 17h28, one of the civets moved out from the tree and at 21h50, the last individual moved out from the tree.

Case 2. Inter-specific interactions between Common Palm Civets and Small-toothed Palm Civets in a fruiting fig tree

At 21h50 on 18 January 2013, I observed a Small-toothed Palm Civet and a Common Palm Civet *Paradoxurus hermaphroditus* in a fruiting *Ficus fistulosa* tree. The fruits were immature judging by their hardness and size. The Common Palm Civet suddenly rushed away from the tree within 10 minutes. At 20h30 on 23rd January, I observed the same Small-toothed Palm Civet feeding in the tree. At 20h59, the Small-toothed Palm Civet ran out from the tree suddenly and growled. At 21h06 I observed that the same Common Palm Civet had moved to the tree and it fed on fruits until 23h55. At 3h00, the Small-toothed Palm Civet came to the tree to feed until 5h35. At 20h20 on 7 February, I observed a new Common Palm Civet feeding in the tree. At 21h40, the same Small-toothed Palm Civet visited the same tree, but the Common Palm Civet did not drive the Small-toothed Palm Civet out. At 22h22, they were within 2 m of each other, and the Common Palm Civet rushed away from the tree and they both growled. The Small-toothed Palm Civet ran toward the upper part of the tree and continued to feed. In all of the observations, growling was the only aggressive behaviour observed.

In case 1, three adult Small-toothed Palm Civets visited the feeding tree during daytime, and continued foraging for over five hours. Although I was unable to determine their sex, at least two individuals were of the same sex among the three observed civets. They arrived and left the tree separately, suggesting a weak association between co-feeding conspecifics, but they were not aggressive towards each other. These interactions contradict those of Common Palm Civets. Nakabayashi *et al.* (2012) reported that a male Common Palm Civet exhibited antagonistic behaviours toward another male in a feeding tree but not toward a female conspecific. Further, I observed antagonistic behaviours between two female Common Palm Civets in a fruiting fig tree. When they were 1–2 m apart they ran out from the tree with emitting strong musk odours. Common Palm Civets may not tolerate co-feeding of same-sex individuals. Conversely, Small-toothed Palm Civets did not exhibit aggression or escape behaviours toward co-feeding conspecifics including same-sex individuals.

In case 2, inter-specific behaviours were aggressive. Duckworth (1997) also reported an aggressive encounter of a Small-toothed Palm Civet and a Common Palm Civets in Laos. Body size determines dominance hierarchy among frugivores in fruiting trees (French & Smith 2005) and as these two civet species are of a similar size, species-specific dominance may be hard to establish. Given that Eaton *et al*. (2010) observed four Common Palm Civets and five Small-toothed Palm Civets co-feeding in a tree without interactions in Java (J. Eaton *in litt*. 2012), the exhibition of aggression may be affected by various factors such as resource abundance. Observations in this study suggest that there may be behavioural differences in Small-toothed Palm Civets' reactions to same-sex conspecifics and different civet species, indicating that they do not always tolerate co-feeding animals.

Small-toothed Palm Civets utilise relatively eclectic food items besides fruits and animal material such as nectar, palm pith, and tree bark sap (Moore & Wihermanto 2014, MN pers. obs.). This minimises resource competition between individuals and facilitates non-aggressive co-feeding of same-sex conspecifics. The observations reported in this study are a first step to describe the social structure of Small-toothed Palm Civets, and suggest the existence of loosely associated groups. Even though Small-toothed Palm Civets and Common Palm Civets belong to the same subfamily Paradoxurinae, there is a large difference in tolerance against co-feeding conspecifics. Further field study is necessary to elucidate social structure in frugivorous/omnivorous carnivorans.

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SHORT COMMUNICATION

A record of Brown Mongoose *Herpestes fuscus* in Pampadum Shola National Park, southern Western Ghats, India

S. NIKHIL [1]

http://www.smallcarnivoreconservation.org
ISSN 1019-5041

1. Munnar Wildlife Division, Kerala Forest Departmant, Munnar, Kerala, India

Correspondence:
S. Nikhil
nikx.suresh02@gmail.com

Associate editor:
Divya Mudappa

Abstract.

An individual of Brown Mongoose *Herpestes fuscus* was recorded using camera trapping technique in Pampadum Shola National Park, near Bison swamp area. There are a few records of Brown Mongoose from the state so far and hence is considered as a rare species.

Keywords: Camera trapping, high-altitude, shola- grassland ecosystem, small carnivore.

Brown Mongoose is a comparatively large forest mongoose, which is characterised with yellowish-brown coloured fur, black feet and short bushy tail which tapers to a conical point (Menon 2014). Details regarding the behaviour of this species are still unknown and the species is currently classified as Least Concern by the IUCN Red List of Threatened Species (Mudappa & Jathanna 2015).

Pampadum Shola is one of the three Shola National Parks in Kerala and is a part of Munnar Wildlife Division. It is a montane grassland shola habitat and is a rich abode of biodiversity.

There are a few records of this species prior to the present one from this part of the world. Mudappa *et al.* (2008) recorded this from Peeramedu, Idukki district. It was also recorded from Parambikulam Tiger Reserve and Eravikulam National Park by Sreehari *et al.* (2013). The record from Eravikulam National Park was at an elevation of 2,032 m asl and the one from Parambikulam Tiger Reserve was at 492 m asl which explained the altitudinal range of the species.

The current record of Brown Mongoose from Pampadum Shola National Park is recorded at an altitude of 1,826 m asl (10° 08.229'N, 077° 15.283'E) at 19h42. The animal was camera trapped in a shola habitat on ground. It was solitary and the species was clearly identified by the uniform dark colouration and bushy conical tail. This record supports the finding of Sreehari *et al.* (2013) which established a new altitudinal range for the species, correcting Mudappa (2013) and Mudappa *et al.* (2008).

Figure 1. Camera trapped image of Brown Mongoose *Herpestes fuscus* from Pampadum Shola National Park

The studies on small carnivores are few when it comes to the Shola National Parks of Kerala. The details regarding the species are poorly known and this is a major setback for their conservation. Records like these are supposed to provide more details regarding the habitat and distribution of the species which in turn will help in the conservation activities.

