

Status and ecology of Large-spotted Civet *Viverra megaspila* in eastern Cambodia

Thomas N.E. GRAY¹, PIN Chanrattana and PIN Chanrattanak

Abstract

There are few published accounts of the status of Large-spotted Civet *Viverra megaspila* (IUCN Red List status, Globally Threatened: Vulnerable) in Cambodia. We conducted intensive camera-trapping in the lowland deciduous forests of Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary, eastern Cambodia, between December 2008 and June 2010. Large-spotted Civet was photographed on 49 occasions from 21 locations and was the most frequently recorded small carnivore in Mondulkiri Protected Forest. Large-spotted Civet was photographed more frequently in deciduous dipterocarp forest than in mixed deciduous and semi-evergreen forest. Mondulkiri Protected Forest and adjacent protected areas may represent the global stronghold for Large-spotted Civet and the species must be regarded as among the significant globally threatened species present in the landscape.

Keywords: camera-trap, deciduous dipterocarp forest, habitat use, Mondulkiri province, *Viverra zibetha*

ស្ថានភាព និងអេកូឡូស៊ីនៃសំពោចធំ *Viverra megaspila* នៅភាគខាងកើត ប្រទេសកម្ពុជា

សង្ខេប :

អត្ថបទដែលស្តីពីស្ថានភាពសត្វសំពោចធំ *Viverra megaspila* (IUCN- ងាយរងគ្រោះ) ពុំសូវមាន ច្រើនទេនៅក្នុងប្រទេសកម្ពុជា។ យើងបានធ្វើការសិក្សាដោយប្រើ កាមេរ៉ាវាស្វ័យប្រវត្តិនៅក្នុងតំបន់ ទំនាបព្រៃបោះចុះនៃព្រៃការពារមណ្ឌលភិរិ និង ដែនជំរកសត្វព្រៃភ្នំព្រេច ភាគខាងកើតប្រទេស កម្ពុជា រវាងខែធ្នូ ឆ្នាំ២០០៨ ដល់ ខែមិថុនា ឆ្នាំ ២០១០។ សំពោចធំត្រូវបានថតចំនួន ៤៩ព្រឹត្តិការ ពី ២១ទីតាំងនៃកាមេរ៉ាវាស្វ័យប្រវត្តិ ហើយត្រូវបានកត់ត្រាជាប្រភេទ ថតសត្វស៊ីសាច់ជាអាហារ ថ្នាក់តូចជាដើម្បី ទៅព្រៃបោះចុះ ព្រៃបោះចុះចំរុះ និងព្រៃពាក់កណ្តាលស្រោង។ ព្រៃការពារ មណ្ឌលភិរិ និង តំបន់ការពារ ផ្សេងៗដែលជាប់នឹងព្រៃប្រទល់ព្រៃការពារ អាចតំណាងអោយ តំបន់ដែលផ្តុំផ្គូផ្គង ជាសកលដល់ សំពោចធំ ហើយប្រភេទនេះត្រូវតែចាត់ទុកជាប្រភេទដែល ត្រូវបានកំរាមកំហែងជាសកល យ៉ាងខ្លាំងដែលមាននៅតំបន់ទេសភាព។

ពាក្យគន្លឹះ: សំពោច *Viverra*. កាមេរ៉ាវាស្វ័យប្រវត្តិ មណ្ឌលភិរិ ព្រៃបោះចុះ ការប្រើប្រាស់ទីជំរក

