

SMALL CARNIVORE CONSERVATION



The Journal of the IUCN/SSC
Small Carnivore Specialist Group



Volume 43

December 2010



Javan Small-toothed Palm Civet *Arctogalidia (trivirgata) trilineata* (Photo: J. A. Eaton)

The production and distribution of this issue has been sponsored by:

CONSERVATION
INTERNATIONAL



Diversity and activity of small carnivores of the Sabangau Peat-swamp Forest, Indonesian Borneo

Susan M. CHEYNE^{1,2}, Simon J. HUSSON², Reychell J. CHADWICK² and David W. MACDONALD¹

Abstract

As part of an ongoing project to identify and assess the distribution and population status of Bornean cats in the Sabangau Peat-swamp forest, Central Kalimantan, Indonesia, data were collected on eight other species of small carnivore as part of the general remit, including the Collared Mongoose *Herpestes semitorquatus*. The activity patterns of small carnivores in Sabangau generally resembled those reported elsewhere, but suggest some behavioural flexibility of the Common Palm Civet *Paradoxurus hermaphroditus*. Of equal interest are the species not sighted despite >6,000 trap-nights including Sunda Stink-badger *Mydaus javanensis*, Masked Palm Civet *Paguma larvata* and Banded Civet *Hemigalus derbyanus*, thus highlighting possible implications for the distributions of these species.

Keywords: activity cycles, camera-trapping, Collared Mongoose, *Herpestes semitorquatus*, species community

Keanekaragaman dan kegiatan karnivora kecil dari Sabangau-rawa Hutan Gambut di Kalimantan,

Indonesia

Abstrak

Sebagai salah satu bagian dari penelitian yang sedang berjalan untuk mengetahui dan menilai distribusi dan status populasi dari kucing hutan Kalimantan di hutan rawa Sebangau, Kalimantan Tengah, Indonesia, maka data telah dikumpulkan untuk delapan spesies karnivora kecil termasuk musang *Herpestes semitorquatus*. Data ditampilkan pada keanekaragaman spesies dan pola aktifitas. Pola aktifitas dari karnivora kecil di Sebangau secara umum serupa dengan aktifitas karnivora yang ada pada habitat lainnya, akan tetapi ada fleksibilitas tingkah laku pada musang *Paradoxurus hermaphroditus*. Perhatian yang sama juga pada juga pada spesies yang jarang tertangkap oleh perangkap malam yang termasuk juga luak *Mydaus javanensis*, musang *Paguma larvata* dan musang *Hemigalus derbyanus*, sehingga perlu ada penekanan untuk implikasi yang mungkin terhadap distribusi dari spesies ini.

Kata-kata kunci: siklus kegiatan, kamera perangkap, Musang (berkerah), *Herpestes semitorquatus*, komunitas spesies

Introduction

Asian tropical forest communities are notable for the high species richness of sympatric mammalian carnivores. The Asian Region supports a total of 80 species in the order Carnivora, and the less-degraded lowland forests support high numbers of species (15–25), especially in sites with extensive closed-canopy forest. Different forest types support up to six cats, six civets (plus *Priodonton*), three mongooses, eight mustelids (including otters), two canids and two bears per site (Corlett 2007). Despite this interesting and valuable species richness, there are few data on many of these carnivores, and the guilds they form.

Borneo was identified as one of seven global priority areas in the 1989 IUCN/SSC Action plan for the conservation of mustelids and viverrids (Schreiber *et al.* 1989) and the important role of Indonesian Peat-swamp Forest as a carbon store and reservoir of floral and faunal diversity is now widely recognised. While tropical peat-swamp forest fires are not new, recent and continuing human disturbances, including water table drainage, deforestation/changes in land use and changes in the El Niño Southern Oscillation weather system, as a result of global warming, have led to increased frequency, incidence and severity of burning (Siegert *et al.* 2001, Harrison *et al.* 2007). This increased burning has serious negative impacts on forest cover (Page 2002, Fuller

et al. 2004), tree mortality (Siegert *et al.* 2001), peat structure/stability, CO₂ release (Page *et al.* 1999), human health (Kunii *et al.* 2002), economy (Varma 2003) and wildlife conservation (Singleton *et al.* 2004). Peatlands are critical for biodiversity conservation and support many specialised species and unique ecosystem types, and can provide a refuge for species that are extirpated from non-peatland areas affected by degradation and climate change (Parish *et al.* 2008). The main threats to such Bornean habitat, and in particular small carnivores, are summarised in Table 1.

Study Site

This study was conducted from the Natural Laboratory for the Study of Peat Swamp Forest (NLPSF), Sabangau catchment, Central Kalimantan, Indonesia (2°19'S, 113°54'E; Fig. 1). The area is peat-swamp forest (Mixed-Swamp Forest sub-type) and was logged under a selective concession system from 1991 to 1997 followed by illegal logging from 1997 to 2004. The site is at an altitude of about 10 m a.s.l. More detailed overviews on the study site can be found in Cheyne *et al.* (2010) and Cheyne & Macdonald (in press).

Methods

A total of 32 cameras was set at permanent locations for the duration of the study (Appendix 1). In addition, 12 roving cameras were in place for 45-day cycles in two additional areas to enlarge

Table 1. Threats to Borneo's forests and small carnivores (based on Cheyne 2010).

Threat	Notes
Oil palm and acacia plantations	Forested land is cleared for plantations
Legal logging	Legal logging is often unsustainable
Illegal logging	Uncontrolled logging in protected (and unprotected areas)
Fire	Fires destroy forest, especially peat-swamp forest, and create palls of smoke that can last for several months and are detrimental to animal health (and to humans).
Habitat fragmentation	Small carnivores might be unable to disperse from small fragments, and inbreeding depression or local extinctions through demographic factors become more likely.
Pet trade	Unknown impact on small carnivores.
Mining	Forest is cleared to expose large areas of land for open-cast mining and oil drilling.
Global warming and climate change	Indirect effects through increased intensity of fires and direct effects through unpredictable food availability.
Clearing forest for urban expansion	Forest habitat is being encroached upon to allow expansion of villages, towns and cities. Status of protected habitat is changed to allow for urban expansion.
Hunting (not for pet trade)	Small carnivores are hunted by local communities for bush meat.
Harvest of non-timber forest products	Small carnivore habitat is encroached upon by people gathering orchids, hunting flying-foxes <i>Pteropus</i> and collecting gemur tree <i>Aleodaphne coriacea</i> (Lauraceae; anti-malarial properties) and agarwood <i>Aquilaria</i> .
Dam development for electricity	Small carnivore habitat is flooded when dams are built.

the surveyed area. All 44 cameras (22 Cuddeback Expert® and 22 Cuddeback Capture IR® Cuddeback Digital, Non-Typical Inc., WI, USA) were placed in pairs about 50–60 cm above ground along established human-made trails (>4 years old) and, where possible, watering areas, to maximise capture rate. The cameras were set to operate during the full 24-hr cycle and no baits or lures were used. Activity times were collated as 06h00–12h00, 12h00–18h00, 18h00–00h00 and 00h00–06h00 to account for average dawn and dusk times in Sabangau, which is situated almost on the equator.

Results

The Orangutan Tropical Peatland Project (OuTrop) and the Wildlife Conservation Research Unit (WildCRU), University of Oxford, UK, initiated the Sabangau Cat Project in May 2008. Until October 2009, we accumulated data from a total of 6,025 trap-nights, giving

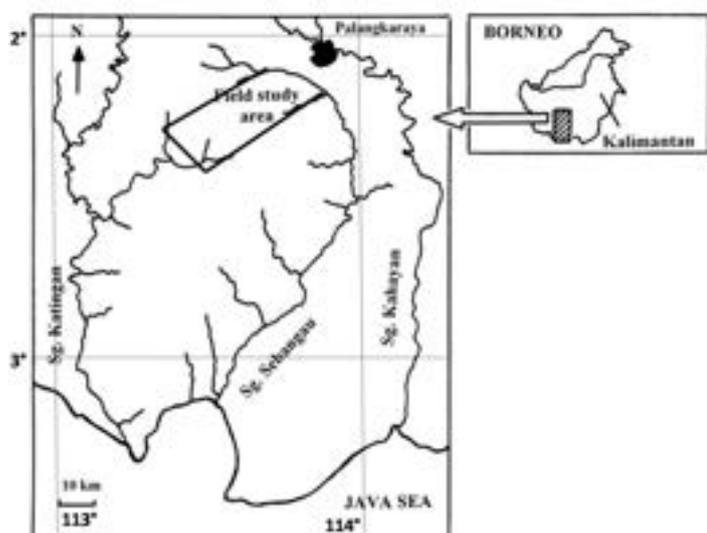


Fig. 1. The study site, in the north-east Sabangau catchment.

845 individual wildlife photos. Species could not be determined in only 1.4% of the photographs (due to poor focus, poor angle or an insufficient proportion of the animal being in the frame).

Small carnivores comprised 53 photographs (6.27% of total wildlife photographs) and represent eight species (Table 2; Appendix 1). All photograph counts given here represent independent events, i.e. sequential photographs of the same animal were not counted. The number of photographs is small, and we carried out cross-checking of identifications with several Indonesian researchers, Santiano, Twentinolosa, Ramadan (Dewa), Yudhi Kuswanto and Adul, and among SMC, RJC and SJH.

Our records indicate a split in active time between species (Fig. 2): Malay Civet was photographed only from dusk to dawn, whereas Short-tailed Mongoose, Collared Mongoose (Table 3) and Yellow-throated Marten were predominantly recorded between dawn and dusk. All four Common Palm Civet records were by day (Table 4). The few records of Banded Linsang (18h23), Otter Civet (21h27 and 02h17) and Small-clawed Otter (08h13 and 16h28) are not included in Fig. 2: there were too few photographs for meaningful comment.

Species sighted but not photographed

Two to three species of small carnivores sighted in Sabangau have not yet been photographed. Binturong *Arctictis binturong* was encountered in the early daylight (before 10h00) in 2008 and a provisional identification of Small-toothed Palm Civet *Arctogalidia trivirgata* was also in the early daylight. The Malay Weasel *Mustela nudipes* was seen during the day once each in 2002 and 2004 by local people in an area where we are now using our camera-traps (Page *et al.* 1997, Duckworth *et al.* 2006, Husson *et al.* 2009).

Discussion

Banded Linsang

That we only once photographed a Banded Linsang (Fig. 3) is consistent with several other studies (Azlan & Lading 2006, Wiltling *et al.* 2010), which failed to find or rarely recorded this spe-

Table 2. Small carnivore species found in Sabangau.

Species	Scientific name	Number of photographs	% of photographs	Number of independent locations where animal photographed	Number of independent events	IUCN Red List 2010 Status
Banded Linsang	<i>Prionodon linsang</i>	1	1.92	1	1	Least Concern
Otter Civet	<i>Cynogale bennettii</i>	2	3.85	2	2	Endangered
Asian Small-clawed Otter	<i>Aonyx cinereus</i>	2	3.85	2	2	Vulnerable
Yellow-throated Marten	<i>Martes flavigula</i>	5	9.62	3	4	Least Concern
Common Palm Civet	<i>Paradoxurus hermaphroditus</i>	5	9.62	3	4	Least Concern
Collared Mongoose	<i>Herpestes semitorquatus</i>	8	15.38	2	6	Data Deficient
Short-tailed Mongoose	<i>Herpestes brachyurus</i>	14	26.92	3	10	Least Concern
Malay Civet	<i>Viverra zibetha</i>	16	30.77	6	10	Least Concern
Total photographs		53		Total events	40	

cies. Several reasons might be responsible why this species appears generally rather rarely on ground-based camera traps: (1) they may be ambush predators, thus do not move around much and therefore have a lower basic probability of being photographed than animals on the move more of the time, and (2) they spend most of their time in thick understorey tangles, and camera traps are (as in the present study) generally placed on more open trails. The fact that they are arboreal may not be that important as they are, apparently, often only a few feet above the ground (J. W. Duckworth *in litt.* 2010). These suggestions are supported by observations of Spotted Linsang *P. pardicolor* summarised in Van Rompaey (1995). The only photo of the Banded Linsang was taken about 1½ hours after dusk, agreeing with other data that this animal is nocturnal (Lim 1973, Azlan 2003).

Otters and Otter Civet

Asian Small-clawed Otter is reported as diurnal (Foster-Turley 1992), and both photos from Sabangau were indeed taken after dawn. The two photos of Otter Civet are both nocturnal, although it is active throughout the day (Veron *et al.* 2006).

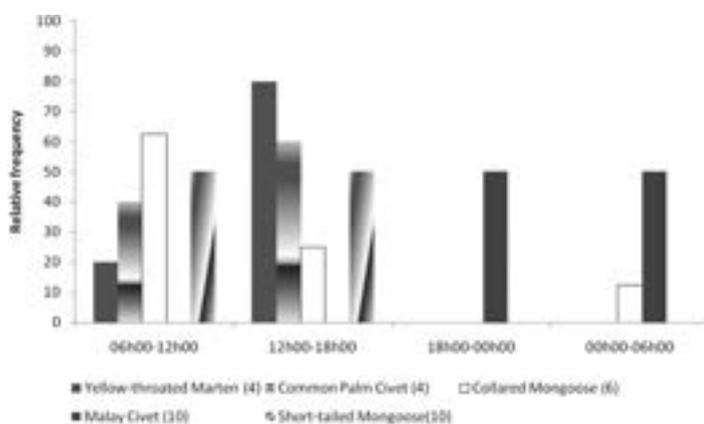


Fig. 2. Active periods of small carnivores (only species with >3 independent events are included).

Malay Civet, Common Palm Civet and Binturong

Our data support the findings from Malaysian Borneo of the Malay Civet as a nocturnal species with activity times in Danum Valley ranging from 18h00 to 07h00 (Macdonald & Wise 1979, Colón 2002). Data from Sulawesi show a significant activity by day (Jennings *et al.* 2006), but Sulawesi has no true diurnal small carnivore species at all, thus offering an explanation for differences in Malay Civet activity patterns between Borneo and Sulawesi. Common Palm Civet seems to be predominantly diurnal in Sabangau (based on the four events), although it is generally regarded as a nocturnal (Dhungel & Edge 1985, Joshi *et al.* 1995, Duckworth 1997, Johnson *et al.* 2009, Wilting *et al.* 2010) or crepuscular species (Azlan 2003). The Sabangau records are all roughly the same time of year (August and September, i.e.