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IUCN/SSC Small Carnivore Specialist Group

ORIGINAL ARTICLE

Small Carnivores of the Lower Kinabatangan Wildlife Sanctuary, Sabah, Borneo, including a new locality for the Otter Civet *Cynogale bennettii*

Meaghan N. EVANS[1,2], Stephen H. VICKERS[2], Mohd Soffian ABU-BAKAR[3] & Benoit GOOSSENS[1,2,3,4]

www.smallcarnivoreconservation.org
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[1] Danau Girang Field Centre, c/o Sabah Wildlife Department, Wisma Muis, Block B, 5th Floor, 88100 Kota Kinabalu, Sabah, Malaysia.
[2] Organisms and Environment Division, Cardiff School of Biosciences, Cardiff University, Sir Martin Evans Building, Museum Avenue, Cardiff, CF10 3AX, UK.
[3] Sabah Wildlife Department, Wisma Muis, Block B, 5th Floor, 88100 Kota Kinabalu, Sabah, Malaysia.
[4] Sustainable Places Research Institute, Cardiff University, 33 Park Place, Cardiff CF10 3BA, UK..

Correspondence:
Meaghan N. Evans
harrismn24@gmail.com

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Jan Schipper

Abstract.

The tropical rainforest biodiversity of Sabah, Borneo is threatened by large-scale agricultural development, logging, and increasing hunting pressures. From 2010—2015, an extensive camera-trapping study in the Lower Kinabatangan Wildlife Sanctuary (LKWS) monitored wildlife utilisation of a lowland riparian forest corridor. This effort, culminating in nearly 600,000 images, was the longest running camera-trapping study in the Sanctuary, and documented 11 small carnivore species over 24,506 trap nights. The Malay Civet *Viverra tangalunga* was the most frequently detected species, followed by the Malay Badger *Mydaus javanensis* and the Common Palm Civet *Paradoxurus hermaphroditus*. The survey also collected the first photographic record of an Otter Civet *Cynogale bennettii* in the LKWS, which represents a new locality for this little-known Southeast Asian species. Opportunistic sightings of five additional species, including the Endangered Flat-headed Cat *Prionailurus planiceps*, increased the total count of small carnivores persisting in the LKWS to 16. Given the highly degraded and fragmented status of the LKWS, this study highlights the importance of riparian lowland forest fragments in sustaining carnivore diversity, and also emphasizes the importance of continued, long-term monitoring efforts.

Keywords: Viverridae, Mustelidae, fragmented lowland rainforest, camera-trapping, Borneo, palm oil plantation

Introduction

Habitat destruction and degradation by the anthropogenic conversion of natural ecosystems is currently the leading threat to global biodiversity (Schipper *et al.* 2008, Crooks *et al.* 2011). Agricultural development alone has resulted in the destruction of over 400 million hectares of tropical forests between 1995 and 2007, and currently threatens at least 40% of all terrestrial vertebrates (Visconti *et al.* 2011). With burgeoning human populations and rising global food demand, the maintenance of biodiversity in increasingly human-dominated landscapes will require specific knowledge of species' ecological responses to fragmented habitats.

The Southeast Asian island of Borneo is undergoing one of the highest rates of deforestation in the world, and is projected to lose an estimated 75% of its remaining native landscapes within the century if land conversion practices persist (Sodhi *et al.* 2004, Rautner *et al.* 2005). The main drivers of the forest loss and fragmentation are the expansions of agricultural oil palm (*Elaeis guineensis*) and logging industries, which are considered the greatest threats to Southeast Asian biodiversity (Wilcove & Koh 2010). Coincidently, the region is identified as a global 'biodiversity hotspot' given the extraordinarily high numbers of endemic species paired with the highest global proportion of threatened species, excluding amphibians, of any region (Myers *et al*. 2000, Brooks *et al*. 2002, Sodhi *et al*. 2010).

In the face of these pressures, Borneo's tropical forests continue to sustain a high diversity of carnivore species (Corbet & Hill 1992). Eight civet species (Viverridae), five cat species (Felidae), one linsang (Prionodontidae), one bear (Ursidae), two mongooses (Herpestidae) and seven confirmed mustelid species have been documented across the island (IUCN 2015). The ecological importance of small carnivore species is well known, with the guild acting as regulatory predators, seed dispersers, and model species for landscape-level conservation research (Colón 2002, Mudappa *et al.* 2007,; Nakashima *et al*. 2010). Borneo has therefore been highlighted as a critically important priority region for small carnivore conservation (Schreiber *et al.* 1989).

As is the case with many small carnivores, there exists a substantial paucity of information regarding even basic ecological parameters of Bornean species (Schipper *et al.* 2008). However, opportunistic sightings (Boonratana & Sharma 1997, Bennett 2014), a handful of targeted research projects (Colón 2002, Nakashima *et al*. 2013) and a growing number of systematic camera-trapping surveys (*e.g.*, Wells *et al*. 2004, Belden *et al*. 2007, Cheyne *et al*. 2010, Mathai *et al*. 2010, Wilting *et al.* 2010a, Brodie & Giordano 2011, Matsubayashi *et al.* 2011) have begun to fill in the information gaps concerning the guild. Attempts at modelling species distributions at a coarse geographic scale are developing (e.g. Jennings & Veron 2011, Cheyne *et al.* in prep, Samejima *et al*. in prep), but progress is slow and based on accurate species presence records, data that are still being accumulated in many regions.

Therefore, this study aimed to provide an inventory of the small carnivore species persisting in a highly fragmented lowland tropical forest in Sabah, Malaysian Borneo. Here, the results from both opportunistic sightings and the first systematic and longest-running camera trapping survey of the Lower Kinabatangan Wildlife Sanctuary in eastern Sabah are reported.

Materials and methods

Study areas

The study was conducted within the Lower Kinabatangan Floodplain (approximate range 5°18’N to 5°24’N and 117°54’E to 118°33’E) in eastern Sabah, Malaysian Borneo. The Kinabatangan River is the longest river in Borneo and sustains some of the richest fisheries in the state (Hai *et al.* 2001, Röper *et al.* 2014). The climate of the area is considered humid tropical, with temperatures ranging from 21°–34° C (Ancrenaz *et al.* 2004). Mean annual rainfall measures 3,000 mm, with wetter months occurring between October-May (Estes *et al.* 2012). The floodplain is subject to intermittent flooding events of varying severity and occasional drought (Estes *et al.* 2012). Nearly 50% of the floodplain has been converted to oil palm plantations, and patches of both private and protected secondary riverine forest persist within the agricultural matrix (Abram *et al.* 2014).