Introduction

Large-spotted Civet *Viverra megaspila* is categorised as Globally Threatened: Vulnerable on *The IUCN Red List of Threatened Species* (Duckworth *et al.* 2008) and, historically, occurred widely in mainland south-east Asia from southern China and Myanmar, through Indochina and Thailand south to Peninsular Malaysia (Corbet & Hill 1992). Lynam *et al.* (2005) reviewed some recent records of the species from Myanmar, Thailand and Malaysia and suggested Large-spotted Civet occurred primarily in lowland forest below 300 m (but see Khounboline 2005, Holden & Neang 2009). They also suggested the species had been recorded from all forest blocks primarily below 300 m and greater than 500 km² in non-Sundaic South-east Asia that had received heavy camera-trapping or spot-lighting effort (Lynam *et al.* 2005). However, given the rapid loss and degradation of lowland forest across the species's range, particularly in Thailand and Vietnam, together with the paucity of recent documented records from the north (e.g. north Vietnam, north Lao PDR and China) and south (e.g. Malaysia) of the historically reported range (Lynam *et al.* 2005, Lau *et al.* 2010), an IUCN listing of Vulnerable is sensibly precautionary.

The northern and eastern Cambodian provinces of Mondulkiri, Rattanakiri, Stung Treng and Preah Vihear support one

of the largest extents of lowland deciduous forest in South-east Asia (Tordoff *et al.* 2005) and, as such, are regarded as possible global strongholds for Large-spotted Civet (Lynam *et al.* 2005). However, whilst there are published records from at least two protected areas in south-west Cambodia (Botum-Sakor National Park and Central Cardamom Protected Forest; Holden & Neang 2009, Royan 2010) there is little documentation of the species's status from the extensive lowland forest of northern and eastern Cambodia (e.g. Schank *et al.* 2009). This paper rectifies this, to some extent, by providing records of Large-spotted Civet, and the sympatric Large Indian Civet *V. zibetha*, obtained during recent extensive camera-trapping in the deciduous dipterocarp dominated forests of Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary, eastern Cambodia.

Study sites and methods

Mondulkiri Protected Forest (MPF; 3,630 km²; approximate location 12°08'N, 106°05'E) and Phnom Prich Wildlife Sanctuary (PPWS; 2,200 km²; 12°40'N, 107°00'E) form part of the trans-boundary Eastern Plains Landscape protected area complex (which also includes Seima Protection Forest and Lumphat Wildlife Sanctuary of Cambodia, and Yok Don National Park, Vietnam). Elevation is generally under 300 m and both sites are dominated by deciduous dipterocarp forest with smaller areas of mixed deciduous forest (in west and south-east MPF and throughout PPWS) and, to a lesser extent, semi-evergreen and evergreen forest in south-east PPWS. Mixed deciduous, semi-evergreen and evergreen forests types generally occur along water-courses and at slightly higher elevations within the wider matrix of deciduous dipterocarp forest and are often dominated by *Lagerstroemia* and *Hopea* trees (Rollet 1962, Rundel 1999).

Between December 2008 and June 2010 the core areas of MPF and eastern PPWS were extensively camera-trapped using commercially available infra-red, remote-trip digital camera units (Reconyx RapidFire Professional PC90; WI, U.S.A.) in which all photographs are digitally stamped with date and time. Cameras were placed in locations (e.g. alongside roads, motorcycle trails and footpaths, dry stream beds and at seasonal waterholes) designed to maximise chances of encountering ground-dwelling mammals, primarily large carnivores and wild cattle. A

total of 127 camera-trap locations (69 in MPF; 57 in PPWS) were trapped for 9,269 camera-trap-nights. Camera-traps were classified as within deciduous dipterocarp forest (24 locations; 1,823 camera-trap-nights), mixed deciduous/semi-evergreen forest (26 locations; 1,715 camera-trap-nights) or mosaic forest (77 locations; 5,731 camera-trap-nights) as defined by remotely-sensed forest cover data-set (JICA 2003). This data-set was produced from 1:25,000 and 1:40,000 aerial photographs in combination with SPOT (Satellite Pour l'Observation de la Terre) and Landsat satellite imagery and even narrow habitat patches (e.g. riverine evergreen strips <100 m wide through deciduous dipterocarp matrix) are easily identifiable. Mosaic forest, as here defined approximating the ecotone between forest types, includes all camera-trap locations <2 km from habitat edge as indicated by the remotely sensed habitat classification. The indicative altitude of camera-traps, obtained in ArcGIS from a digital elevation model for the Eastern Plains Landscape (WWF internal data), was between 136 m and 336 m asl (mean 227 m asl). No cameras were baited and all were operational continuously. All cameras were placed on trees at 20–150 cm above ground (mean = 57 cm) and no two cameras were placed closer than 1 km from each other.