Table 3. Records of Collared Mongoose *Herpestes semitorquatus* at Sabangau.

Month	Time	Number of animals	Number of events
Dec-08	05h13	2	1
Dec-08	08h03	1	1
Dec-08	09h24	1	1
Dec-08	15h51	2	1
Feb-09	15h44	1	1
Mar-09	10h43	1	1
Apr-09	11h50	1	1
May-09	08h05	1	1

Table 4. Records of Common Palm Civet *Paradoxurus hermaphroditus* at Sabangau.

Month	Time	Number of animals	Number of events
Sep-08	08h23	2	1
Sep-08	13h34	1	1
Aug-09	09h45	1	1
Sep-09	10h34	1	1



Fig. 3. Banded Linsang *Prionodon linsang* photographed on 25 October 2009 at an altitude of 11 m a.s.l., about 1.6 km south of the Setia Alam base camp (2°20'S, 113°53'E) and about 2.8 km south of the Sabangau River.

mid to end of the dry season). While they might reflect a change in foraging behaviour due to increased food demands for lactating or pregnancy, this would not explain why there are no records at night (J. W. Duckworth *in litt.* 2010). Why there would be this difference from other sites is unclear for now. Binturongs are likely to have been under-recorded due to the placing of cameras on human-made trails.

Yellow-throated Marten and mongooses

Yellow-throated Marten is primarily diurnal (e.g. Duckworth 1997, Grassman *et al.* 2005), a behaviour pattern which is supported by data from Sabangau. Bornean species of mongoose are also reported as diurnal (Belden *et al.* 2007) with all Sabangau sightings being between 06h00 and 18h00. However Wilting *et al.* (2010) recorded Collared Mongoose mainly around at dawn and dusk, with occasional night records, and Payne *et al.* (1985) considered this species nocturnal and crepuscular. It is possible that the presence of other carnivores in the guild in different areas will affect the activity periods of these species.

Species not found

Several species of Bornean small carnivore were not sighted, photographed, or reported by local people: Hose's Civet *Diplogale hosei* and Bornean Ferret Badger *Melogale everetti* would not be expected based on known distribution and habitat use (see Payne *et al.* 1985, Yasuma 2004, Wells *et al.* 2005, Boonratana 2010, Mathai *et al.* 2010). The lack of records of Sunda Stink-badger *Mydaus javanensis* is interesting as it was one of the most common carnivores photographed in lowland (<250 m a.s.l.) forest in Sabah (Wilting *et al.* 2010) but was not photographed in a similar study in Sarawak (>300 m a.s.l. (Mathai *et al.* 2010). If the data from the present study reflect a genuine absence of this animal in lowland peat forest this lends weight to suggestions that the Stink-badger is highly patchy in its distribution (Mathai *et al.* 2010).

Masked Palm Civet *Paguma larvata* has recently been suggested to be perhaps rarer in lowland Borneo than hitherto assumed (Wilting *et al.* 2010). Despite reasonable effort in this study, it was not found, adding another such lowland site.

The lack of records of Banded Civet *Hemigalus derbyanus* is

particularly important, as this is one of few Globally Threatened (IUCN 2010) small carnivores in South-east Asia. In some areas of Malaysian Borneo it apparently remains common (Mathai *et al.* 2010; Wilting *et al.* 2010) but some other recent studies in its historical geographic range have failed to find it (Holden 2006, Than Zaw *et al.* 2008). IUCN (2010) suggests that this species primarily lives in lowland forest, and it has been reported in peat-swamp forest in Malaysia. Sabangau has been affected by logging and has seasonal flooding, so this may perhaps not be the best habitat, for a species that moves mainly on the ground. Alternatively, Wilting *et al.* (2010) concluded that it is active mainly off trails and so the camera deployment here was probably not particularly well suited to pick it up.

The Small-toothed Palm Civet is nocturnal and arboreal so not susceptible to camera-trapping, and there were no spotlight surveys such as are almost necessary to find this animal (e.g., Belden *et al.* 2007, Wilting *et al.* 2010).

Cameras are placed on human trails, not set in good sites for otters such as by the water's edge, particularly at slides, holts and sprouting sites, so assessing their true status in the site is difficult. Sasaki *et al.* (2009) traced no records of Hairy-nosed Otter *Lutra sumatrana*, globally the rarest of the Bornean species, from Central Kalimantan, and it cannot be speculated whether it occurs at Sabangau.

Concluding remarks

Camera traps are frequently deployed to obtain photos of specific target animals or guilds (in this case, Sunda Clouded Leopard *Neofelis diardi*); thus encounters of animals with differing home-range size or other aspects of natural history may be few. Longer-term camera-trap data increases opportunities for photographing non-target animals, and so enhances biodiversity data for the area. Careful thought about natural history of each potentially 'missing' species, and then actively positioning cameras for them, is probably a better way to maximise species found; but such flexibility is rarely practicable when one or two focal species drive camera-trap deployment.

The NLPSF underwent sustained disturbance up to 2002. All cameras are placed on trails for maximising captures of Clouded Leopards; this may bias against captures of small carnivore species preferring dense undergrowth and avoiding open trails. Ongoing investigations of micro-habitat vegetation characteristics around the camera-trap localities will hopefully identify key habitat parameters which might explain the different species occurrences. Absence of certain species from the photographs, despite >6,000 trap nights, cannot conclusively prove that a species is absent. Conversely, the specialised peat-swamp habitat and the seasonal flooding (8–9 months each year) perhaps limit the number of species present in this habitat. Equally, the drainage of the peat through logging canals and the increasing fire events are causing ongoing and extreme disturbance to the ecology of Sabangau. The impacts of this disturbance on small carnivores are hard to predict, highlighting the need for more long-term studies specifically targeting this poorly studied group of animals. For all these species, bar Malay Civet and Common Palm Civet, the activity data, distribution and coarse abundance data from Borneo are poor, and from Indonesian Borneo are almost non-existent.

Acknowledgements

SMC was funded through a grant to David W. Macdonald from the Kaplan family and by the Clouded Leopard Project. SMC and DWM's work on Bornean cats is part of the WildCRU/Panthera collaboration, and was carried out within the OuTrop-CIMTROP multi-disciplinary research project in the northern Sabangau forest, Central Kalimantan, Indonesia. SMC gratefully thanks the Centre for the International Cooperation in Management of Tropical Peatlands (CIMTROP) for sponsoring her research and providing invaluable logistical support. We gratefully acknowledge the contribution of all the researchers who assisted with the project: Adul, Aman, Ramadhan, Santiano, Twentinolosa, Yudhi Kuswanto and all the OuTrop volunteers. SMC thanks the Indonesian Ministry for Science and Technology for providing research permissions for this work. We thank John Mathai, Andreas Wilting, Jerry Belant and Will Duckworth for comments on earlier drafts of this manuscript, and Oktovianus Kalvin for translation.

References

- Azlan J., M. 2003. The diversity and conservation of mustelids, viverrids, and herpestids in a disturbed forest in Peninsular Malaysia. *Small Carnivore Conservation* 29: 8–9.
- Azlan J., M. & Lading, E. 2006. Camera trapping and conservation in Lambir Hills National Park, Sarawak. *Raffles Bulletin of Zoology* 54: 469–475.
- Belden, G., Stuebing, R. & Nyegang, M. 2007. Small carnivores in mixed-use forest in Bintulu division, Sarawak, Malaysia. *Small Carnivore Conservation* 36: 35–37.
- Boonratana, R. 2010. Sighting of the Bornean Ferret Badger *Melogale everetti* in the Kinabatangan floodplains, and implications of its apparent lowland distribution. *Small Carnivore Conservation* 42: 22–24.
- Cheyne, S. M. 2010. Behavioural ecology and socio-biology of gibbons (*Hylobates albobarbis*) in a degraded peat-swamp forest. Pp. 121–156 in Supriatna, J. & Gursky, S. L. (eds) *Indonesian primates*. Springer, New York, U.S.A.
- Cheyne, S. M. & Macdonald, D. W. in press. Wild felid diversity and activity patterns in Sabangau Peat-Swamp Forest, Indonesian Borneo. *Oryx*.
- Cheyne et al 2010. First Otter Civet photographed in Sabangau Peat-swamp Forest, Indonesian Borneo. *Small Carnivore Conservation* 42: 25–26.
- Colón, C. P. 2002. Ranging behaviour and activity of the Malay Civet (*Viverra zangulunga*) in a logged and an unlogged forest in Danum Valley, East Malaysia. *Journal of Zoology, London* 257: 473–485.
- Corlett, R. T. 2007. What's so special about Asian tropical forests? *Current Science* 93: 1551–1557.
- Dhunge, S. K. & Edge, W. D. 1985. Notes on the natural history of *Paradoxurus hermaphroditus*. *Mammalia* 49: 302–303.
- Duckworth, J. W. 1997. Small carnivores in Laos: a status review with notes on ecology, behaviour and conservation. *Small Carnivore Conservation* 16: 1–21.
- Duckworth, J. W., Lee, B. P. Y.-H., Meijaard, E. & Meiri, S. 2006. The Malay Weasel *Mustela nudipes*: distribution, natural history and a global conservation status review. *Small Carnivore Conservation* 34&35: 2–21.
- Foster-Turley, P. 1992. *Conservation ecology of sympatric Asian otters Aonyx cinerea and Lutra perspicillata*. University of Florida (Ph.D. thesis), Gainesville, U.S.A.
- Fuller, D. O., Jessup, T. C. & Salim, A. 2004. Loss of forest cover in Kalimantan, Indonesia, since the 1997–1998 El Niño. *Conservation Biology* 18: 249–254.
- Grassman, L. I., Jr, Tewes, M. E. & Silvy, N. J. 2005. Ranging, habitat use and activity patterns of Binturong *Arctictis binturong* and Yellow-throated Marten *Martes flavigula* in north-central Thailand. *Wildlife Biology* 11: 49–57.
- Harrison, M. E., Cheyne, S. M., Sulistiyanto, Y. & Rieley, J. O. 2007. Biological effects of smoke from dry-season fires in non-burnt areas of the Sabangau Peat-Swamp Forest, Central Kalimantan, Indonesia. Pp. 107–114 in Rieley, J. O., Banks, C. J. & Radjagukguk, B. (eds) *The International symposium and workshop on tropical peatland “carbon–climate–human interactions – carbon pools, fire, mitigation, restoration and wise use”*, Yogyakarta, Indonesia. EU Carbopeat and Restorpeat Partnership, Gadjah Mada University, Yogyakarta, Indonesia, and University of Leicester, Leicester, U.K.
- Holden, J. 2006. Small carnivores in central Sumatra. *Small Carnivore Conservation* 34: 35–38.
- Husson, S. J., Morrogh-Bernard, H., D'Arcy, L. J. & Cheyne, S. M. 2009. List of mammal species recorded in the Sabangau catchment from 1993–2009. P. 4 in *Orangutan Tropical Peatland Project report*. Orangutan Tropical Peatland Project, Palangka Raya, Indonesia.
- IUCN 2010. *IUCN Red List of Threatened Species*. <www.iucnredlist.org>. Downloaded on 8 February 2010.
- Jennings, A. P., Seymour, A. S. & Dunstone, N. 2006. Ranging behaviour, spatial organization and activity of the Malay Civet (*Viverra zangulunga*) on Buton island, Sulawesi. *Journal of Zoology, London* 268: 63–71.
- Johnson, A., Vongkhamheng, C. & Saithongdam, T. 2009. The diversity, status and conservation of small carnivores in a montane tropical forest in northern Laos. *Oryx* 43: 626–633.
- Joshi, A. R., Smith, J. L. D. & Cuthbert, F. J. 1995. Influence of food distribution and predation pressure on spacing behaviour in palm civets. *Journal of Mammalogy* 76: 1205–1212.
- Kunii, O., Kanagawa, S., Yajima, I., Hisamatsu, Y., Yamamura, S., Amagai, T. & Ismail, I. 2002. The 1997 haze disaster in Indonesia: its air quality and health effects. *Archives of Environmental Health* 57: 16–22.
- Lim B. L. 1973. The Banded Linsang and Banded Musang of West Malaysia. *Malayan Nature Journal* 26: 105–111.
- Macdonald, D. W. & Wise, M. J. 1979. Notes on the behaviour of the Malay Civet, *Viverra zangulunga* Gray. *Sarawak Museum Journal* 27 (48): 295–299.
- Mathai, J., Hon, J., Juat, N., Peter, A. & Gumal, M. 2010. Small carnivores in a logging concession in the Upper Baram, Sarawak, Borneo. *Small Carnivore Conservation* 42: 1–9.
- Page, S. E. 2002. *The biodiversity of peat swamp forest habitats in S.E. Asia: impacts of land-use and environmental change; implications for sustainable ecosystem management*. STRAPEAT Project, Wageningen, Netherlands.
- Page, S. E., Rieley, J. O., Doody, K., Hodgson, S., Husson, S., Jenkins, P., Morrogh-Bernard, H., Otway, S. & Wilshaw, S. 1997. Biodiversity of tropical peat swamp forest: a case study of animal diversity in the Sungai Sebangau catchment of Central Kalimantan, Indonesia. Pp. 231–242 in Rieley, J. O. & Page, S. E. (eds) *Tropical peatlands*. Samara Publishing, Cardigan, U.K.
- Page, S. E., Rieley, J. O., Shtyk, O. W. & Weiss, D. 1999. Interdependence of peat and vegetation in tropical peat swamp forest. *Philosophical Transactions of the Royal Society of London B* 354: 1885–1897.
- Parish, F., Sirin, A., Charman, D., Joosten, H., Minayeva, T., Silvius, M. & Stringer, L. 2008. *Assessment on peatlands, biodiversity and climate change: main report*. Global Environment Centre and Wetlands International, Kuala Lumpur, Malaysia.
- Payne, J., Francis, C. M. & Phillipps, K. 1985. *A field guide to the mam-*