The camera-trapping survey occurred in the riparian lowland forests of the Lower Kinabatangan Wildlife Sanctuary (LKWS), a 279 km^2 area of degraded habitat flanking the Kinabatangan River surrounded by large oil palm plantation estates. Comprised of 10 lots of varying degrees of disturbance history and isolation, the sanctuary is connected to seven additional fragments of Virgin Forest Reserves, managed by the Sabah Forestry Department, increasing the size of protected area to 450 km^2 (Ancrenaz *et al.* 2004, Goossens *et al.* 2005). The sanctuary contains a mixture of dry lowland, semi-inundated, and swamp forests interspersed with small grasslands (Abram *et al*. 2014). Despite the extensive anthropogenic habitat fragmentation, the LKWS supports many endemic Bornean species (Goossens *et al*. 2005, Sha *et al*. 2008, Goossens *et al*. 2016), and serves as the sole forest corridor bridging the coastal mangroves to the east and the large continuous tracts of rainforest in central Sabah.

Camera-trapping

Camera traps were deployed within the LKWS from 12 November 2010 through 9 May 2015. Active camera trap sites varied from nine to 25 stations throughout this period due to logistical constraints (*i.e.*, wildlife damage, theft, battery failure). Sites were stationed at least 1 km apart within the thin (~100-1200 m) forest corridor of the LKWS Lots 5 and 7, forest blocks on the north bank of the river (Figure 1). At each site, one or two Reconyx HyperFire Professional Infrared (IR) passive camera traps (Model HC500 or PC800, Reconyx, Holmen, USA) were deployed and protected by armour casing. Traps were tree-mounted and set 0.5 m from the forest floor on naturally occurring riverine trails. Once cameras detected a moving heat source, a series of three photos at 1-second intervals were recorded. In lowlight conditions, an IR flash was triggered to illuminate the subject while minimizing animal disturbance. When two cameras were mounted at a site, units were placed facing each other but slightly offset to avoid night-time image washout from the opposing camera's IR flash. Sites were checked biweekly or monthly, based on battery performance, and riverine trails were cleared of excess foliage to reduce camera misfires.

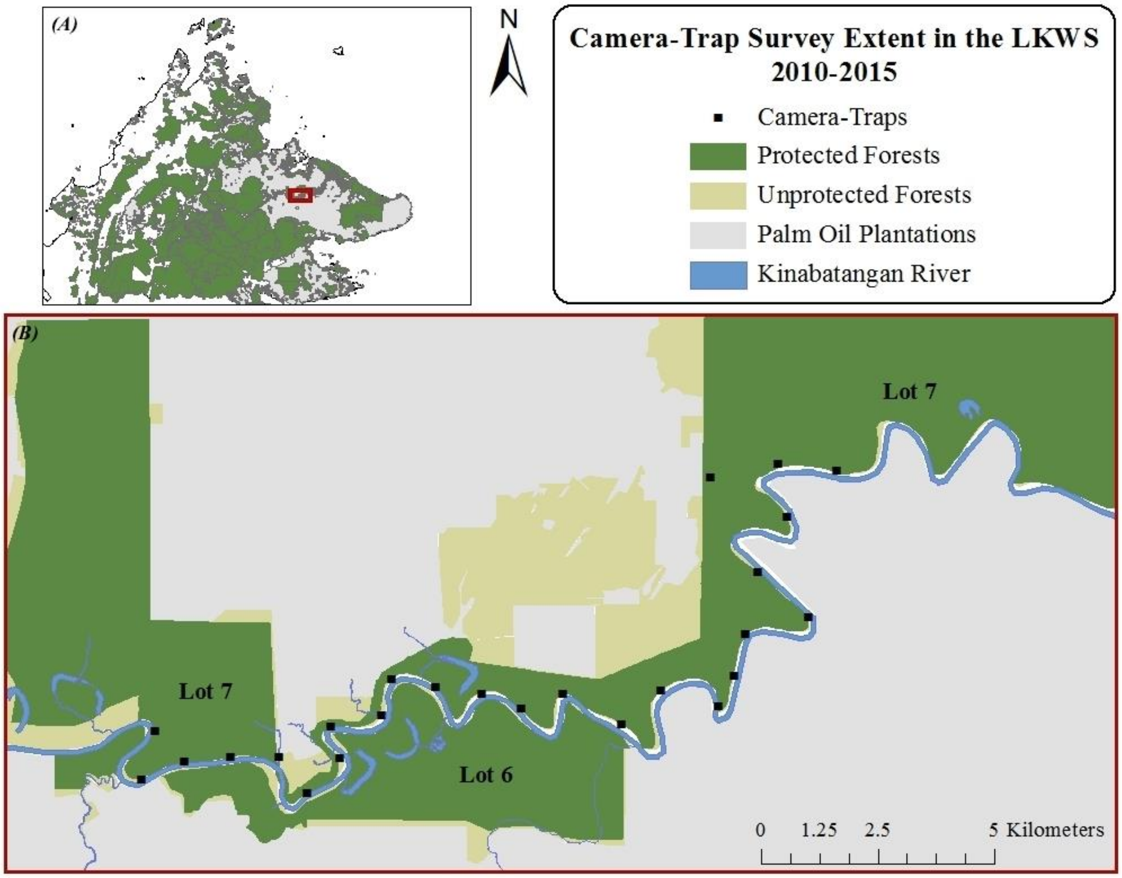

Figure 1. Map of camera-trap survey stations within Lots 5 and 7 in the Lower Kinabatangan Wildlife Sanctuary from 2010—2015.

Data handling

Once SD cards were collected, metadata were extracted from the images using ExifTool 9.6.8.0. Each photo was individually examined for the presence of an animal and, if a confident identification could be recorded, was classified based on the species present. If no positive identification could be made, the photo was excluded from future analyses. Each burst of three images was considered a single capture. Captures were then further grouped into unique events, whereby photos of the same species >30 minutes apart were classified as independent events, per Yasuda & Tsuyuki (2012), in order to avoid pseudoreplication. Survey effort was quantified by calculating total potential camera-trap nights (active calendar nights x number of active camera-traps).