All independent encounters with Large-spotted and Large Indian Civets, defined as 'independent' when successive photographs of the same species were separated by more than 20 minutes, were extracted from camera-trap data and the date, time and camera-trap location were recorded. Large-spotted Civets were identified by the presence of distinct, large, bold spotting on the flanks and a continuous black line along the top of the tail compared with Large Indian Civets where distinct alternating com-



Fig. 1. Camera-trap photographs of Large-spotted Civet *Viverra megaspila* (top) and Large Indian Civet *V. zibetha* (bottom) from Mondulkiri Protected Forest (MPF), eastern Cambodia.

Table 1. Number of encounters, number of locations recorded from ($n = 127$), camera-trap encounter rate (number of independent encounters per 100 trap-nights) and altitude of camera-trap records of Large-spotted *Viverra megaspila* and Large Indian Civets *V. zibetha* from Mondulkiri Protected Forest (MPF) and Phnom Prich Wildlife Sanctuary (PPWS), eastern Cambodia.

	Large-spotted Civet		Large Indian Civet	
	MPF	PPWS	MPF	PPWS
Number of independent encounters	48	1	45	52
Number of locations with records	20	1	15	24
Encounters per 100 trap-nights	0.99	0.02	0.93	1.18
Mean altitude (range; m)	190 (140–320)	250	230 (145–310)	250 (190–305)

plete rings of black and white along the tail are usually obvious (Duckworth 1994, Jenks *et al.* 2010; Fig. 1).

Results

Although cameras targeted large mammals, a wide variety of species was photographed varying in size from Asian Elephant *Elephas maximus* to Berdmore's Squirrel *Menetes berdmorei*. Nine species of small carnivore were photographed (Appendix). *Viverra* civets were photographed from 55 camera-trap locations (21 locations for Large-spotted Civet, 39 for Large Indian Civet; Table 1) with sympatric occurrence at five camera-traps (four in MPF and one in PPWS). In MPF Large-spotted Civet was the most frequently encountered small carnivore (Appendix) with an encounter rate of approximately one independent photograph per 100 camera-trap-nights. This was similar to the encounter rates of Large Indian and Common Palm Civets *Paradoxurus hermaphroditus*. In contrast in PPWS Large-spotted Civet was photographed only once, whilst there were 52 independent encounters with Large Indian Civet (Table 1).

In both protected areas Large-spotted Civet was photographed more frequently by cameras located in deciduous dipterocarp and mosaic forest than by those in large blocks of mixed deciduous and semi-evergreen forest; in the latter, the species was encountered just once (Fig. 2). In contrast Large Indian Civet was encountered more often in mixed deciduous and semi-evergreen forest and less regularly photographed (13 encounters from five camera-trap locations) in deciduous dipterocarp forest isolated from other habitat types (Fig. 2). Encounter rates (number of independent photographs per 100 trap-nights) in both species were similar from camera-trap locations adjacent (<500 m as identified in GIS) and distant (>500 m) from river-beds (Large-spotted Civet: 0.6 encounters/100 trap-nights <500 m from river-beds; 0.5 encounters/100-trap-nights >500 m from river-beds; Large Indian Civet 0.9 encounters/100 trap-nights <500 m from river-beds; 1.1 encounters/100 trap-nights >500 m from river-beds). Both species were recorded from the full range of altitudes in which camera-trapping occurred although locations with Large-spotted Civet