- mals of Borneo*. The Sabah Society, Kota Kinibalu, Malaysia.
- Sasaki, H., Mohd Nor, B. & Kanchanasaka, B. 2009. Past and present distribution of the Hairy-nosed Otter *Lutra sumatrana* Gray 1865. *Mammal Study* 34: 223–229.
- Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives: an action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.
- Siegert, F., Ruecker, G., Hinrichs, A. & Hoffmann, A. A. 2001. Increased damage from fires in logged forests during droughts caused by El Niño. *Nature* 414: 437–440.
- Singleton, I., Wich, S. A., Husson, S., Stephens, S., Utami Atmoko, S., Leighton, M., Rosen, N., Traylor-Holzer, K., Lacy, R. & Byers, O. 2004. *Orang-utan Population and Habitat Viability Analysis*. Orangutan Foundation, Jakarta, Indonesia.
- Than Zaw, Saw Htun, Saw Htoo Tha Po, Myint Maung, Lynam, A. J., Kyaw Thinn Latt & Duckworth, J. W. 2008. Status and distribution of small carnivores in Myanmar. *Small Carnivore Conservation* 38: 2–28.
- Van Rompaey, H. 1995. The Spotted Linsang, *Prionodon pardicolor*. *Small Carnivore Conservation* 13: 10–13.
- Varma, A. 2003. The economics of slash and burn: a case study of the 1997/1998 Indonesian forest fires. *Ecological Economics* 46: 159–171.
- Veron, G., Gaubert, P., Franklin, N., Jennings, A. P. & Grassman, L. I., Jr 2006. A reassessment of the distribution and taxonomy of the Endangered Otter Civet *Cynogale bennettii* (Carnivora: Viverridae) of South-east Asia. *Oryx* 40: 42–49.
- Wells, K., Biun, A. & Gabin, M. 2005. Viverrid and herpestid observations by camera and small mammal cage trapping in the lowland rainforests on Borneo including a record of the Hose's Civet, *Diplogale hosei*. *Small Carnivore Conservation* 32: 12–14.
- Wilting, A., Samejima, H. & Mohamed, A. 2010. Diversity of Bornean viverrids and other small carnivores in Deramakot Forest Reserve, Sabah, Malaysia. *Small Carnivore Conservation* 42: 10–13.
- Yasuma, S. 2004. Observations of a live Hose's Civet *Diplogale hosei*. *Small Carnivore Conservation* 31: 3–5.

**¹Wildlife Conservation Research Unit (WildCRU),
Department of Zoology, University of Oxford, The Recanati-
Kaplan Centre, Tubney House, Abingdon Road, Tubney,
Oxon, OX13 5QL, U.K.**

Email: susan.cheyne@zoo.ox.ac.uk

**²Orang-utan Tropical Peatland Project, Centre for the
International Cooperation in Management of Tropical
Peatlands (CIMTROP), University of Palangka Raya,
Indonesia.**

APPENDIX 1. Positions of cameras and species recorded at each.

Location number	Name of location	Latitude South	Longitude East	Yellow-throated Marten	Common Palm Civet	Malay Civet	Otter Civet	Small clawed Otter	Collard Mongoose	Short-tailed Mongoose	Banded Linsang
1	KM3 x RLWY	2°20'	113°53'	0	0	0	1	0	0	0	0
2	KM2 x RLWY	2°20'	113°54'	0	0	0	0	0	0	0	0
3	T1.6 x TF (Pondok Owa-Owa)	2°20'	113°53'	0	0	1	0	0	0	0	1
4	T2 x TD	2°20'	113°53'	0	0	0	0	0	0	0	0
5	TD x Jelutong Pondok	2°19'	113°53'	0	0	2	1	0	1	0	0
6	Km4 x RLWY	2°21'	113°53'	2	1	2	0	1	0	2	0
7	Km3.8 x RLWY	2°20'	113°46'	0	0	0	0	0	0	2	0
8	T1A x RLWY 1012m	2°19'	113°54'	0	0	0	0	1	0	0	0
9	Old Railway 400m	2°19'	113°55'	0	0	0	0	0	0	0	0
10	Km5 x RLWY	2°21'	113°53'	2	1	7	0	0	7	10	0
11	Tower Path	2°19'	113°54'	1	3	2	0	0	0	0	0
12	T.0 x T.C	2°19'	113°54'	0	0	2	0	0	0	0	0
13	T0 x TD	2°19'	113°54'	0	0	0	0	0	0	0	0
14	T0 x TH	2°19'	113°53'	0	0	0	0	0	0	0	0
15	T0.8 x THH	2°19'	113°53'	0	0	0	0	0	0	0	0
16	T2 x THH	2°20'	113°53'	0	0	0	0	0	0	0	0
17	OR 1150m	2°20'	113°55'	0	0	0	0	0	0	0	0
18	Canal I 200m	2°19'	113°53'	0	0	0	0	0	0	0	0
19	Canal I 1200m	2°19'	113°53'	0	0	0	0	0	0	0	0
20	Forest edge Canal I W	2°19'	113°53'	0	0	0	0	0	0	0	0
21	Interior Canal I SE	2°19'	113°53'	0	0	0	0	0	0	0	0
22	Interior canal I x TJ	2°19'	113°53'	0	0	0	0	0	0	0	0
23	Jelutong TA 0m	2°18'	113°50'	0	0	0	0	0	0	0	0
24	Jelutong TA 1200m	2°19'	113°50'	0	0	0	0	0	0	0	0
25	Jelutong TB 1000m	2°19'	113°51'	0	0	0	0	0	0	0	0
26	Jelutong TC 1000m	2°19'	113°50'	0	0	0	0	0	0	0	0
27	JB Edge	2°19'	113°51'	0	0	0	0	0	0	0	0
28	JC edge	2°18'	113°50'	0	0	0	0	0	0	0	0
29	Secret Transect	2°19'	113°54'	0	0	0	0	0	0	0	0
30	T2xTB	2°20'	113°53'	0	0	0	0	0	0	0	0
31	Otter cam	2°19'	113°51'	0	0	0	0	0	0	0	0
32	Canal Bahan	2°18'	113°52'	0	0	0	0	0	0	0	0

Numbers represent the number of photographs obtained.

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 កាមេរ៉ាវាស្ស៊ីយប្រវត្តិនៅក្នុងតំបន់ ទំនាបព្រៃបោះចុះនៃព្រៃការពារមណ្ឌលភិរិ និង ដែនជំរកសត្វព្រៃភ្នំព្រេច ភាគខាងកើតប្រទេស កម្ពុជា រវាងខែធ្នូ ឆ្នាំ២០០៨ ដល់ ខែមិថុនា ឆ្នាំ ២០១០។ សំពោចធំត្រូវបានថតចំនួន ៤៩ប្រើក្រិការ ពី ២១ទីតាំងនៃកាមេរ៉ាវាស្ស៊ីយប្រវត្តិ ហើយត្រូវបានកត់ត្រាជាប្រភេទ ថតសត្វស៊ីសាច់ជាអាហារ ថ្នាក់តូចជាដើម្បីយា នៅព្រៃបោះចុះ ព្រៃបោះចុះចំរុះ និងព្រៃពាក់កណ្តាលស្រោង។ ព្រៃការពារ មណ្ឌលភិរិ និង តំបន់ការពារ ផ្សេងៗដែលជាប់នឹងព្រៃប្រទល់ព្រៃការពារ អាចតំណាងអោយ តំបន់ដែលផ្តុំផ្សំ ជាសកលដល់ សំពោចធំ ហើយប្រភេទនេះត្រូវតែចាត់ទុកជាប្រភេទដែល ត្រូវបានកំរាមកំហែងជាសកល យ៉ាងខ្លាំងដែលមាននៅតំបន់ទេសភាព។

ពាក្យគន្លឹះ: សំពោច *Viverra*. កាមេរ៉ាវាស្ស៊ីយប្រវត្តិ 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

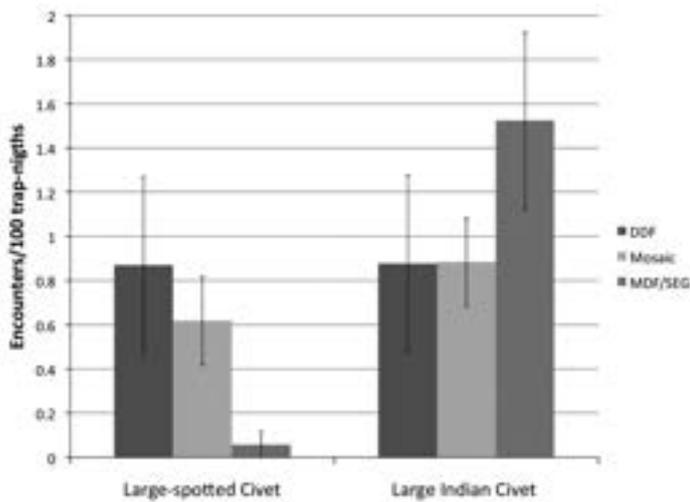


Fig. 2. Camera-trap encounter rates (number of independent photographs per 100 camera-trap-nights; \pm SEM, using per-camera encounter rate as the sample statistic) of Large-spotted *Viverra megaspila* and Large Indian Civets *V. zibetha* from camera-traps located in deciduous dipterocarp forest, mosaic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

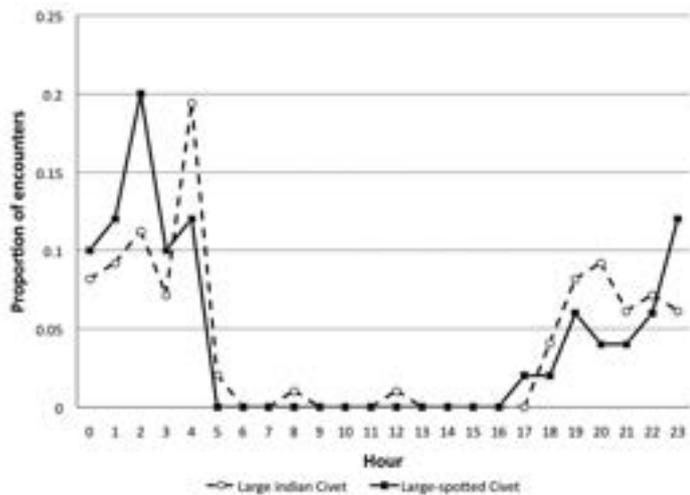


Fig. 3. Activity patterns (percentage of encounters per hour) of Large-spotted *Viverra megaspila* and Large Indian Civets *V. zibetha* from camera-trap data from Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary, eastern Cambodia.

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., Wanghongs, 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 Monduliri 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, Monduliri, 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 Monduliri Protected Forest (MPF) and Phnom Prich Wildlife Sanctuary (PPWS), eastern Cambodia, December 2008 – June 2010.

Observations of civets on Fraser's Hill, Peninsular Malaysia

Celine H. S. LOW

Abstract

Eleven observations of four civet species were made in Fraser's Hill, Peninsular Malaysia, during 2009–2010. Five observations were in or adjacent to the introduced plant *Piper aduncum*.

Keywords: *Arctictis binturong*, *Arctogalidia trivirgata*, *Paguma larvata*, *Paradoxurus hermaphroditus*, *Piper aduncum*, spotlighting

Survei dan pemerhatian musang di Bukit Fraser, Semenanjung Malaysia

Abstrak

Empat spesis musang telah direkod dan diperhati dalam sebelas survei di Bukit Fraser, Semenanjung Malaysia, dalam tempoh 2009–2010. Lima daripada pemerhatian tersebut adalah dalam atau berdekatan dengan pokok *Piper aduncum*, spesis eksotik yang diperkenalkan ke Malaysia.

Kata-kata kunci: *Arctictis binturong*, *Arctogalidia trivirgata*, *Paguma larvata*, *Paradoxurus hermaphroditus*, *Piper aduncum*, tumpuan cahaya dari lampu suluh

Introduction

Peninsular Malaysia is rich in civet species, holding Large Indian Civet *Viverra zibetha*, Large-spotted Civet *V. megaspila*, Malay Civet *V. tangalunga*, Small Indian Civet *Viverricula indica*, Common Palm Civet *Paradoxurus hermaphroditus*, Masked Palm Civet *Paguma larvata*, Binturong *Arctictis binturong*, Small-toothed Palm Civet *Arctogalidia trivirgata*, Banded Civet *Hemigalus derbyanus* and Otter Civet *Cynogale bennettii*, and the superficially similar, although not closely related, Banded Linsang *Prionodon linsang* (Wilson & Mittermeier 2009). All except Large-spotted Civet range up into the hills. All are widespread in tropical Asia (Francis 2008), but for all there is less information than would be desired on current conservation status.

Fraser's Hill (Bukit Fraser), rising to 1,310 m elevation (3°43'N, 101°44'E), in the Peninsular Malaysian states of Pahang and Selangor, is part of the forested Titiwangsa Mountain Range, which extends longitudinally from southern Thailand into Peninsular Malaysia (Strange 2004). The 20,000 km² of the Titiwangsa Range in Peninsular Malaysia is dissected by highways and development, e.g. three major roads (Kawanishi *et al.* 2003). An area of 4,979 hectares around Fraser's Hill is protected (DWNP 2010), but roads, especially those crossing the Range latitudinally, threaten to isolate this forest.

Fraser's Hill is covered and surrounded by submontane primary rainforest, and has cool temperatures of 17°–25°C year round (Strange 2004). The area was developed shortly after 1917 and today has a small town; recently tightened laws on hill development have kept Fraser's Hill relatively free of major new housing developments (Kathirithamby-Wells 2005). Consistent with the sparse resident human population and relatively low tourist traffic, this hill retains many medium-size mammals, among which I have seen Sunda Slow Loris *Nycticebus coucang*, Red and Spotted Giant Flying Squirrels *Petaurista petaurista* and *P. elegans punctata*, Leopard Cat *Prionailurus bengalensis*, Sunda Pangolin *Manis javanica* and White-thighed Langur *Presbytis siamensis*; calls of Siamangs *Symphalangus syndactylus* can be heard every-

day. I have heard of Yellow-throated Martens *Martes flavigula* being seen, and residents have reported seeing Tigers *Panthera tigris* a few times. Fraser's Hill is also a prime bird-watching location.