Results

Throughout the 48 non-consecutive month survey, camera-traps accumulated 24,506 total potential trap nights and captured a total of 596,240 images. Of these, 419,528 photos recorded the presence of wildlife, with the remaining images consisting of humans or false trigger events. Species could not be identified in 1,254 images, and as such, were excluded from analyses.

Overall, 13 species of Bornean Carnivora were detected in 21,715 images across 2,327 unique events. This count includes multiple captures of the Sunda Clouded Leopard *Neofelis diardi* and the Malayan Sun Bear *Helarctos malayanus*, which, per Mathai *et al*. (2011), are excluded from these results. After the removal of these species, 11 small carnivore species were detected in 2,030 unique capture events throughout the survey (Table 1). Small carnivores detected on the camera traps comprised of five Viverridae species, one Prionodontidae species, three Mustelidae species, one Felidae species, and either one or two Herpestidae species. In most cases, low photo quality made distinguishing between the Bornean mongooses (Collared Mongoose *Herpestes semitorquatus* and the Short-tailed Mongoose *Herpestes brachyurus*) difficult, and as such we did not differentiate between the two in this survey.

Table 1. Small carnivore results from November 2010—May 2015 camera-trapping survey within Lots 5 and 7 of the Lower Kinabatangan Wildlife Sanctuary.

Species	Scientific name	No. of Capture events	No. of camera-trap stations detected	No. of trap nights until first detection	2015 IUCN Red List Status
Malay Civet	*Viverra tangalunga*	1,108	24	21	Least Concern
Common Palm Civet	*Paradoxurus hermaphroditus*	179	20	21	Least Concern
Banded Palm Civet	*Hemigalus derbyanus*	62	12	208	Vulnerable
Otter Civet	*Cynogale bennettii*	1	1	208	Endangered
Binturong	*Arctictis binturong*	2	1	19,321	Vulnerable
Banded Linsang	*Prionodon linsang*	1	1	12,211	Least Concern
Malay Badger	*Mydaus javanensis*	470	18	188	Least Concern
Smooth-coated Otter	*Lutrogale perspicillata*	140	12	166	Vulnerable
Yellow-throated Marten	*Martes flavigula*	11	6	565	Least Concern
Mongoose sp.	*Herpestes* sp.	28	11	628	Least Concern
Leopard Cat	*Prionailurus bengalensis*	28	11	48	Least Concern

The greatest abundance of captures occurred for Malay Civets, followed by the Malay Badger and the Common Palm Civet, all of which were documented across the greatest number of camera-trap stations. Only a handful of unique capture events were recorded for the Binturong, Banded Linsang and Otter Civet, and each were documented at one station only. Seven of these photo-captured species are listed as Least Concern, three as Vulnerable, and one as Endangered on the IUCN Red List (IUCN 2015).

Of special note, the first reported camera-trap image of the Endangered Otter Civet in the LKWS was taken on 27 November 2010 at 04h58 (5°25’N, 118° 04’E; Figure 2).

The camera-trap station was located in Lot 5 of the LKWS approximately 50 m from the riverbank and 530 m from the nearest oil palm plantation.

Figure 2. Camera-trap photo of an Otter Civet *Cynogale bennettii* within Lot 5 of the Lower Kinabatangan Wildlife Sanctuary (DGFC/SWD).

Opportunistic Sightings

Additionally, five small carnivore species were opportunistically sighted but not recorded on camera-traps, raising the total number of documented species to 16. Multiple records of the Small-toothed Palm Civet *Arctogalidia trivirgata* were reported throughout the LKWS (Figure 3A). The Malay Weasel *Mustela nudipes* was documented in several unique events within Lot 6 of the LKWS. The Endangered Flat-headed Cat *Prionailurus planiceps* was sighted and photographed by researchers along both sides of the riverbanks on multiple occasions (Figure 3B). The Asian Small-clawed Otter *Aonyx cinereus* was documented on a separate research camera-trap in the study area, and signs of the species have been recorded along the oxbow lakes in the LKWS (Evans unpublished data). A single non-related camera-trap recorded the presence of a Marbled Cat *Pardofelis marmorata* at the eastern edge of this study's survey extent. Lastly, in addition to the camera-trap photo of the Otter Civet, opportunistic sightings were made within Lot 6 of the LKWS in three separate occurrences. In the early evening of 25 July 2013, a solitary individual was documented close to an oxbow lake in close proximity to Danau Girang Field Centre (~5°24'N, 118°02'E). In mid-August 2013, an individual was seen crossing the concrete main path of the Field Centre (~5°25'N, 118°02'E). Lastly, on 8 February 2015, several research assistants observed an adult Otter Civet accompanied by two offspring once again crossing the concrete path, confirming the presence of a breeding unit of *C. bennettii* in the area.

Figure 3. Photos of (A) a Small-toothed Palm Civet *Arctogalidia trivirgata* and (B) Flat-headed Cat *Prionailurus planiceps* imaged within Lot 6 of the Lower Kinabatangan Wildlife Sanctuary by researcher S. H. Vickers on 7 June 2015 at 20h12 and 6 May 2015, 21h47.

Discussion

The results from this long-term monitoring survey of small carnivores within a degraded and fragmented riverine habitat demonstrate the importance of the Lower Kinabatangan Wildlife Sanctuary for small carnivore persistence. Overall, the sanctuary appears to support species diversity comparable to less disturbed forests throughout Borneo, with generalist species such as the Malay Civet and the Common Palm Civet documented routinely (e.g. Belden *et al.* 2007, Wilting *et al.* 2010a, Brodie & Giordani 2011, Mathai *et al.* 2010, Matsubayashi *et al.* 2011). Species with low capture rates are those species displaying behavioural traits nonconductive to capture by trail-based camera-traps, such as the arboreal Binturong (Wilting *et al.* 2010a) or the dense understory-preferring Banded Linsang (Cheyne *et al.* 2010). It is of interest, however, to note the relatively low number of photographic capture events of Leopard Cats, given that many authors suggest the species may thrive in disturbed areas, especially in regions containing oil palm plantations (Azlan & Sharma 2006, Rajaratnam *et al.* 2007, Jennings *et al.* 2015).