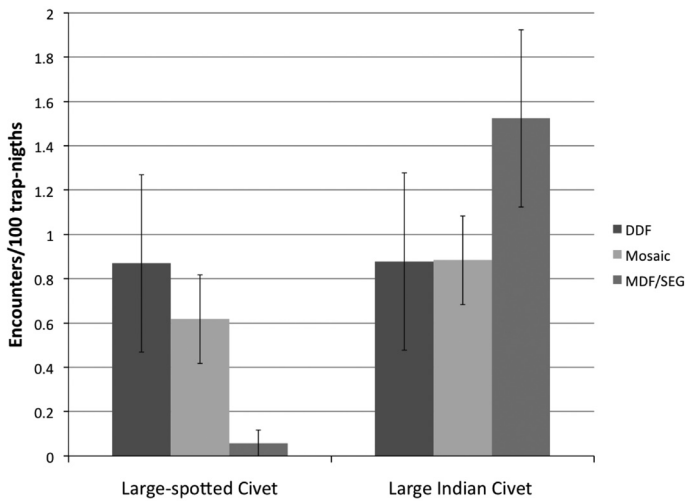


Fig. 2. Camera-trap encounter rates (number of independent photographs per 100 camera-trap-nights; \pm SEM, using per-camera encounter rate as the sample statistic) of Large-spotted *Viverra megaspila* and Large Indian Civets *V. zibetha* from camera-traps located in deciduous dipterocarp forest, mosaic and mixed deciduous / semi-evergreen forest in Mondulkiri Protected Forest (MPF) and Phnom Prich Wildlife Sanctuary (PPWS), eastern Cambodia.

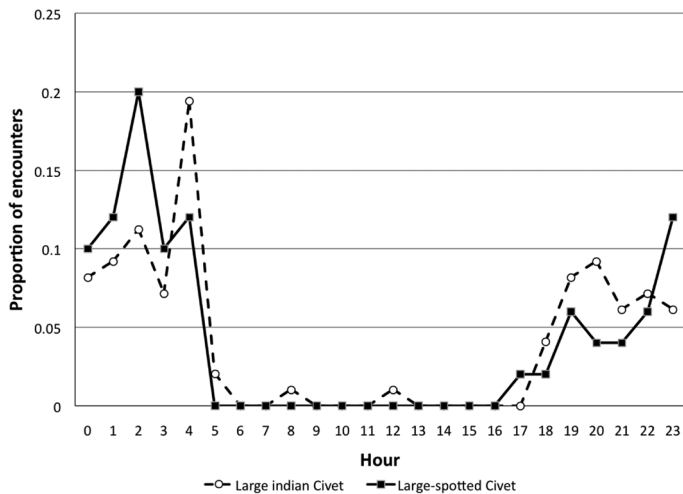


Fig. 3. Activity patterns (percentage of encounters per hour) of Large-spotted *Viverra megaspila* and Large Indian Civets *V. zibetha* from camera-trap data from Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary, eastern Cambodia.

were, on average, lower than locations supporting Large Indian Civet (Table 1). As expected, both species were strongly nocturnal, with peaks of activity in the early morning (02h00–05h00; Fig. 3). Large Indian Civet was, however, also photographed on two occasions during the day.

Discussion

We present the first published records of Large-spotted Civet from Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary, eastern Cambodia. We also provide the first evidence of micro-scale sympatry between Large-spotted and Large Indian Civets,

with both species recorded from the same camera-trap locations (c.f. Duckworth 1994, Austin 1999, Jenks *et al.* 2010). In MPF Large-spotted Civet was the most frequently recorded small carnivore, occurring widely and appearing particularly common within the flatland deciduous dipterocarp forest, which is the dominant habitat in the protected area. The use of open deciduous dipterocarp forest has been previously noted for Large-spotted Civet in southern Laos (Duckworth 1994, Austin 1999) and south-west Cambodia (Holden & Neang 2009) and we suggest this may be the preferred habitat for this species. Although previous studies have suggested some association with water (e.g. Holden & Neang 2009, Jenks *et al.* 2010) we found limited evidence for this. However, two of the ten cameras with highest encounter rates (>3 photographs per 100 camera-trap-nights) were located on the edges of seasonal waterholes (*trapeang*) in deciduous dipterocarp forest.