Fraser's Hill is largely accessed by an 8 km narrow road from The Gap (or Semangko Pass), at 790 m, to the gate near the town centre at 1,165 m (Strange 2004). A new road opened in 2001 was hit with numerous landslides and had to be closed in December 2007. At the time of writing, repair works on the new road are still in progress. The new road is about 3.12 km from the top to the landslide area, with an elevation of about 1,110 m. The road being now used only by vehicles of repair workers and by wildlife watchers, its fringing vegetation has grown closer and denser, and wildlife has become more frequent.

Methods

LED torch lights (rarely, incandescent torches) were used to spot the eyeshine of the animals. Of about 25 hours of spotlighting time at various locations most was from motorcar, some on foot (Table 1). Animals were photographed using zoom or telephoto lens with flash. Sightings without photographs clear enough to confirm the species are not listed in Table 2, excepting the Masked Palm Civet on 1 July 2009, illuminated brightly by motorcar headlights and lights from the Tamil School by which it was feeding.

Results

Eleven observations of four civet species were made (Table 2, Fig. 1). I did not encounter any civets in Fraser's Hill while spotlighting in 2008.

Masked Palm Civet *Paguma larvata* was observed on four dates. The individual seen three times on 24 April 2009 repeatedly avoided spotlights but returned to the fig tree shortly after each retreat. An apparently pregnant animal observed on 9 May 2010 did not appear disturbed by our presence, moving unhurriedly along the slope in and out of vegetation.

Of five observations of Small-toothed Palm Civet *Arcto-*

Table 1. Spotlighting schedule at Fraser's Hill, 2008–2010.

Date	Time	N° hours	Mode of travel	Location	Weather
5 Apr 2008	21h30–23h00	1.5	Motorcar / foot	High Pines Road to Jeriau Waterfall	After rain
7 Apr 2008	21h30–23h30	2	Motorcar / foot	Telecom loop	Foggy
8 Sep 2008	21h30–23h00	1.5	Motorcar / foot	Telecom loop	Clear
24 Apr 2009	00h25–01h00, 23h06, 23h36, 00h24 (25 Apr 2009)	0.6	On foot	High Pines Road	Clear
29 Jun 2009	21h30–00h00	2.5	Motorcar	High Pines Road to Jeriau Waterfall	Clear
30 Jun 2009	23h15–03h00 (1 Jul 2009)	3.75	Motorcar / foot	High Pines Road to New road to Telecom loop	Clear
30 Dec 2009	21h45–00h45 (31 Dec 2009)	3	Motorcar / foot	High Pines Road to New road	Clear
31 Dec 2009	23h00–02h00 (1 Jan 2010)	3	Motorcar / foot	New road	Clear
2 Jan 2010	23h00–23h50	0.8	Motorcar	New road	Wet
9 May 2010	20h30–00h00	3.5	Motorcar / foot	New road	Clear
10 May 2010	20h30–21h00	0.5	Motorcar	New road	Clear
11 May 2010	21h30–00h00	2.5	Motorcar / foot	New road	Clear
	Total hours	25.15			



Fig. 1. Four civet species at Fraser's Hill, (top left) Masked Palm Civet in *Ficus vasculosa*; (bottom left) Small-toothed Palm Civet; (top right) Binturong in *Ficus scortechnii* tree; and (bottom right) Common Palm Civet in *Piper aduncum*.

Table 2. Civets observed on Fraser's Hill, Peninsular Malaysia, 2009–2010.

Species	Date	Time	Description
Masked Palm Civet	24 Apr 2009	23h06, 23h36, 00h24	3–4 m up feeding on figs of <i>Ficus vasculosa</i> (native) at 3°42.970'N, 101°43.936'E
	30 Jun 2009	23h27	50 m above new road in <i>Ficus</i> sp. with ripe orange figs
	1 Jul 2009	02h15–02h30	On ground near new road feeding on boiled rice with curry stain
	9 May 2010	23h13	6 m above new road on concrete slope
Small-toothed Palm Civet	1 Jul 2009	01h52	1.5 m up along new road, near <i>P. aduncum</i>
	9 May 2010	20h47	2 m up along new road eating inflorescence of <i>P. aduncum</i>
	9 May 2010	23h20	8 m up on tree branch along new road
	10 May 2010	20h40	1.5 m up in <i>P. aduncum</i> along new road
	11 May 2010	22h51	1.5 m up in <i>P. aduncum</i> along new road
Binturong	30 Dec 2009	22h34	8 m up in tree with <i>Ficus scortechinii</i> (native climbing fig)
Common Palm Civet	9 May 2010	22h17	2 m up in <i>P. aduncum</i> along new road

All sightings were at ~ 1,110 m, excepting that on 24 April 2009 which was at 1,280 m; 'up' refers to height above ground.



Fig. 2. Small-toothed Palm Civet *Arctogalidia trivirgata* feeding on inflorescence of *Piper aduncum* on Fraser's Hill.

galidia trivirgata, four were in or adjacent to *Piper aduncum* (Piperaceae). On 9 May 2010 at 21h08 I photographed a Small-toothed Palm Civet eating the inflorescence of *P. aduncum* (Fig. 2). It is not possible to tell how many Small-toothed Palm Civets were involved in the observations over 9–11 May 2010: all sightings were within one 3 km stretch of road.

The only Binturong *Arctictis binturong* seen was in a tree with a native climbing fig, *Ficus scortechinii* (Moraceae), with ripe red figs on which it was presumed to be feeding. It did not display any nervousness and calmly watched us while it was photographed by flash.

The single Common Palm Civet *Paradoxurus hermaphroditus* quickly moved from sight after it was first observed.

Discussion

Both Small-toothed and Common Palm Civets were observed in *Piper aduncum*. This shrub or small tree grows to 7 m tall, has a stem diameter over 10 cm, and is native to the West Indies and tropical America. The inflorescence is a leaf-opposed curved spike

on a 12–17 cm peduncle, white to pale yellow and turning green on maturity. The flowers are crowded in regular transverse ranks. The fruit is a one-seeded berry, compressed into greyish, worm-like spikes. The plant is found in rainforest in disturbed areas and along forest margins, and can grow in elevations up to 1,700 m. Although an introduced plant, it provides food and cover for wildlife and is used for re-vegetating disturbed areas (ISSG 2005). Its invasion of Peninsular Malaysia began before July 1957 (Allen 1966, Whitmore 1967, Carrick 1968). Presently, about one third of the new road on Fraser's Hill is lined with *P. aduncum*. On Fraser's Hill, we have also seen many Sunda Slow Lorises in *P. aduncum*, including one eating the inflorescence.

There seem to be rather few recent published records of Small-toothed Palm Civet from Peninsular Malaysia, but this may more reflect the difficulty of finding it by methods other than by spotlighting (Duckworth & Nettelbeck 2007), rather than any real rarity.

Out of the ten species of civets and linsangs likely to occur on Fraser's Hill, I recorded only four. All civets not recorded, although not the Banded Linsang, are largely active on the ground (Francis 2008) and may have moved off before observers came near, whereas those sighted in trees were largely unconcerned by people. Also, chances of encountering Malay Civet (up to 1,100 m), Small Indian Civet (1,200 m), Banded Civet (1,200 m) and Otter Civet (1,200 m) (maximum altitudes from Wilson & Mittermeier 2009) on Fraser's Hill at altitudes where observations were concentrated seem low.

Civets 3–4 m or less from the observers generally moved away and into thicker foliage, perhaps reacting to the spotlights/camera flash or the proximity of observers, or both. Those further away seemed less nervous, like the Small-toothed Palm Civet and Binturong 8 m above ground, perhaps feeling less threatened due to the distance from observers and ground.

The new road seems to give a higher yield of sightings compared with other locations in Fraser's Hill: ten civet observations at the new road in 17.05 spot-lighting hours (once per 1.7 hours), compared with only one civet observation at the other locations in 8.1 hours. Various other locations in Fraser's Hill, like Richmond Road, the old road and the numerous trails, were not investigated on this survey.

Acknowledgements

I thank Chris Shepherd, J. W. Duckworth, Jerry Belant and Anthony Sebastian for their feedback to improve my manuscript. I am grateful to: Kelvin Lim for editorial assistance and access to certain publications; Gary Lim for help with translation; my field companions Vilma D'Rozario, Ng Bee Choo, Marcus Chua, Chan Kwok Wai, Andrew Tay, Gloria Seow and Yeo Suay Hwee; Andrew Tay, Gary Lim, Joseph Lai and Angie Ng for help with plant identification; and Marcus Chua for GPS, altitude and distance readings.

References

- Allen, B. M. 1966. *Piper aduncum* L. in Malaya. *Malayan Nature Journal* 19: 307.
- Carrick, J. 1968. A further note on *Piper aduncum* L. *Malayan Nature Journal* 21: 63.
- Duckworth, J. W. & Nettelbeck, A. R. 2007. Observations of Small-toothed Palm Civets *Arctogalidia trivirgata* in Khao Yai National Park, Thailand, with notes on feeding techniques. *Natural History Bulletin of the Siam Society* 55: 187–192.
- [DWNP] Department of Wildlife and National Parks, Peninsular Malaysia 2010. *List of protected areas managed by DWNP*. http://www.wildlife.gov.my/printed_material/PA/PAlist.pdf. Downloaded on 31 July 2010.

- Francis, C. M. 2008. *A field guide to the mammals of South-east Asia*. New Holland, London, U.K.
- [ISSG] IUCN/SSC Invasive Species Specialist Group 2005. *Global Invasive Species Database*. www.issg.org/database/species/ecology.asp?si=332. Downloaded on 27 June 2010.
- Kathirithamby-Wells, J. 2005. *Nature and nation: forests and development in Peninsular Malaysia*. University of Hawaii Press, Honolulu, U.S.A.
- Kawanishi, K., Siti Hawa Y., Abdul Kadir A. H. & Rahmat T. 2003. Distribution and potential population size of the Tiger in Peninsular Malaysia. *Journal of Wildlife and Parks (Malaysia)* 21: 29–50.
- Strange, M. 2004. *Birds of Fraser's Hill. An illustrated guide and checklist*. Nature's Niche Pte Ltd, Singapore.
- Whitmore, T. C. 1967. *Piper aduncum* in Malaya. *Malayan Nature Journal* 20: 83.
- Wilson, D. E. & Mittermeier, R. A. (eds) 2009. *Handbook of the mammals of the world, vol. 1. Carnivores*. Lynx Edicions, Barcelona, Spain.

**Vertebrate Study Group, Nature Society (Singapore),
510 Geylang Road, #02-05 The Sunflower,
Singapore 398466.
Email: leopardcat@pacific.net.sg**

SUBSCRIBING TO *SMALL CARNIVORE CONSERVATION*

We request all members of the Small Carnivore Specialist Group, all readers, and institutional libraries to subscribe to this bi-annual journal. The subscription for one year (two issues) is USD 40 or EURO 26, excluding bank charges. We also welcome subscriptions for 3 years at the rate of USD 100 and EURO 70. Kindly add USD 5 or EURO 4 or its equivalent for bank charges. Students from developing countries may contact the following directly for special subscription rates:

- Dr. Jerrold L. Belant, Editor-in-Chief, Email: jbelant@cfr.msstate.edu
Dr. Barney Long, Editor, Email: barneylong@boltblue.com
Dr. Divya Mudappa, Editor, Email: divya@ncf-india.org

Subscription payment can be made through our website <www.smallcarnivoreconservation.org> via *PayPal*, bank transfers, or cheques. For bank transfer details please contact one of the persons/email addresses provided above. Cheques made in favour of "NATURE CONSERVATION FOUNDATION" should be mailed to:

- Dr. Divya Mudappa, Editor, *Small Carnivore Conservation*,
Nature Conservation Foundation, 3076/5, 4th Cross, Gokulam Park,
Mysore 570 002, Karnataka, INDIA

When you subscribe, please notify Jerry Belant, Barney Long, and Divya Mudappa over email with details of your cheque or bank transfer.

Recent records of the Javan Small-toothed Palm Civet *Arctogalidia (trivirgata) trilineata*

J. A. EATON¹, R. WÜST², R. WIRTH³, C. R. SHEPHERD⁴, G. SEMIADI⁵, J. HALL⁶
and J. W. DUCKWORTH⁷

Abstract

Small-toothed Palm Civet *Arctogalidia trivirgata* is widespread and often locally common in mainland South-east Asia, Borneo and Sumatra. By contrast the Javan taxon, *A. (t.) trilineata*, was said in 1937 to be among the least-known larger mammals of Java, a description still apt today. Several Javan Small-toothed Palm Civets watched and photographed in a large fig tree at Cikaniki research station, Gunung Halimun National Park, West Java, Indonesia, in 2008–2010 may constitute the first explicit field records of the taxon for decades. Some animals (probably young) were beige-coloured (a form of pelage unknown in congeneric populations outside Java), while even the darker ‘typically pelaged’ animals (presumably adults) differ from Small-toothed Palm Civets elsewhere in pelage colour and pattern. The last taxonomic revision of the genus was in 1952, in an era of broad species inclusion, and a modern investigation would doubtless consider the distinctive Javan form a full species endemic to the island. The paucity of modern records may indicate a small population and/or localised distribution, or it may simply reflect limited published spot-lighting survey information from Java coupled with low interest in the taxon as ‘only’ a subspecies. The civet is one of several endemic crepuscular or nocturnal mammals of uncertain conservation status, reflecting a generally low level of international interest in the island’s threatened mammals. Surveys to assess current status and conservation needs, if any, of the civet are strongly warranted. Identification of the civet by pelage features may need great care, given the similarity in markings of a group of young civets (photographed at a menagerie in Bali) to Javan Small-toothed Palm Civets which were apparently closer to Common Palm Civet *Paradoxurus hermaphroditus* in build and proportions.