The importance of supporting camera-trapping surveys with researcher presence within a study area is highlighted by the results of this survey, as five additional species would have been otherwise undocumented. The Small-toothed Palm Civet is highly arboreal, making terrestrial detection improbable (Walston & Duckworth 2003), while Asian Small-clawed Otters and Flat-headed Cats reside in close proximity to shallow pools and tributaries, areas not targeted by this survey (Wilting *et al.* 2010b, Hussain *et al.* 2011). It has been suggested that historically low photographic detection rates of Malay Weasels might be attributable to a behavioural preference of hunting in dense undergrowth (Duckworth *et al.* 2006, Ross *et al.* 2013). When attempting to document the carnivore species within an area, species' specific behavioural ecology should be taken into consideration during survey design and planning (Sunarto *et al.* 2013).

Of the remaining Bornean Carnivora species, five species were neither photographed nor observed throughout the five-year monitoring survey of the LKWS. Neither the Masked Palm Civet *Paguma larvata* nor the Hose's Civet *Diplogale hosei* were detected, results not entirely surprising, as it has been suggested these species do not occur in lowland forests (Wilting *et al.* 2010a, Matsubayashi *et al.* 2011). Neither the Hairy-nosed Otter *Lutra sumatrana* nor the Bay Cat *Catopuma badia* were detected in the lower floodplains, despite both being documented in Deramakot Forest Reserve within the Kinabatangan, approximately 75 km upriver from the current survey site (Mohamed *et al.* 2009, Wilting *et al.* 2010a). Finally, despite apparent observations of the Bornean Ferret Badger *Melogale everetti* approximately 45 km downriver from this study area in the early 1990's (Boonratana 2010), this survey did not detect the species during over four years of monitoring.

This study confirms a new locality for the Endangered Otter Civet, an elusive and significantly understudied Southeast Asian civet species (Veron *et al.* 2006). This nocturnal animal is believed to reside in swampy areas and lowland primary forest streams, although some observations have been made in secondary forests (Heydon & Ghaffar 1997, Veron *et al.* 2006, Cheyne *et al.* in prep). However, this documentation of *C. bennettii* in a significantly degraded and fragmented environment suggests that the species may persist in a broader range of habitats than originally believed. Alternatively, the presence of a breeding unit could suggest the LKWS forest patches are of sufficient ecological health to act as species reservoirs, offsetting the immediate detriments to species residing in close proximity to oil palm plantations. These preliminary records demand more targeted research efforts to determine the population status of *C. bennettii* within the floodplain. Regardless, the confirmed presence of this incredibly rare species in the LKWS strikes a strong case for the importance of these forest lots, and should play a substantial role in spearheading the extension of legal protective measures to the 30,173 ha of unprotected forests persisting within the floodplain (Abram *et al.* 2014).

Although these preliminary results demonstrating the presence of both common and rare small carnivores in the LKWS are undoubtedly positive, this inventory itself should be taken with caution, as several of these occurrences were marked by a single photo across over four years of continuous monitoring. Species residing in fragmented habitats are faced with a multitude of threats and survival pressures (Laurance 2008, Gerber *et al.* 2012), such that it is possible the LKWS small carnivore guild is not yet at equilibrium. Specifically, the authors would like to emphasize the threat of increased illegal hunting activities, which are exacerbated in habitat fragments due to the relative ease of accessing the forest (Cullen *et al.* 2000, Milner-Gulland *et al.* 2003). Throughout this survey period, multiple photos documented illegal encroachment and evidence of hunting within the LKWS. In order to preserve the tenuously rich biodiversity persisting in the protected regions, significant effort must be invested to curb these illegal activities (Shepherd & Shepherd 2010). In face of these threats, more detailed and rigorous population and density estimates for the small carnivores from this region are required, which will, in turn, provide researchers a greater understanding of the conservation importance of degraded and fragmented riverine habitats. It is suggested that research efforts pair survey transects with both trail-based and arboreal camera trapping efforts, as by Oliveira-Santos *et al.* (2008), to maximize the probability of cataloguing all potential small carnivore species, regardless of behavioural traits. As the agricultural sector continues to expand and pristine rainforests are encroached upon all over the globe, it will be critical for the conservation community to understand the mechanisms by which forest fragments may benefit biodiversity.

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ORIGINAL ARTICLE

Notes on young Large-spotted Civets *Viverra megaspila* and their use of water sources as foraging sites in North Cambodia

Ai SUZUKI[1*], THONG Sokha[2], TAN Setha[2,3] & Akihisa IWATA[1]

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[1] Ecology and Environment, Division of Southeast Asia, Graduate School of Asian and African Area Studies, Kyoto University, Kyoto, 606-8501, Japan.
[2] Wildlife Conservation Society Cambodia Program, Phnom Penh, Cambodia.
[3] Forestry Administration, Ministry of Agriculture, Forestry and Fisheries, Royal Government of Cambodia

Correspondence:
Ai Susuki
a-suzuki@asafas.kyoto-u.ac.jp

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Abstract.

Whilst there are relatively large amounts of data on the current distribution of Large-spotted Civet *Viverra megaspila*, there is limited information on other aspects of the species' ecology. On 14 occasions between 2012 and 2015, one or two juveniles were photographed in the early to mid-dry season (when camera-trap effort was concentrated) in northern Cambodia. These juveniles are likely to have been born around the change from the rainy to dry season. All camera-trap stations that photographed young Large-spotted Civet were within 50 m of a water source. At one camera-trap station, foraging and regular visits by young and adult were recorded around a very shallow pool; the civets were probably preying on leaf-litter arthropods. Further research could clarify the dependency of Large-spotted Civet on waterholes (locally called trapeangs) during the dry season in northern Cambodia, but it is clear that mitigating threats at these trapeangs, particularly the use of snares and poison, is very likely to be a priority for Large-spotted Civet conservation within this landscape.

Keywords: Preah Vihear Protected Forest, Prey Preah Rokha, trapeangs, waterholes, poisoning.

Introduction

In recent decades, the Large-spotted Civet *Viverra megaspila* has been recorded from a small part of southern China through lowland mainland South-east Asia, south to northern peninsular Malaysia (Schreiber *et al.* 1989, Jennings & Veron 2011). Its ecology remains poorly understood and information obtained from captive individuals is also very limited compared with that for other species of Viverrinae, such as African Civet Civettictis civetta (Ewer & Wemmer 1974), Small Indian Civet *Viverricula indica* (Balakrishnan & Sreedevi 2007a, 2007b) and Large Indian Civet *Viverra zibetha* (Nowak 1991). To the best of our knowledge, no information has been published regarding the reproduction of Large-spotted Civet, with the descriptions simply stating "unknown" (Hunter 2011) or "nothing known" (Jennings & Veron 2009).