The Eastern Plains Landscape is amongst the largest, most remote and least disturbed areas of lowland forest in Indochina. In addition to its presence in Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary, Large-spotted Civet has been recorded from Seima Protection Forest (Walston *et al.* 2001, Schank *et al.* 2009) and Yok Don National Park, Vietnam (one camera-trap record in March 2003; Eames *et al.* 2004). Given the extent of suitable flatland deciduous dipterocarp forest habitat within MPF and the adjacent ecologically similar Lumphat Wildlife Sanctuary and O’Yadao Protected Forest we suggest the Eastern Plains Landscape may be the global stronghold for the species.

There is, however, some evidence that Large-spotted Civet may be tolerant, at least to some extent, of degraded lowland forest (Austin 1999, Jenks *et al.* 2010). Degraded and disturbed lowland deciduous forest is widespread across the northern and eastern Cambodian provinces of Oddar Meanchey, Preah Vihear, Rattanakiri, Stung Treng, Kratie and Kompong Thom. Whether Large-spotted Civet persists in such landscapes, in which medium–large terrestrial mammals are heavily hunted, is unclear. However, given ambiguous identification of foot-prints, and inevitable camera-trap loss from such areas with relatively high levels of human activity, clarifying the extent to which Large-spotted Civet occupies degraded lowland forest away from the protected area network in Cambodia will be difficult. In addition, lowland forest in Cambodia, even within some protected areas, is severely threatened by clearance for social and agricultural concessions (particularly rubber plantations). Therefore long-term persistence of Large-spotted Civet across many areas of lowland Cambodia is doubtful. Maintaining the integrity of protected areas in the Eastern Plains Landscape therefore may be close to essential for the conservation of Large-spotted Civet together with a suite of marginally higher-profile threatened species that are associated with lowland deciduous forest (e.g. Banteng *Bos javanicus* and Green Peafowl *Pavo muticus*; Goes 2009). Strong protected area management across the Eastern Plains Landscape is required for safeguarding habitat for Large-spotted Civet which should be promoted as among the significant globally threatened species present in the landscape.

Acknowledgements

We thank the Forestry Administration and the Ministry of the Environment of the Royal Cambodian Government for support and permission to work in Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary. Phan Channa, Prum Sovanna, Kheav Oudom, Ing Seangrithy, Lien Nor, Vann

Sonny, Lien Kha, Men Samorn and Sary Tre assisted with camera-trapping and Jeremy Holden provided camera-trap training. Two anonymous reviewers provided comments which improved the quality of this manuscript. Major funding for camera-trapping was provided by WWF-US and Humanscale. Jeremy Holden and Ed Pollard provided useful references and information and encouraged the production of this manuscript.

