

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

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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 °C to 35.6 °C.

Preah Vihear Protected Forest covers 1,900 km² in total. Its major forest types are: deciduous forest (1,272 km², 67 %), evergreen forest (357 km², 19 %), and semi-evergreen forest (182 km², 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 km². 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.

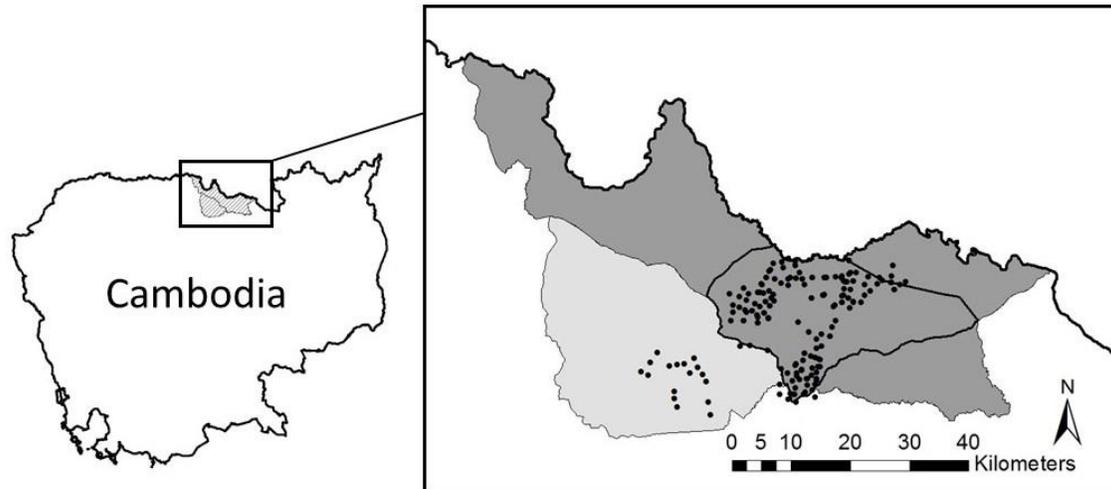


Figure 1. The location of Preah Vihear Protected Forest (dark grey area, 13°51' – 14°25'N, 104° 51' – 105°47'E) with its core zone (black bold line) and Prey Preah Rokha (light grey area, 13°48' – 14°09'N, 104° 58' – 105°02'E), and the locations of camera traps (black dots).

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 juveniles 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 Station 1 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 zibellina* (Hunter 2011). Based on the size of the young compared with that of accompanying adult(s), and from information known from related species of Viverrinae (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 <i>Pradoxurus hermaphroditus</i> Crab-eating Mongoose <i>Herpestes urva</i> Yellow-throated Marten <i>Martes flavigula</i>	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 <i>Viverricula indica</i>	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 <i>Viverra zibetha</i> , 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 <i>Melogale</i>	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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