Somewhat more information is available on the species' distribution from sighting and camera-trap records. These suggest that Large-spotted Civet occurs mostly in gentle terrain and below 300 m asl, although it is occasionally recorded above 500 m asl (Khounboline 2005, Lynam *et al.* 2005, Holden & Neang 2009, Gray *et al.* 2010, Jenks *et al.* 2010, Chutipong *et al.* 2014). Large-spotted Civet has been recorded in various habitats including evergreen, semi-evergreen, and deciduous forests, and in wetlands (Duckworth 1994, Lynam *et al.* 2005, Holden & Neang 2009, Jenks *et al.* 2010, Chutipong *et al.* 2014). In one landscape in eastern Cambodia, the camera-trap encounter rate of Large-spotted Civet was higher in deciduous dipterocarp forest than in mixed deciduous and semi-evergreen forest (Gray *et al.* 2010). An ecological niche model suggested that Large-spotted Civet is more likely to occur in deciduous forest/scrub than in evergreen forest/scrub (Jennings & Veron 2011). However, subsequent information does not support deciduousness as a primary determinant of distribution (*e.g.*, Chutipong *et al.* 2014); rather it seems to be level and gentle terrain, which happens to be where most deciduous forest occurs in the species' geographic range (J. W. Duckworth in litt. 2016). Other studies also indicate that the species' possible association with water sources; Jenks *et al.* (2010) found that all stations at which this species was photographed were along waterways or near water sources, and Holden & Neang (2009) also recorded the species near the water's edge, frequently. In contrast, Gray *et al.* (2010) found little evidence to support the association of this species with water sources.

Materials and methods

Study areas

Preah Vihear Protected Forest and Prey (= forest) Preah Rokha proposed Protected Forest are located in Preah Vihear province in northern Cambodia (Figure 1). Together with Kulen Promtep Wildlife Sanctuary, this landscape is referred to as the northern plains. Like the eastern plains of Cambodia, the northern plains have a high predicted probability of Large-spotted Civet occurrence based on habitat and elevation (Jennings & Veron 2011). Large-spotted Civet has been camera-trapped in Preah Vihear Protected Forest (WCS unpublished data; 2001, 2002, 2004, 2005). This area has a distinct wet season, from May to October. In the dry season, human-caused forest fires burn frequently in deciduous and bamboo forests. The average annual rainfall is 1,556 mm and the average temperature ranges from 32.1 ºC to 35.6 ºC.

Preah Vihear Protected Forest covers 1,900 km^2 in total. Its major forest types are: deciduous forest (1,272 km^2, 67 %), evergreen forest (357 km^2, 19 %), and semi-evergreen forest (182 km^2, 10 %) (Forestry Administration 2010). In Preah Vihear Protected Forest, the survey was conducted in the core zone (Figure 1).

Prey Preah Rokha covers 1,043 km^2. It is a relatively large area of evergreen and semi-evergreen forest dominated by species of Dipterocarpaceae, Myrtaceae and Melastomaceae (Kao & Iida 2006). It has been proposed for protected status given its importance as a corridor between Preah Vihear Protected Forest and Kulen Promtep Wildlife Sanctuary.

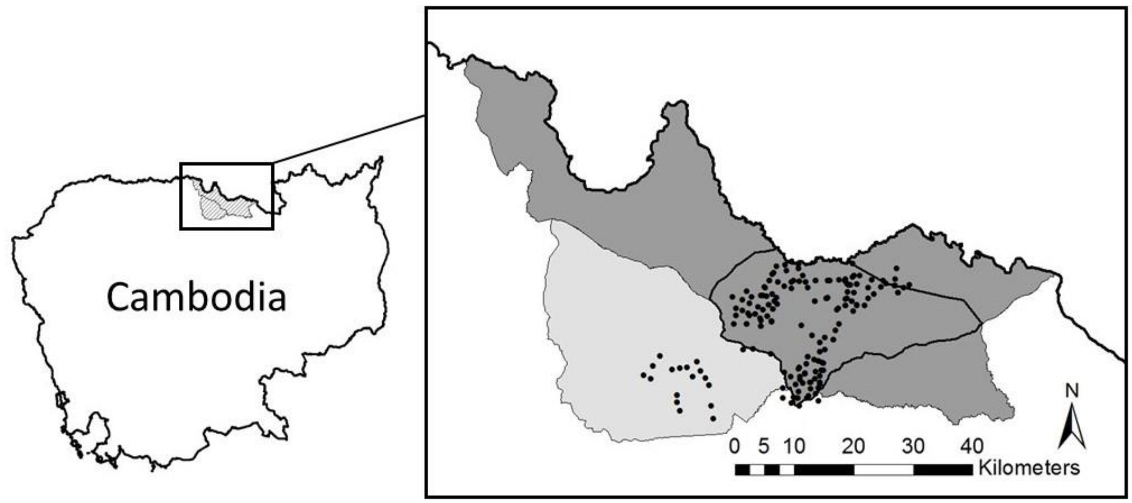

Figure 1. The location of Preah Vihear Protected Forest (dark grey area, 13º51' – 14º25'N, 104º 51' – 105º47'E) with its core zone (black bold line) and Prey Preah Rokha (light grey area, 13º48' – 14º09'N, 104º 58' – 105º02'E), and the locations of camera traps (black dots).

Methods

A camera-trap survey was carried out over three successive dry seasons from 2012 to 2015. Camera-trap stations were set a minimum of 1 km apart, along animal trails, human-made footpaths or motorcycle-dirt-tracks, and mounted on trees approximately 30–50 cm above the ground (Table 1). A single camera-trap was used at each station in 2012–2013 and 2013–2014. Paired camera-traps were used at each station in 2014–15. Passive infrared digital cameras were used. No stations were baited. A camera-trap record was defined as one capture event at least 30 minutes after the previous photograph of the same species at the same station. The identification of individual Large-spotted Civet adults was made visually, based on the distinctive pelage pattern on the flank following Jenks *et al.* (2010).

Table 1. Details for the camera-trap surveys in Preah Vihear Protected Forest during 2012–13, 2013–14 and 2014–15 campaigns.