Keywords: conservation status, field identification, Gunung Halimun National Park, Indonesia, survey needs, taxonomic uncertainty

Catatan terbaru mengenai musang akar *Arctogalidia (trivirgata) trilineata*

Abstrak

Musang akar *Arctogalidia trivirgata* mempunyai persebaran yang cukup luas dan banyak dijumpai di daratan Asia Tenggara, Borneo dan Sumatera. Namun demikian, untuk anak jenis asal Pulau Jawa *A. (t.) trilineata*, sejak tahun 1937 dinyatakan sebagai salah satu kelompok mamalia P. Jawa yang tidak banyak diketahui. Deskripsi mengenai jenis inipun masih banyak diperdebatkan hingga kini. Beberapa perjumpaan dan hasil foto dari jenis ini dari sekitar stasiun penelitian di Cikaniki, Taman Nasional Gunung Halimun, Jawa Barat, Indonesia, sejak 2008 hingga 2010, merupakan catatan lapang pertama selama dekade terakhir ini. Beberapa individu (kemungkinan umur muda) berwarna coklat keputihan (keadaan warna tidak jelas untuk jenis di luar P. Jawa). Demikian pula dengan individu yang berwarna lebih gelap (kemungkinan dewasa), menunjukkan pola corak bulu dan warna yang berbeda dengan kelompok musang akar lainnya. Revisi terakhir dari taxa ini dilakukan tahun 1952. Di masa kini, dengan penelitian modern, tidak menutup kemungkinan kelompok P. Jawa ini adalah jenis terpisah yang endemik. Kurangnya catatan di era modern ini memungkinkan suatu populasi kecil dan atau persebaran yang terlokalisasi, ditunjang oleh kurangnya perhatian pada takson ini, menjadikan kelompok ini tercatat hanya sebagai anak jenis. Musang merupakan salah satu dari satwa malam dengan status konservasi yang belum jelas. Ini merupakan gambaran dari rendahnya perhatian dunia terhadap mamalia yang terancam. Survey untuk memetakan kondisi populasi dan kebutuhan langkah konservasi, apabila perlu, terhadap musang ini sangat dibutuhkan. Identifikasi musang melalui karakter rambut memerlukan kehati-hatian, mengingat kesamaannya dengan kelompok lain pada umur muda (foto dari Bali), seperti antara musang akar dengan musang luwak Civet *Paradoxurus hermaphroditus*.

Kata kunci: identifikasi lapang, Indonesia, ketidakpastian taksonomi, status konservasi, survey, Taman Nasional Gunung Halimun

Introduction

The Small-toothed Palm Civet *Arctogalidia trivirgata* occurs from north-east India though mainland South-east Asia to the islands of Sumatra, Borneo and Java (Pocock 1939, Schreiber *et al.* 1989, Corbet & Hill 1992). Within this large range, three subspecies-groups are often distinguished (e.g. Corbet & Hill 1992): the northern, *leucotis*, group; the Sundaic, *trivirgata*, group; and the Javan *trilineata* (standing alone from other subspecies). The former two remain widespread and common, even in heavily hunted areas such as Lao PDR, and are not of conservation concern (e.g. Duckworth 1997, Belden *et al.* 2007).

By contrast, the status of *A. (t.) trilineata* is poorly known: Bartels (1937) described it as one of the least observed and collected larger mammals of Java, and this is still apt. Natural history notes were given in Bartels (1937, 1941) and Grey Owl (1942). Schreiber *et al.* (1989) knew of only about two dozen museum specimens of *A. (t.) trilineata* and traced only one record, in 1978, for then-recent decades. Neither the present authors, nor their close correspondents, know of any records since 1978 other than those documented here. Its conservation status might, therefore, be of grave concern, although it may simply be much under-recorded, particularly because as a mere subspecies of a widespread and common species (as it is currently generally treated) the impetus

for observers to document their observations, or search for the animals in the first place, is no doubt much lower than if it were seen as a species endemic to Java. Therefore, the present compilation documents recent records of Small-toothed Palm Civet in Java in a taxonomic and conservation context.

Recent records

Two observers, JAE and JH, independently photographed Small-toothed Palm Civets feeding at a large fruiting fig *Ficus* by the Cikaniki research station, Gunung Halimun National Park (NP), West Java (6°44'48.50"S, 106°32'15.18"E; 1,000 m altitude). JAE visited this area on 15–16 June and 3–4 July 2008, and 20–21 July 2009: he saw palm civets each time, concluding from multiple checks that they were in the tree continually from dusk to dawn on those nights. Maxima in view at one time were four Common Palm Civets *Paradoxurus hermaphroditus* and five Small-toothed Palm Civets. Of the latter, at least three were typical in colour of the genus (Fig. 1), but two were beige in tone (Fig. 2). JH saw at least two beige Small-toothed Palm Civets (Fig. 3) and a Common Palm Civet on the night of 4–5 July 2010 during repeated checks at the tree between dusk and midnight; at least one beige Small-toothed Palm Civet was present the next night. Suyanto (2003: 73) listed Small-toothed Palm Civet for Cikaniki but reference to Yossa *et al.* (1991) suggests that this may have been based solely on local people's reports. Moreover, an earlier account of the area's mammals (Yoneda *et al.* 1998) stated that the species was not camera trapped, seen or found by any other method there, although neither the methods used, nor their coverage and intensity, were fully detailed.

Gunung Halimun NP comprises about 400 km², over 600–1,927 m a.s.l., of largely primary submontane forest and retains a rich mammal fauna including much decreased species such as Javan Gibbon *Hylobates moloch* and the Javan race of Leopard *P. pardus melas* (Suyanto 2003). Cikaniki research station is in the interior of the park. The animals observed by JAE fed by 'fruit-pressing' (see Duckworth & Nettelbeck 2008), squeezing out juice from the fig in the mouth, then dropping the residue.

Van Bemmelen (1952: 39) concluded, from examining 16 Small-toothed Palm Civet skins and mounted specimens from Java, and observing an adult female with two young, that individuals of the Javan taxon darkened with age, "passing from pinkish buff via avellaneous, cinnamon buff, clay colour and buckthorn brown to wood brown". At his time of observations, JAE was unaware of this text, and independently considered that the beige animals were youngsters based on their size and build. The recently photographed animals are not identical in appearance with each other, for example, in colour of the distal half of the tail (compare Fig. 2 with 3). Apparent differences in body pelage colour at Cikaniki (compare Fig. 3 with 2), while perhaps in part reflecting different lighting, and JAE's aging of those animals, are consistent with van Bemmelen's (1952) conclusion that animals darken with age.

CRS saw one live Small-toothed Palm Civet for sale in a Jakarta pet market during trade surveys spread over a few days (recording in total 37 carnivores) in April 2010, but it did not resemble the Javan taxon. In its pelage, particularly its dark head, it was typical of animals on Sumatra and it quite plausibly came from that island; many animals traded in Java come from other islands in Indonesia (Shepherd *et al.* 2004, Shepherd 2006). Further visits by CRS and by B. Yaap and M. Hill in Javan markets in

2010 found no other Small-toothed Palm Civets.

Field identification

With a good view, Small-toothed Palm Civet is so distinctive in head structure and thus facial expression it cannot be confused with any native genus within its range. Similarly, the tail, very long even for a palm civet, and looking tubular and softly woolly, differs from other South-east Asian species. In Java, the only conceivable native confusion species is Common Palm Civet, although the heavy live animal 'pet' trade means that non-native species are sometimes seen at large (e.g. Masked Palm Civet *Paguma larvata*; Brooks & Dutson 1994).

Because their build looks identical to that of typically-pelaged animals, the beige animals are readily identifiable as Small-toothed Palm Civets on some photographs (Figs 2–3). From other angles, identification from a single image is more difficult. For example, the apparent head shape of individuals in some images (Fig. 4) led RWi, JWD and C. P. Groves (*in litt.* 2010) initially to suspect the animals might be Common, not Small-toothed, Palm Civets, until seeing other images of each series. Under good field conditions, there should be no difficulty identifying animals because the features of build should be apparent at most angles, in addition to the very different styles of arboreal motion of the two species (see Duckworth 1997).

Common Palm Civet is so variable in pelage that numerous invalid taxa have been named; Corbet & Hill (1992) listed nearly 40 species-level synonyms of which only a small proportion are likely to represent valid races. This variability suggests that beige-toned Common Palm Civets might occur. In this context is an extraordinary further recent civet record. During March 2010, RWü visited an advertised 'marine turtle conservation facility' at Tanjung Benoa, Bali, Indonesia. This turned out to be a third-class commercial tourist attraction, where visitors can handle Brahminy Kite *Haliastur indus*, Wreathed Hornbill *Aceros undulatus* and pythons *Python*. A dark, locked box, opened only after some insistence, held four subadult palm civets (Fig. 5). The people at Tanjung Benoa had no idea what these animals were, and RWü made no enquiry about their origin; they are likely to have been bought at a street market, with no possibility of determining their origin, even to island.

The identity of these Bali captives is uncertain, even though two clear photographs were taken and three heads in different postures can be seen (in the two images, each animal is in almost the same respective position). The captives do not resemble, in build of either head or tail, typical Small-toothed Palm Civets. The ears seem too close together, including on the animal looking directly at the camera where the appearance should be least distorted by orientation. While their overall facial mien looks also unlike Common Palm Civet to most observers, whether this reflects anything structural, rather than being a side effect of their strange colour, is difficult to judge. They are young animals, which tend to have scrawnier-looking tails than do adults (e.g. Fig. 6): the tails of these animals could be consistent with either genus. An odd head-shape as an effect of age seems less plausible, and is not suggested by young Small-toothed Palm Civets from Borneo and Sumatra (Fig. 6). Moreover, eyes are noticeably larger in adult Small-toothed Palm Civets than in adult Common Palm Civets, and these young Small-toothed Palm Civets from the other Greater Sunda islands have eyes looking of almost tar-

sier *Tarsius*-like size, not at all like the small ‘currants’ of the Bali captives. The photographs of the animals in typical pelage at Gunung Halimun NP do not suggest that there are any differences in head shape between Javan Small-toothed Palm Civets and the other congeneric taxa. In sum, structurally, the Bali captives look more like Common Palm Civets than Small-toothed Palm Civets.

In pelage, the Bali captives fit neither species as typically seen. They are similar in overall tone to the beige Gunung Halimun NP Small-toothed Palm Civets. However, the irregularity of their dark dorsal lines, of which, moreover, there seem to be more than the three typical of Small-toothed Palm Civet, looks more like Common Palm Civets’ typical markings: Small-toothed Palm Civets’ stripes are generally straighter and with distinct edges when the stripe itself is prominent (e.g. Fig. 7). However, other than strongly leucistic animals, Common Palm Civets invariably have a defined pattern of dark fur over much of the face (Fig. 8). The Bali captives show no such markings. Leucism can be expressed patchily over an animal (Fig. 8, animal second from left), so occasional Common Palm Civets might appear with dark marks weak on the head but strong on the back; but this form of pigment abnormality seems unlikely to produce several animals so similar in appearance.

The head markings on the Bali captives resemble those of a Javan Small-toothed Palm Civet mount held at Rijksmuseum voor Natuurlijke Historie (National Museum of Natural History; ‘Naturalis’), Leiden, Netherlands (Fig. 9): in this mount and the lower-right animal in Fig. 5, the pattern of dark and light is very similar, including the small dark smudge anterior to the eye, and the light intrusion up from the side of the head into the dark rear-cap, between its front margin and the ear. The captives’ close similarity in overall colour and precise markings pose a major identification risk to identifying Small-toothed Palm Civets in Java by pelage, on the assumption (based on build) that they are not Javan Small-toothed Palm Civets.

In 2010, CRS saw traders in the Jati Negara market, Jakarta, dying macaques *Macaca*, civets and mongooses *Herpestes* blonde with hydrogen peroxide. Lightened Common Palm Civets were seen shortly afterwards by C. Fumage and B. Yaap (*in litt.* 2010); apparently, their novelty value commands higher prices in the pet trade. This activity cannot account for the appearance of the Bali captives, as it does not eliminate the mask (Fig. 10). It might present an additional problem in field identification of palm civets on Java, especially in markets and in any areas where such animals might escape or be released.

Taxonomic notes

The last taxonomic investigation of *Arctogalidia* was by van Bemmelen (1952). He examined a large proportion of available Sundaic specimens, but gave little consideration to those of northern South-east Asia, for which he relied largely on Pocock (1933, 1939). He employed rarely-used terms for his findings, with his ‘greges’ (singular, ‘grex’) corresponding to subspecies-groups, and ‘gregal forms’ being less distinctive than greges, but not sensibly placed within any grex. He concluded that the genus was monospecific, the single species being divisible into three: the gregal form *A. t. trilineata* was considered to show stronger affinity with grex *A. t. leucotis* than with its geographical neighbour, grex *A. t. trivirgata*. This trifold arrangement was maintained, but using

conventional taxonomic terms, by Corbet & Hill (1992) and each is hereafter referred to as a ‘subspecies-group’ even though *A. t. trilineata* is a race on its own (that is, in a group of one). During his examination, van Bemmelen (1952) was able to remove a considerable amount of the confusion (based upon specimens with incorrectly inferred locations) in previous accounts of the genus.

Despite substantial individual variation within *Arctogalidia* populations (Pocock 1933), van Bemmelen (1952) found consistent morphological differences between the three subspecies-groups. The Indochinese races have thinly furred ears, with large bright pale pink patches on the skin, whereas the non-Javan Sundaic races have densely furred ears with both fur and skin dark. Indochinese animals are also paler, with bolder dark dorsal lines, than are non-Javan Sundaic populations (Fig. 11; also Low 2010; also < <http://www.youtube.com/watch?v=uVIIHbMZMac> > for footage accompanying Wilting *et al.* 2010). Additionally, Indochinese animals have dark head fur confined to the muzzle, whereas on non-Javan Sundaic animals much of the head and usually also the nape are darker than the rest of the dorsum (Corbet & Hill 1992). These differences are readily apparent on field sightings.