References

- Austin, S. C. 1999. Camera-trapping evidence of Large-spotted Civet *Viverra zibetha* in Xe Piang National Biodiversity Conservation Area (NBCA), southern Lao PDR. *Natural History Bulletin of the Siam Society* 47: 255–257.
- Corbet, G. B. & Hill, J. E. 1992. *The mammals of the Indomalayan region*. Natural History Museum publications & Oxford University Press, Oxford, U.K.
- Duckworth, J. W. 1994. Field observations of Large-spotted Civet *Viverra zibetha* in Laos with notes on the identification of the species. *Small Carnivore Conservation* 11: 1–3.
- Duckworth, J. W., Timmins, R. J., Olsson, A., Robertson, S., Kanchanasaka, B., Than Zaw, Jennings, A. & Veron, G. 2008. *Viverra zibetha*. In: IUCN 2010. *IUCN Red List of Threatened Species*. Version 2010.3. www.iucnredlist.org. Downloaded on 17 September 2010.
- Eames, J. C., Nguyen D. T., Le T. T., Dang N. C., Ngo V. T., Hoang D. D., Thai N. T. & Nguyen T. T. H. 2004. *Draft final biodiversity report for Yok Don National Park, Dak Lak province*. PARC Project VIE/95/G31&031, Government of Viet Nam (FPD) / UNOPS / UNDP / Scott Wilson Asia-Pacific Ltd, Hanoi, Vietnam.
- Goes, F. G. 2009. The status and distribution of Green Peafowl *Pavo muticus* in Cambodia. *Cambodian Journal of Natural History* '2009': 7–15.
- Holden, J. & Neang T. 2009. Small carnivore records from the Cardamom Mountains, southwestern Cambodia. *Small Carnivore Conservation* 40: 16–21.
- Jenks, K. E., Wanghongsa, S., Songsasen, N., Leimgruber, P. & Howard, J. 2010. Camera-trap evidence of Large-spotted Civet *Viverra zibetha* in Khao Ang Rue Nai Wildlife Sanctuary and Khao Yai National Park, Thailand. *Small Carnivore Conservation* 42: 19–21.
- [JICA] Japanese International Cooperation Agency 2003. *Cambodia reconnaissance survey digital data project. Meta database*. Ministry of Public Works and Transportation, Phnom Penh, Cambodia.
- Khounbolin, K. 2005. A Large-spotted Civet *Viverra zibetha* record from a mid-altitude plateau, Lao PDR. *Small Carnivore Conservation* 33: 26.
- Lau, M. W.-N., Fellowes, J. R. & Chan, B. P. L. in press. Carnivores (Mammalia: Carnivora) in south China: a status review with notes on the commercial trade. *Mammal Review*.
- Lynam, A. J., Myint Maung, Saw Htoo Tha Po & Duckworth, J. W. 2005. Recent records of Large-spotted Civet *Viverra zibetha* from Thailand and Myanmar. *Small Carnivore Conservation* 32: 8–11.
- Rollet, B. 1962. *Inventaire forestier de l'est Mekong*. UN/FAO, Rome, Italy.
- Royan, A. 2010. Significant mammal records from Botum-Sakor National Park, southwest Cambodia. *Cambodian Journal of Natural History* '2010': 22–26.
- Rundel, P. W. 1999. *Forest habitats and flora in Lao PDR, Cambodia and Vietnam*. WWF Indochina Programme, Hanoi, Vietnam.
- Schank, C., Pollard, E. H. B., Sechrest, W., Timmins, R., Holden, J. & Walston, J. 2009. First confirmed records of Large-toothed Ferret Badger *Melogale personata* in Cambodia, with notes on country records of *Melogale*. *Small Carnivore Conservation* 40: 11–15.
- Tordoff, A. W., Timmins, R. J., Maxwell, A., Huy V., Lic V. & Khou E. A. (eds) 2005. *Biological assessment of the Lower Mekong Dry Forests Ecoregion*. WWF Cambodia, Phnom Penh, Cambodia.
- Walston, J., Davidson, P. & Men S. 2001. *A wildlife survey of southern Mondulkiri province, Cambodia*. Wildlife Conservation Society Cambodia Program, Phnom Penh, Cambodia.

Eastern Plains Landscape Project, WWF Greater Mekong Cambodia Country Program, Phum Doh Kromom, Sen Monorom, Mondulkiri, Cambodia.
Corresponding author email: tomngray@hotmail.com

Appendix

Species	MPF	PPWS	Total
Large Indian Civet <i>Viverra zibetha</i>	45	52	97
Common Palm Civet <i>Paradoxurus hermaphroditus</i>	45	35	80
Large-spotted Civet <i>Viverra zibetha</i>	48	1	49
Small Indian Civet <i>Viverricula indica</i>	11	9	20
Hog Badger <i>Arctonyx collaris</i>	3	5	8
Crab-eating Mongoose <i>Herpestes urva</i>	5	1	6
Ferret badger <i>Melogale</i>	2	1	3
Yellow-throated Marten <i>Martes flavigula</i>	1	1	2
Small Asian Mongoose <i>Herpestes javanicus</i>	1	0	1

Number of independent encounters of all small carnivore species photographed in Mondulkiri Protected Forest (MPF) and Phnom Prich Wildlife Sanctuary (PPWS), eastern Cambodia, December 2008 – June 2010.