Survey area*	Survey dates	Target taxon	Survey purpose	Number of camera stations	Camera-trap/nights
PVPF	Nov 2012– Mar 2013	Carnivores	Presence survey	47	2335
PVPF	Nov 2013– Mar 2014	Viverrinae	Occupancy	53	5207
PPR	Dec 2013– Mar 2014	Mammals	Presence survey	17	1504
PVPF	Dec 2014– Mar 2015	Large-spotted Civet	Density estimation	119**	3526

*PVPF = Preah Vihear Protected Forest, PPR = Prey Preah Rokha.
**Paired camera-traps were set at 30 stations and rotated each month.

The foraging behaviour of Large-spotted Civet has been poorly studied, but aural records at close distance suggests behaviour similar to that of African Civet, *i.e.* "a slow walk accompanied by much side-to-side casting of the head as the animal searches through leaf-litter" (Duckworth 1994). Therefore, for the purpose of this study, foraging was considered to occur when an individual adopted a posture with its muzzle near to, or on the ground covered with the leaf litter and was continuously photographed at a same camera-trap station for more than one minute.

Results

Records of young Large-spotted Civet

Total camera-trap effort was approximately 13,000 camera-trap-nights. The median distance of all cameras from a water source was 165.4 m (lower quartile: 41.2 m, upper quartile: 583.2 m). Large-spotted Civet was photographed at 116 out of 236 camera-trap stations during the survey period. Median distance of camera-trap stations which detected the species at least once was 95.6 m from a water source (lower quartile: 21.0 m, upper quartile: 279.3 m), while stations which did not record the species was 279.5 m (lower quartile: 90.5 m, upper quartile: 907.1 m). Groups of young and adult Large-spotted Civets were photographed within single frames on 14 occasions at six camera trap stations located in dry deciduous forest, evergreen forest, semi-evergreen forest and at the forest edge (Figure 2A-B). All six stations were within 50 m of various types of water source, including small pools of water left after rivers had dried up, a shallow waterhole, and ditches along a dirt-track for cars (Table 2). Young and adult Large-spotted Civets were photographed together between 18h00 and 24h00 and between 02h00 and 06h55. The group sizes recorded are the minimum; other animals might have been present but outside the photograph's frame.

Figure 2. (A) An adult and two juvenile recorded at camera-trap station 5 on 2 January 2015 and (B) one juvenile and two adult Large-spotted Civets *Viverra megaspila*, recorded at camera-trap station 6 on 18 January 2015, Preah Vihear Protected Forest, Cambodia.

Use of water sources by young and adult Large-spotted Civets

At station 1 (Table 2), set near a shallow waterhole at the edge of semi-evergreen forest, a young and an adult Large-spotted Civet were photographed exhibiting foraging behaviour. Water remained in this waterhole under the tangled branches of a shrub until February (Figure 3A). The camera trap was functioning between 25 January and 17 February 2013, providing 24 camera-trap-nights. During this period, Large-spotted Civet was photographed daily except for three nights, producing a total of 48 events. Foraging behaviour was recorded in 31% of these events. Of the 48 events, young and adult were photographed together nine times, and foraging behaviour exhibited in six of these nine events (e.g. Figure 3B). It was not possible to identify if all nine were the same adult-young pair, but one individual adult was identified in four events.

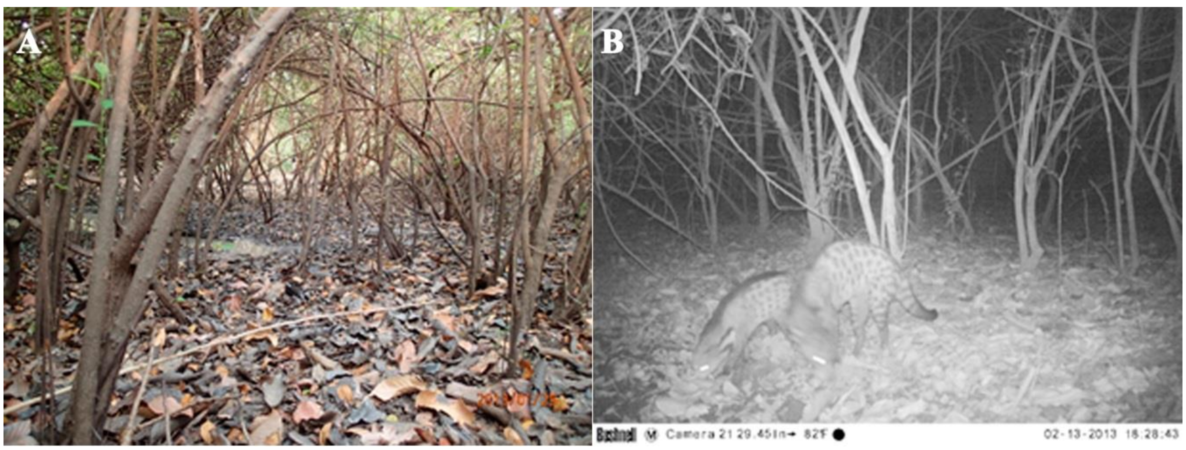

Figure 3. (A) A shallow waterhole under the tangled branches of a shrub at Station1 and (B) a young and an adult Large-spotted Civet *Viverra megaspila* exhibiting foraging behaviour at the same station on 13 February 2013, Preah Vihear Protected Forest, Cambodia. Note the blurred heads, indicating movement (see text description of foraging style).

Discussion

One or two young Large-spotted Civets were recorded accompanied by one or two adults on 14 occasions between December and February during three dry seasons: in 2012–2013, 2013–2014 and 2014–2015. The observed number of young was consistent with the breeding records for other species of Viverrinae. The litter size is reported to be two to three for captive African Civet (Ewer & Wemmer 1974), two to five for Small Indian Civet (Balakrishnan & Sreedevi 2007a), one to four for Large Indian Civet and one to three for Malay Civet *Viverra tangalunga* (Hunter 2011). Based on the size of the young compared with that of accompanying adult(s), and from information known from related species of Viverinnae (see Ewer & Wemmer 1974, Balakrishnan & Sreedevi 2007a), the photographed young were probably about two or three months old, and would have therefore been born between September and December, *i.e.* the late rainy to early dry season.

Table 2. Records of young and adult Large-spotted Civets *Viverra megaspila* photographed within single frames during camera-trap surveys in 2012–2013, 2013–2014 and 2014–2015 at Preah Vihear Protected Forest, Cambodia.