Van Bemmelen (1952) wrote that the Javan taxon has ears entirely pale, lacks a pale streak down the muzzle, and often has light markings on the tail, whereas the Indochinese animals (which they generally resemble more than they do those of non-Sundaic Java) mostly have some dark on the ears, lack light tail markings and have a pale streak (often prominent) down the muzzle. Pale tail markings are apparent on some Cikaniki photographs, as is the lack of well-defined muzzle-streak, but there seems to be a diffuse, broad pale area across the rostrum (Fig. 12). In contrast to van Bemmelen’s (1952) statements, the ears on the Javan animals are largely dark, being pale only on the inside basal third of the pinna (Fig. 4b).

Two common loud calls given by the genus each differ somewhat between Bornean and Lao animals, although are recognisably homologous (Duckworth 1997). Bartels (1937) assumed that a long ‘miauing’ cry, usually repeated after short pauses, was from the Javan taxon. When a female of a pair he observed fell off a branch into low vegetation the male called to it with alternating quiet roars and high pitch calls. How these relate to calls transcribed for the genus elsewhere is not clear.

Van Bemmelen’s (1952) conclusion that the genus is monospecific should be taken in the general taxonomic thinking of the time: a “regrettable trend from about 1920 to 1980, when specific recognition was excessively restrained” (Brandon-Jones *et al.* 2004: 98). Under a phylogenetic species concept, all of van Bemmelen’s (1952) three main divisions (at minimum) constitute species (compare to, e.g., Groves 2007). Biological species concepts are fundamentally untestable with populations inhabiting different islands, as for the Javan taxon of *Arctogalidia* relative to its congeners. However, modern applications of biological species concepts are forced to consider some similar-looking taxa non-conspecific because they are sympatric and do not interbreed, so must be separate species under any concept (Tobias *et al.* 2010). Therefore, species as defined under modern revisions using biological species concepts are often less inclusive than in the mid-20th century. Such a revision would very probably consider van Bemmelen’s two greges and one gregal form as three separate species. This is particularly so given that the pelage differences between populations presented by van Bemmelen (1952) seem also to be accompanied by change in general pelage colour with age for the Javan form, but

not in the races outside Java. Van Bemmél's (1952) own investigations found no suspicion of comparable changes in the other Sundaic taxa, nor do modern observations suggest any (e.g. Fig. 6), and they have never been proposed to occur in the Indochinese taxa. Few modern taxonomic reanalyses of small carnivores have specified the species concepts under which their conclusions are drawn, making it difficult to compare the variation evident within *Arctogalidia* to that in other animals with perhaps similar levels of divergence (e.g. *Eupleres*; Goodman & Helgen 2010)

Speculations on conservation status

The Gunung Halimun NP records prove that *A. (t.) trilineata* survives. The lack of other recent records does not prove that it is rare: both the *leucotis* and *trivirgata* subspecies-groups are strictly arboreal and are therefore only very rarely camera-trapped, and because they are almost as strictly nocturnal, the only practicable technique by which to survey them is spotlighting. Otherwise, surveys are reliant on chance records of animals in hunters' bags, camps and houses, or, more demanding, baited live-trapping (e.g. Borissenko *et al.* 2004, Wells *et al.* 2005, Duckworth & Nettelbeck 2008, Wilting *et al.* 2010). Spotlighting may speedily prove the genus very common; for example, Belden *et al.* (2007) never detected Small-toothed Palm Civet in extensive camera-trapping and sign surveys in one area of Sarawak, but spotlighting there found ten individuals in two hours.

Few spotlighting data from Java seem to have been published. JAE has never seen Javan Small-toothed Palm Civet away from the particular fig at Cikaniki, despite spotlighting at Gunung Halimun NP (totalling about 20 hrs), Gunung Gede NP (about 70 hrs) and Carita (about 20 hrs) and observing many Common Palm Civets (30 or more), Javan Ferret Badgers *Melogale orientalis* (at least 40; only at Gunung Gede) and Red Giant Flying Squirrels *Petaurista petaurista* (at least 20), as well as several other mammal species less frequently.

At least some non-Javan races survive in both degraded and fragmented landscapes: for example a Small-toothed Palm Civet was observed by CRS on 10 February 2007 in Bukit Kiara Recreational Park, Kuala Lumpur, Malaysia (3°08'31"N, 101°38'01"E). This suburban area was a rubber estate until its 1980 establishment as a park, and today consists of overgrown rubber plantation and secondary forest, much used by joggers and cyclists. It is inconceivable that this animal could be an escaped captive, given that palm civets are so rare as pets in West Malaysia (CRS pers. obs.). Harrison (1968) also noted this species in rubber plantations in Selangor, Peninsular Malaysia, and in cocoa plantations in Sabah, Malaysia, although the latter were adjacent to primary forests and it is unknown if observations were of animals sedentary in the plantation or merely on foraging excursions. Van Bemmél (1952: 23) noted that populations persisted on "small islands with no or little maiden-forest". If the Javan taxon be similarly adaptable, then it might well remain fairly common. However, there is presently no reason to assume that the Javan taxon uses habitat as does its congeners and, for example, the ecological distribution of ferret badgers *Melogale* differs greatly between Borneo and elsewhere in South-east Asia (Schreiber *et al.* 1989).

All records of Javan Small-toothed Palm Civet traced by van Bemmél (1952) and Schreiber *et al.* (1989) were from West Java. Gunung Halimun NP is in the same province, but with so few records overall of the taxon, its range may be much underesti-

ated. Schreiber *et al.* (1989: 36) stated that it "is restricted to primary forests far from human settlements", but this statement also appears in Lekagul & McNeely (1977: 582) for Thailand (for where it is misleading; Duckworth & Nettelbeck 2008) and its applicability to the Javan taxon is unknown. The altitudinal range able to support the species is not known, although the regular occurrence at Cikaniki suggests that it is not dependent on lowland forests: in west Java, these are limited and highly fragmented (Schreiber *et al.* 1989). Species of mid altitudes have, on habitat grounds, better survival prospects.

In Indonesia, Small-toothed Palm Civet is Totally Protected, although relatively small numbers are traded (Shepherd 2008).

Conclusions and recommendations

Javan Small-toothed Palm Civet is one of several medium-large mammals on Java with few recent (and in some cases, historical) records and/or of clear conservation concern. As well as the extinction of the Javan population of Tiger *Panthera (tigris) sondaica* (Mazák & Groves 2006) and the remnant population of Lesser One-horned Rhinoceros *Rhinoceros sondaicus*, perhaps the only population left in the world (Hoogerwerf 1970, WWF Vietnam 2010), the endemic Javan race of Leopard is highly threatened (Santiapillai & Ramono 1992, Gippoliti & Meijaard 2007); the conservation status of the endemic Javan Slow Loris *Nycticebus javanicus* is almost unknown (Nekaris *et al.* 2008); the endemic Javan Chevrotain *Tragulus javanicus (sensu stricto)*, as defined by Meijaard & Groves 2004) is very little recorded recently and may be in steep decline (Meijaard in press); the Javan Warty Pig *Sus verrucosus* faces a high risk of extinction (Semiadi & Meijaard 2006); and Javan Rusa *Cervus timorensis*, until recently considered stable in population, declined steeply during the 2000s (S. Hedges *in litt.* 2008). Among other small carnivores, the Indonesian Mountain Weasel *Mustela lutreolina*, endemic to Java and Sumatra, remains known by fewer than two dozen specimens (Meiri *et al.* 2007 and references therein); the Javan Ferret Badger, endemic to Java and Bali, requires conservation status clarification but on information available (Duckworth *et al.* 2008) may not be seriously threatened; and the Javan race of Yellow-throated Marten *Martes flavigula robinsoni* is not well known (Schreiber *et al.* 1989), but does occur at Gunung Halimun NP (it was observed on about half of JAE's eight visits to date) and Gunung Gede (JAE). These taxa, in combination with the palm civet, propelled Java to the third most important global priority area for mustelid and viverrid (*sensu* conventional 1980s taxonomic thinking) conservation (Schreiber *et al.* 1989).

Java supports one of the densest human populations over an area of such size, and therefore warrants more serious international conservation attention than it has recently had. This oversight is perhaps because it now lacks mega-charismatic species like Tiger and Asian Elephant *Elephas maximus* (extinct on the island for several hundred years; Cranbrook *et al.* 2007), or large tracts of virgin evergreen forest. The most important action specifically for Javan Small-toothed Palm Civet, and moreover one that could be undertaken with relative ease, is to search for it. This recommendation was made by Schreiber *et al.* (1989) but has not been implemented.

The locations most important to search cannot sensibly be defined, because the historical records come from various altitudes and sites. The latter are all from West Java, making this a

sensible starting area. Hoogerwerf (1970: 414) wrote that "...it was only observed once for certain in Ujung Kulon, viz. on 18 July 1939; in the late afternoon two were seen on a forest path near the Tjikorang; they moved slowly away on the author's approach...". Such behaviour would be extraordinary in the other taxa of this arboreal, nocturnal, genus, and it should not be seen as typical of the Javan taxon without corroboration. Otherwise, the limited information available suggests that *A. (t.) trilineata* is as arboreal and nocturnal as are the populations elsewhere in the genus's range (van Bemmelen 1952; recent observations). Therefore, spotlight surveys would speedily inform whether the taxon is any sort of conservation priority (and would also give information on the loris and chevrotain). At least in Lao PDR, detection rates seem to vary with season, being higher in the hot season, partly because at that time of year Small-toothed Palm Civets frequently give characteristic loud calls, but also apparently reflecting higher general activity then (Duckworth 1997). There seems to be no information about possible such seasonality in Java, so if early spotlighting surveys fail to find the species, as well as seeking it at further sites, attempts at other times of year may be important. More intensive trade surveys could provide useful indications, but establishing origins of animals would be difficult, and interpreting numbers found would be no more easy. For an arboreal nocturnal species, a lack or rarity of trade records might reflect limited use of hunting techniques suitable to catch it alive, a genuine rarity of the animal, or some combination. Hence, field searches are essential.

One innovative method of detecting the animal could be examination of alimentary tracts of large snakes in the reptile skin trade industry on Java, which is large (R. Melisch *in litt.* 2010). Small-toothed Palm Civets have been found in the tracts of harvested Reticulated Pythons *Python reticulatus* in Sumatra (Shine *et al.* 1999) and although that study found them only rarely (two of 163 identified prey items), liaison with any investigations of large-snake diet in Java could result in records.

The identification of Small-toothed Palm Civet in Java requires great care and, unless it be documented to be widespread and at least reasonably common, records should be published making explicit the basis for identification.

The urgency for a detailed investigation of intrageneric taxonomy of *Arctogalidia* is, as with so much else concerning the Javan taxon, unclear. If *A. (t.) trilineata* be a taxon of conservation concern, then a misleading treatment as a mere subspecies will handicap conservation efforts on its behalf. However, if it be simply much overlooked, then given the various other impending mammalian conservation crises on Java urgently needing better information for effective conservation interventions, taxonomic investigation would be of low priority.

Acknowledgements

We thank the Mammal Section, Natural History Museum, London; Museum Zoologicum Bogoriense, Cibinong, Bogor, Indonesia; and the Rijksmuseum voor Natuurlijke Historie (National Museum of Natural History; 'Naturalis'), Leiden, Netherlands for access to specimens. We thank Betsy Yaap, Dave Ware, Joe Walston, Géraldine Veron, Louise Tomsett, Alexander Sliwa, Klaus Rudloff, Johannes Pfeleiderer, Belden Gimán Neilson, Jonathan Murray, Roland Melisch, Erik Meijaard, James F. Maxwell, John Mathai, Jonas Livet (<http://www.leszoosdanslemonde.com>), Andy Jennings, Madeline Hill, Colin Groves, Lon Grassman Jr, Craig Furnage, Neil Franklin, Nick Brickley, Thiemo Braasch and Jerry Belant for advice

and assistance, including permitting the use of photographs.

References

- Bartels, M., Jr 1937. Zur Kenntnis der Verbreitung und der Lebensweise Javanische Säugetiere. *Treubia* 16: 149–164.
- Bartels, M., Jr 1941. Iets over de "Loewaks" en verwante kleine roofdieren van Java. *Nederlandsch-Indische Jager* (Maandblad von het Nederlandsch-Indisch Jagersgenootschap, Batavia) 11: 172–176.
- Belden, G., Stuebing, R., & Nyegang, M. 2007. Small carnivores in mixed-use forest in Bintulu division, Sarawak, Malaysia. *Small Carnivore Conservation* 36: 35–37.
- Borissenko, A. V., Ivanova, N. V. & Polet, G. 2004. First recent record of the Small-toothed Palm Civet *Arctogalidia trivirgata* from Vietnam. *Small Carnivore Conservation* 30: 5–6.
- Brandon-Jones, D., Eudey, A. A., Geissmann, T., Groves, C. P., Melnick, D. J., Morales, J. C., Shekelle, M. & Stewart, C.-B. 2004. Asian primate classification. *International Journal of Primatology* 25: 97–164.
- Brooks, T. M. & Dutson, G. C. L. 1994. A sighting of a Masked Palm Civet (*Paguma larvata*) on Java. *Small Carnivore Conservation* 11: 19.
- Corbet, G. B. & Hill, J. E. 1992. *The mammals of the Indomalayan region*. Natural History Museum Publications and Oxford University Press, Oxford, U.K.
- Cranbrook, Earl of, Payne, J. & Leh, C. M. U. 2007. Origin of the Elephants *Elephas maximus* L. of Borneo. *Sarawak Museum Journal* 63 (N.S. 84): 95–125.
- Duckworth, J. W. 1997. Small carnivores in Laos: a status review with notes on ecology, behaviour and conservation. *Small Carnivore Conservation* 16: 1–21.
- Duckworth, J. W. & Nettelbeck, A. R. 2008. Observations of Small-toothed Palm Civets *Arctogalidia trivirgata* in Khao Yai National Park, Thailand, with notes on feeding technique. *Natural History Bulletin of the Siam Society* 55: 187–192.
- Duckworth, J. W., Robertson, S. I. & Brickley, N. W. 2008. Further notes on Javan Ferret Badger *Melogale orientalis* at Gunung Gede Pangrango National Park, Java. *Small Carnivore Conservation* 39: 39–40.
- Gippoliti, S. & Meijaard, E. 2007. Taxonomic uniqueness of the Javan Leopard; an opportunity for zoos to save it. *Contributions to Zoology* 76: 55–58.
- Goodman, S. M. & Helgen, K. M. 2010. Species limits and distribution of the Malagasy carnivoran genus *Eupleres* (Family Eupleridae). *Mammalia* 74: 177–185.
- 'Grey Owl' 1942. Loewaks. *Nederlandsch-Indische Jager* (Maandblad von het Nederlandsch-Indisch Jagersgenootschap, Batavia) 12: 19.
- Groves, C. 2007. On some weasels *Mustela* from eastern Asia. *Small Carnivore Conservation* 37: 21–25.
- Harrison, J. L. 1968. The effect of forest clearance on small mammals. Pp. 153–158 in Talbot, L. M. & Talbot, M. H. (eds) *Conservation in tropical South East Asia. Proceedings of the conference on conservation of nature and natural resources in tropical South East Asia. Bangkok, Thailand*. IUCN, Morges, Switzerland (Publications new series, n° 10).
- Hoogerwerf, A. 1970. *Ujung Kulon, the land of the last Javan Rhinoceros*. E. J. Brill, Leiden, Netherlands.
- Lekagul, B. & McNeely, J. A. 1977. *Mammals of Thailand*. Association for the Conservation of Wildlife, Bangkok, Thailand (revised 1988 printing).
- Low, C. H. S. 2010. Observations of civets on Fraser's Hill, Peninsular Malaysia. *Small Carnivore Conservation* 43 [Divya: please fill in