#	Coordinates (Lat Long – DD MM SS.S)	Date	Time	Large-spotted Civet records		Habitat	Distance from a water source	Type of water source	Other small carnivore records	Human presence (capture events per 100 camera-trap-nights)
				Adult	Juv.					
1	13°53'41.3"N 105°22'52.2"E	26-Jan-13	19h57	1*	1	Edge between semi-evergreen forest and dry deciduous forest	less than 5 m	Shallow waterhole	Common Palm Civet *Pradoxurus hermaphroditus* Crab-eating Mongoose *Herpestes urva* Yellow-throated Marten *Martes flavigula*	Men (8.33)
		27-Jan-13	02h31	1	1					
		28-Jan-13	18h17	1	1					
		29-Jan-13	04h24	1	1					
		29-Jan-13	18h09	1	1					
		30-Jan-13	18h12	1	1					
		07-Feb-13	18h55	1*	1					
		13-Feb-13	18h28	1*	1					
		13-Feb-13	23h47	1*	1					
2	14°02'30.9"N 105°27'58.2"E	17-Dec-13	20h48	1	2	Dry deciduous forest	less than 5 m	Shallow pool in a riverbed	Common Palm Civet, Yellow-throated Marten, Small Indian Civet *Viverricula indica*	Men (0.87)
3	13°55'38.8"N 105°13'07.1"E	04-Jan-14	04h25	1	2	Evergreen forest	less than 5 m	Shallow stream	Large Indian Civet *Viverra zibetha*, Common Palm Civet	Men (26.39)
4	14°05'28.5"N 105°28'06.6"E	31-Jan-15	22h50	1	1	Semi-evergreen forest	40 m	Shallow pools in a riverbed	Large Indian Civet, Common Palm Civet	Men (9.68)
5	13°56'11.6"N 105°25'17.4"E	02-Jan-15	06h55	1	2	Edge of semi-evergreen forest with a very small stream	13 m	Shallow pool in a streambed	Large Indian Civet, Common Palm Civet, Crab-eating mongoose, Yellow-throated Marten, ferret badger *Melogale*	Domestic dogs (3.22)
6	14°04'24.5"N, 105°26'46.3"E	18-Jan-15	21h53	2	1	Dry deciduous forest	16 m	Ditches along a dirt-track for cars	Common Palm Civet, Crab-eating mongoose	No photographs

*Identified as the same adult individual based on flank pelage pattern.
# = camera-trap station number.
Juv. = Juvenile.

All records of young came during December to February but this does not necessarily indicate a seasonal breeding peak, given the lack of wet season camera-trap effort. Some species of Viverrinae exhibit aseasonal breeding (Jennings & Veron 2009, Hunter 2011). Two reproductive seasons, February–April and August–September, have been reported for captive Small Indian Civets in China (Xu & Sheng 1994). Breeding in African Civet occurs throughout year (Nowak 1991), but in some areas is more seasonal, peaking in the wet summer months in South Africa (Skinner & Chimimba 2005), and in the wet season in Eastern Africa (Hunters 2011). The northern plains in Cambodia comprise seasonally dry forests (Bunyavejchewin *et al.* 2011), so strong seasonality is quite likely to limit the breeding season. However, further research in the wet season would be needed to confirm this.

All camera-trap stations that photographed young were located within 50 m of water sources, in various types of forest. At Station 1 (Table 2), either adult or young Large-spotted Civets were photographed nearly every night that the camera-trap was operational for, often visiting multiple times per night, and were photographed exhibiting probable foraging behaviour. Foraging close to water is consistent with the findings of Holden and Neang (2009), and such regular visits suggest the importance of this spot, at least in the mid-dry season. One possible explanation is that moisture in the leaf-litter around pools may retain higher availability of arthropod prey in the dry season. At other sites in Indochina, soil humidity is one of the most important determinants of arthropod richness and abundance (Wiwatwitaya & Takeda 2005, Sackchoowong *et al.* 2015).

Whilst the relative importance of arthropods in the diet of Large-spotted Civet remains unknown, they are among the major components in African Civet and Malay Civet diet (Bekele *et al.* 2008, Colon & Sugau 2013, Amiard *et al.* 2015). Furthermore, Ewer and Wemmer (1974) indicate the importance of insects for young African Civet. They observed captive young attempting to catch live insects at the age of two months, and suggested that in the wild, insects could serve as effective dietary supplements at this stage. Young African Civets killed a mouse not until the age of 55 days and a rat at the age of 154 days (Ewer & Wemmer 1974). Colon & Sugau (2013) found presence of earthworms, grass, bees and grasshoppers in the stomach of a juvenile Malay Civet and unidentified berries, earthworms, ants, beetles, grasshoppers and leaf matter in a sub-adult’s stomach. Arthropods may be essential diet for young African and Malay Civets, possibly for young Large-spotted Civets as well, and given the foraging style, water sources amid abundant leaf-litter could be good foraging sites in the dry season.

Assuming that water sources are important foraging sites for Large-spotted Civet and considering that this part of Cambodia has been predicted as among the last strongholds of this species (Jennings & Veron 2011), it is essential that the future of water sources in this landscape is secured. Because of decreased water availability around villages, increased mobility by motorcycle, and their spare time after harvesting rice, people are likely to visit water sources in Preah Vihear Protected Forest more often in the dry season. Among the various types of water sources that people use in Preah Vihear Protected Forest, conservation interventions are likely to be needed for waterholes, locally called trapeangs; snares and poisons are put around these waterholes to hunt wildlife for commercial trade and/or subsistence. One Large-spotted Civet was killed in February 2015 by poison placed around a small waterhole. The poison was identified as Carbofuran (A. Mould & M. Pruvot, Wildlife Conservation Society, verbally 2016). Increasing enforcement efforts around waterholes in the dry season will reduce these threats to the species as well as to the many other forms of wildlife attracted to trapeangs. Patrol routes should focus on trapeangs that retain water until very late in the dry season; these are targets for illegal activities, including wildlife hunting. Further investigation of the species' dependence on different water sources, in both the wet and dry seasons, would help to clarify the vulnerability of Large-spotted Civet to the threats to trapeangs in dry forest landscapes.

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Bassaricyon neblina osborni from Tamesis, Antioquia department (Photo: C. Ortiz)

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