- page numbers]]].
- Mazák, J. H. & Groves, C. P. 2006. A taxonomic revision of the Tigers (*Panthera tigris*) of Southeast Asia. *Zeitschrift für Säugetierkunde* 71: 268–287.
- Meijaard, E. in press. Family Tragulidae (chevrotains). In Wilson, D. E. & Mittermeier, R. A. (eds) *Handbook of the mammals of the world*, vol. 2. Lynx Edicions, Barcelona, Spain.
- Meijaard, E. & Groves, C. P. 2004. A taxonomic revision of the *Tragulus* mouse-deer (Artiodactyla). *Zoological Journal of the Linnean Society* 140: 63–102.
- Meiri, S., Duckworth, J. W. & Meijaard, E. 2007. Biogeography of Indonesian Mountain Weasel *Mustela lutreolina* and a newly discovered specimen. *Small Carnivore Conservation* 37: 1–5.
- Nekaris, K. A. I., Blackham, G. V. & Nijman, V. 2008. Conservation implications of low encounter rates of five nocturnal primate species (*Nycticebus* spp.) in Asia. *Biodiversity and Conservation* 17: 733–747.
- Pocock, R. I. 1933. The rarer genera of Oriental Viverridae. *Proceedings of the Zoological Society of London* '1933': 969–1035.
- Pocock, R. I. 1939. *The fauna of British India, including Ceylon and Burma. Mammalia*, 2nd ed., vol. I. Taylor & Francis, London, U.K.
- Santiapillai, C. & Ramono, W. S. 1992. Status of the Leopard (*Panthera pardus*) in Java, Indonesia. *Tigerpaper* 19(2): 1–5.
- Schreiber, A., Wirth, R., Riffel, M., & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives: an action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.
- Semiadi, G. & Meijaard, E. 2006. Declining populations of the Javan Warty Pig (*Sus verrucosus*). *Oryx* 40: 50–56.
- Shepherd, C. R. 2006. The bird trade in Medan, north Sumatra: an overview. *Birding Asia* 5: 16–24.
- Shepherd, C. R. 2008. Civets in trade in Medan, North Sumatra, Indonesia (1997–2001) with notes on legal protection. *Small Carnivore Conservation* 38: 34–36.
- Shepherd, C. R., Sukumaran, J. & Wich, S. A. 2004. *Open season: an analysis of the pet trade in Medan, Sumatra, 1997–2001*. TRAFFIC Southeast Asia, Petaling Jaya, Selangor, Malaysia.
- Shine, R., Ambaryanto, Harlow, P. S. & Mumpuni 1999. Reticulated Pythons in Sumatra: biology, harvesting and sustainability. *Biological Conservation* 87: 349–357.
- Suyanto, A. 2003. *Mammals of Gunung Halimun National Park, West Java*. Puslit Biologi, LIPI, Bogor, Indonesia.
- Tobias, J. A., Seddon, N., Spottiswoode C. N., Pilgrim, J. D., Fishpool, L. D. C. & Collar, N. J. 2010. Quantitative criteria for species delimitation. *Ibis* 152: 724–726.
- van Bommel, A. C. V. 1952. Contribution to the knowledge of the genera *Muntiacus* and *Arctogalidia* in the Indo-Australian archipelago (Mammalia, Cervidae & Viverridae). *Beaufortia* 2 (16): 1–50.
- Wells, K., Bium, A. & Gabin, M. 2005. Viverrid and herpestid observations by camera and small mammal cage trapping in the lowland rainforests on Borneo including a record of the Hose's Civet, *Diplogale hosei*. *Small Carnivore Conservation* 32: 12–14.
- Wiltling, A., Samejima, H. & Mohamed, A. 2010. Diversity of Bornean viverrids and other small carnivores in Deramakot Forest Reserve, Sabah, Malaysia. *Small Carnivore Conservation* 42: 10–13.
- WWF Vietnam 2010. Rarest of the rare: Javan Rhinoceros *Rhinoceros sondaicus annamiticus*: rare Javan Rhino death in Cat Tien National Park, Vietnam. *Babbler (Birdlife International in Indochina)* 34: 32–33.
- Yoneda, M., Ladjar, L. N. & Sakaguchi, N. 1998. Camera trap study in Cikaniki, Gunung Halimun National Park. Pp. 96–104 in Simbolon, H., Yoneda, M. & Sugardjito, J. (eds) *Gunung Halimun: the last submontane tropical forest in West Java*. Research and Conservation of Biodiversity in Indonesia, vol IV. LIPI–JICA–PHPA Biodiversity Conservation Project in Indonesia, Bogor, Indonesia.
- Yossa, I., Navy, P., Dolly, P., Yudha, N., Azwar & Yosias, M. 1991. Survey of the carnivores of Gunung Halimun Nature Reserve, Java. *Mustelid & Viverrid Conservation* 5: 3.
- 17 Keats Avenue, Littleover, Derby, DE23 4EE, United Kingdom.**
Email: jameseaton@birdtourasia.com
- 2ZGAP-FbP, Faberstr. 4, D-70188, Stuttgart, Germany.**
Email: rene.wuest@zgap.de
- 3Zoologische Gesellschaft für Arten- und Populationsschutz, Untertaxetweg 144, 82131 Gauting, Germany.**
Email: roland.wirth@zgap.de
- 4Puslit Biologi LIPI, Jl. Raya Jakarta-Bogor Km. 46, Cibinong 16911, Jawa Barat, Indonesia.**
Email: semiadi@gmail.com
- 5TRAFFIC Southeast Asia, Unit 3-2, 1st Floor, Jalan SS23/11, Taman SEA, 47400 Petaling Jaya, Selangor, Malaysia.**
Email: cstsea@po.jaring.my
- 62 rue André Pascal, Paris, France 75775.**
Email: jonhall1@gmail.com
- 73 Camerton Close, Saltford, Bristol BS31 3BT, UK.**
Email: willduckworthdprk@yahoo.com

Figures (on back cover)

Fig. 1. Adult Javan Small-toothed Palm Civet *Arctogalidia (trivirgata) trilineata*, Cikaniki Research Station, Gunung Halimun National Park, Java, 2 July 2008 (Photot: J. A. Eaton).

Fig. 2. Beige-coloured, presumed young, Javan Small-toothed Palm Civet *Arctogalidia (trivirgata) trilineata*, Cikaniki Research Station, Gunung Halimun National Park, Java, 16 June 2008 (Photo: J. A. Eaton).

Fig. 3. Beige-coloured, presumed young, Javan Small-toothed Palm Civets *Arctogalidia (trivirgata) trilineata*, Cikaniki Research Station, Gunung Halimun National Park, Java, (a) 5 July 2010, (b) 4 July 2010 (Photos: J. Hall).

Fig. 4. Beige-coloured, presumed young, Javan Small-toothed Palm Civets *Arctogalidia (trivirgata) trilineata*, Cikaniki Research Station, Gunung Halimun National Park, Java, (a) 4 July 2010 (Photo: J. Hall), (b) 16 June 2008 (Photo: J. A. Eaton). Note the dark pinnae except for the proximal interior, which is pink. At the angle of viewing of Fig.4a, the head structure is less obviously that of Small-toothed Palm Civet.

Fig. 5. Unidentified captive palm civets, Tanjung Benoa, Bali, March 2010 (Photo: R. Wüst).

Fig. 6. Small-toothed Palm Civets *Arctogalidia trivirgata*, showing structure of young animals in Borneo and Sumatra. (a) RT Setimbo, West Kalimantan (kept behind a village house

as a pet; caught locally), 25 October 2008 (Photo: B. Yaap); (b) Binyo-Penyilam Conservation Area, Bintulu, Sarawak, Malaysia, 2006 (Photo: Rose Ragai / Sarawak Planted Forests); (c) Bukit Tigapuluh forest block, border of Riau and Jambi provinces, Sumatra, October 2004 (Photo: N. Franklin, Sumatran Tiger Conservation Program).

Fig. 7. Javan Small-toothed Palm Civets *Arctogalidia (trivirgata) trilineata* in Museum Zoologicum Bogoriense, Cibinong, Bogor, Indonesia. Upper: MZB 7113 from Gamboeng, Pengalengan, Preanger, West Java, May 1912 (collector T. H. Kerkoeen; Photo: G. Semiadi).

Fig. 8. Common Palm Civets *Paradoxurus hermaphroditus*, Natural History Museum, London, UK, showing remarkable variation but presence of dark face-mask in all but the albino. Left to right: BMNH 58.5.4.1, origin unknown (via Zoological Society of London); BMNH 98.8.25.1 from Kondmals, Orissa, India, nineteenth century (Collector J. Taylor); BMNH 10.4.6.41 from Kangean island, Java Sea, 20 November 1909 (Collector: G. C. Shortridge); BMNH 81.12.2.3 from Kyeikpadein, lower Pegu, Myanmar, 25 August 1879 (Collector: E. Oates; Photo: J. W.

Duckworth, © Natural History Museum).

Fig. 9. Javan Small-toothed Palm Civet *Arctogalidia (trivirgata) trilineata*, Rijksmuseum voor Natuurlijke Historie, Leiden (Photo: R. Wirth).

Fig. 10. Common Palm Civet *Paradoxurus hermaphroditus*, bleached with hydrogen peroxide, Pramuka markets, Java, 19 June 2010 (Photo: C. Furrage).

Fig. 11. Small-toothed Palm Civets *Arctogalidia trivirgata* from (a) Phu Khieo Wildlife Sanctuary, Thailand (16° 22'17.26"N, 101°35'19.91"E; 900 m asl), representative of the leucotis subspecies-group (17 March 2002; Photo: L. Grassman); and (b) Murud Kecil, upper Baram drainage, Sarawak, Malaysia (3°23'N, 115°13'E), representative of the *trivirgata* subspecies-group (15 June 2004; Photo: WCS Malaysia).

Fig. 12. Javan Small-toothed Palm Civets *Arctogalidia (trivirgata) trilineata*, Cikaniki Research Station, Gunung Halimun National Park, Java; presumed adult, 2 July 2008 (Photo: J. A. Eaton).

New records of the Nilgiri Marten *Martes gwatkinsii* in Western Ghats, India

Y. Chaitanya KRISHNA¹ and Divya KARNAD²

Abstract

The Nilgiri Marten *Martes gwatkinsii* is a rare and little known species endemic to the Western Ghats mountain range of Southern India. Information about its distribution and occurrence is largely lacking. This paper collates information about Nilgiri Marten presence in the Palni Hills in Tamil Nadu state and presents new records of Nilgiri Marten occurrence from Karnataka state as part of a compilation of opportunistic sightings of this species throughout the Western Ghats.

Keywords: Bisale Reserve Forest, endemic, distribution, Mustelidae, Palni hills

ಭಾರತದ ಪಶ್ಚಿಮ ಘಟ್ಟಗಳಿಂದ ನೀಲಗಿರಿ ಮಾಟೀನ್ಸ್ *Martes gwatkinsii* ಬಗೆಗಿನ ಹೊಸ ಮಾಹಿತಿ.

ನೀಲಗಿರಿ ಮಾಟೀನ್ಸ್ *Martes gwatkinsii* ಅಥವಾ ಮರನಾಯಿ, ಒಂದು ಬಹಳ ಅಪರೂಪವಾದ ಹಾಗೂ ಅಪ್ಪೊಂದು ಪರಿಚಿತವಲ್ಲದ ದಕ್ಷಿಣ ಭಾರತದ ಪಶ್ಚಿಮ ಘಟ್ಟಗಳ ಕಾಡುಗಳಿಗಷ್ಟೇ ಸೀಮಿತವಾಗಿರುವಂತಹ ಪ್ರಾಣಿ. ಈ ಸಸ್ತನಿಯ ಭೌಗೋಳಿಕ ವ್ಯಾಪ್ತಿ ಹಾಗೂ ಆವಾಸ ಸ್ಥಾನದ ಬಗ್ಗೆ ದೊರೆಯುವಂತಹ ಮಾಹಿತಿಯು ಬಹಳ ಕಡಿಮೆ. ಮರನಾಯಿಯ ವಾಸ್ತವ್ಯದ ಬಗ್ಗೆ ತಿಳಿಯುವುದಿಲ್ಲವೆಂದು ಪಳನಿ ಬೆಟ್ಟ ಹಾಗೂ ಕರ್ನಾಟಕದ ಕಾಡುಗಳಿಂದ ದೊರೆಯುವಂತಹ ಇತ್ತೀಚಿನ ದಾಖಲೆಗಳನ್ನು ಈ ಲೇಖನದಲ್ಲಿ ಒದಗಿಸಲಾಗಿದೆ. ಇದಲ್ಲದೇ, ಇಡೀ ಪಶ್ಚಿಮ ಘಟ್ಟಗಳಿಂದ ದೊರಕುವ ಮರನಾಯಿಯ ಬಗೆಗಿನ ಎಲ್ಲ ಅಪಕಾಶವಾದಿ ನೇರ ನೋಟದ ದಾಖಲೆಗಳನ್ನು ಕೂಡ ಈ ಲೇಖನವು ಒದಗಿಸುತ್ತದೆ.

ಪ್ರಮುಖ ಶಬ್ದಗಳು: ಮಸ್ತಲಿಡೆ ಜಾತಿ, ಸೀಮಿತ ಪ್ರದೇಶ, ವ್ಯಾಪ್ತಿ, ಬಿಸಲೆ ಮೀಸಲು ಅರಣ್ಯ, ಪಳನಿ ಬೆಟ್ಟ.

Introduction

The Nilgiri Marten *Martes gwatkinsii* Horsfield, 1851 is a mustelid endemic to the Western Ghats (8°19'–21°16'N), a range of low mountains in south-west India and a global biodiversity hotspot (Myers *et al.* 2000). It is one of the rarest and least known species of martens in the world (Wirth & Van Rompaey 1991), and is currently listed on *The IUCN Red List of Threatened Species* as Vulnerable (Choudhury *et al.* 2008), with existing information largely based on opportunistic sightings (for a review, see Balakrishnan 2005). The species is found throughout the Western Ghats south of 13°N (Schreiber *et al.* 1989), with the northernmost published location being the Shiradi Ghat-Sampaje area (12°30'–50'N, 75°30'–75°35'E), although it was considered to be rare in that region by the early 1980s (Karanth 1985).

The marten has generally been reported from evergreen forests at medium (700–1,400 m) and high (1,300–1,800 m) elevations (Mudappa 1999, 2002, Balakrishnan 2005), montane forests (sholas) (Madhusudhan 1995, Gokula & Ramachandran 1996), and, rarely, from moist deciduous forests (Mudappa 2002) and plantations (Kumar & Yoganand 1999). It is thought to be opportunistic in diet and has been recorded feeding on a wide variety of animal as well as plant matter (Balakrishnan 2005). Recent studies have found that this species occurs at very low densities in contiguous rainforests and is sensitive to habitat fragmentation (Kumar *et al.* 2002, Sridhar *et al.* 2008). However, there have been no intensive studies on this species and knowledge of its occurrence and distribution is very sketchy.

In this paper, we compile sighting records of the Nilgiri Marten, including hitherto overlooked records. We present sighting records from Tamil Nadu, Kerala and Karnataka states by collating information gathered from opportunistic sightings by biologists and local residents.

The Palni hills

The Palni hills (10°05'–25°N, 77°15'–50°E; 2,068 km² in area) are an eastern offshoot of the Western Ghats with two distinct zones, the Lower and the Upper Palnis, separated by a ravine. The Chinnar Wildlife Sanctuary and Indira Gandhi Wildlife Sanctuary (now called Anamalai Tiger Reserve) are located to the west of the Palni hills with the Pambadum Shola National Park situated to the southwest. The area receives an annual rainfall of 1,600 mm and the altitude ranges from 400 to 2,554 m. The major vegetation types are scrub, dry and moist deciduous and montane evergreen forests, grasslands and plantations of *Acacia* spp., *Eucalyptus* spp. and *Pinus* spp. Around 2,478 plants, 200 birds and 35 mammals have been recorded from this landscape (DA-PHCC 1991, Mathew 1994, 1999). A previous review of Nilgiri Marten distribution did not document them in this region (Balakrishnan 2005).

Nilgiri Marten records in the Palni hills

The Nilgiri Marten has previously been reported from the Palni hills (Mathew 1994, Meena 2002). A comprehensive review of mammals in the Palni hills lists the Marten from the Upper Palni hills and Chinnur (DA-PHCC 1991, PHCC 1993). The earliest Nilgiri Marten record dates back to the mammal collections made around 100 years ago and are currently housed at the Shembaganur Museum in the Sacred Hearts College at Kodaikanal, Tamil Nadu (R. Nandini, National Institute of Advanced Studies, Bangalore, India *in litt.* 2010). Over the years several opportunistic sightings of Martens have occurred although few have entered published literature. The most recent sighting we report is from 15 May 2008, when both authors spotted a solitary individual at the edge of the Vattakanal Shola, about 500 m away from the Vattakanal village. The Marten was on a tree in the late morning hours, then moved

Table 1. Previously unpublished Nilgiri Marten *Martes gwatkinsii* sightings in the Palni hills.

Sl no	Location	Date	Latitude	Longitude	Elevation (metres)	Comments	Reference
1	Vathalakundu-Kodaikanal Ghat Road	Mid 1970s	10°16'	77°33'	1,000–1,500	One individual crossing the road.	Romulus Whitaker (Madras Crocodile Bank Trust, India, <i>in litt.</i> 2009)
2	Berijam Lake	1990	10°10'	77°23'	2,170	-	Uma Ramakrishnan (Department of Environmental Science and Studies, Juniata College, USA, <i>in litt.</i> 2009)
3	Berijam Forest	Between April 2002 and April 2004	10°10'	77°23'	2,170	Sighted once around 08h30 resting on a tree.	Somasundaram (Gujarat Institute of Desert Ecology, India, <i>in litt.</i> 2010)
4	Poombarai Road	April 2006	10°12'	77°26'	2,200	Two individuals sighted in the early afternoon in a degenerating <i>Acacia mearnsii</i> plantation.	Robert Stewart & Tanya Balcar (Vattakanal Conservation Trust, Kodaikanal, India, <i>in litt.</i> 2009)
5	Vattakanal Shola	May 2008	10°12'	77°28'	2,060	Single individual running across branches of several trees, ~11h00.	Both authors

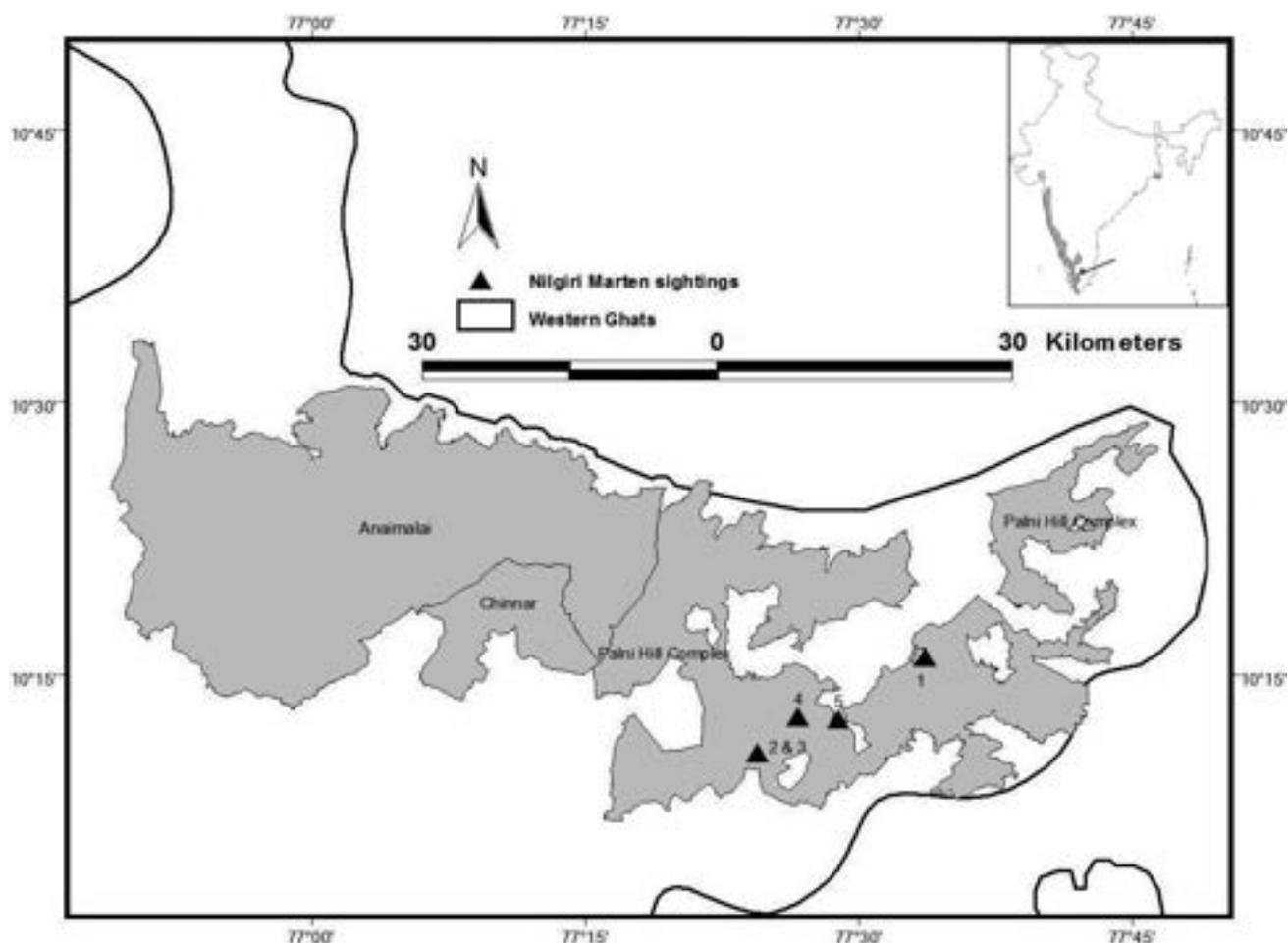


Fig. 1. Nilgiri Marten *Martes gwatkinsii* sightings in the Palni hills. The numbers correspond to the sighting details as listed in Table 1. The Chinnar Wildlife Sanctuary and the Anamalais lie to the west of the Palni hills.

Table 2. Previously unpublished Nilgiri Marten *Martes gwatkinsii* records in the Western Ghats (outside the Palni hills).

Sl no.	Location	Date	Latitude	Longitude	Elevation (meters)	Comments	Reference
1	Periyar Tiger Reserve	February 2006	9°16–36'	76°56'–77°25'	N. A.	One individual seen at 08h00 near the Unnikothal stream in the Thanikudi area.	N. A. Naseer (Kerala, India, verbally 2010)
2	Topslip (Indira Gandhi Wildlife Sanctuary)	2006	10°28'	76°50'	N. A.	One individual at 18h00.	Deepak (Wildlife Institute of India, India, <i>in litt.</i> 2010)
3	Bisale Reserve Forest	January 2007	12°41–47'	75°37–43'	N. A.	Three individuals crossing a road together.	Swapna Reddy (Bangalore, India, <i>in litt.</i> 2010)
4	Grass Hills National Park	May 2007	10°19'	77°02'	2,000	One seen at the edge of a large shola patch at 10h00.	Robin Vijayan (National Centre for Biological Sciences, Bangalore, India, <i>in litt.</i> 2010)
5	Periyar Tiger Reserve	November 2007	9°16–36'	76°56'–77°25'	N. A.	<i>En route</i> to Mangaladevi watchtower two individuals were seen crossing a stream.	Anish Anderia (Wildlife Conservation Trust, Mumbai, India, <i>in litt.</i> 2010)
6	Pambadum Shola National Park	January 2008	10°07–09'	77°15–16'	N. A.	Two individuals seen in the morning moving on the ground.	N. A. Naseer (Kerala, India, <i>in litt.</i> 2010)
7	Periyar Tiger Reserve	February 2008	9°16–36'	76°56'–77°25'	1,500	Two individuals seen at around 08h00 on a tree near a stream in the Upper Manalar area.	Suhel Quader (National Centre for Biological Sciences, Bangalore, India, <i>in litt.</i> 2010)
8	Talakaveri Wildlife Sanctuary	March 2008	12°17–26'	75°25–33'	1,200–1,300	One individual seen at 11h30 near a stream in shola forest.	Rajat Nayak (National Centre for Biological Sciences, Bangalore, India, <i>in litt.</i> 2010)
9	Periyar Tiger Reserve	May 2008	9°16–36'	76°56'–77°25'	N. A.	One individual seen emerging from a hole in a dead tree across the river from the Mlapara anti-poaching camp at 10h00.	Malini Pittet (Bangalore, India, <i>in litt.</i> 2010)
10	Periyar Tiger Reserve	May 2008	9°16–36'	76°56'–77°25'	N. A.	One individual seen near Thekkady at 10h00.	M. Arvind (India, <i>in litt.</i> 2010)
11	Nelliampathy Reserve Forest	January 2009	10°26–30'	76°34–45'	N. A.	One individual moving on the ground in the Hilltop Area.	N. A. Naseer (Kerala, India, verbally 2010)
12	Sandynallah, Nilgiris	March 2009	11°26'	76°38'	2,100	An individual found dead in a pasture.	Sreekumar (Tamil Nadu Veterinary and Animal Sciences University, <i>in litt.</i> 2010)
13	Pambadum Shola National Park	July 2009	10°07–09'	77°15–16'	1,900	Two individuals crossing a road at 16h00.	Ravi Kailas (Ficus Wildlife & Natural History Tours, Madras, India, <i>in litt.</i> 2010)
14	Kalakad-Mundanthurai Tiger Reserve	N. A.	8°25–53'	77°10–35'	N. A.	One individual on a tree on the path to Netterikal Dam around 11h00.	Rohini Mann (Foundation for Ecological Research, Advocacy and Learning, India, <i>in litt.</i> 2010)
15	Indira Gandhi Wildlife Sanctuary	Jan 2010	10°12–35'	76°49'–77°24'	N. A.	Two individuals seen at 09h00.	Satish (Nature Conservation Foundation, Valparai, India, verbally 2010)

N. A. refers to non-availability of data due to the opportunistic nature of the sightings

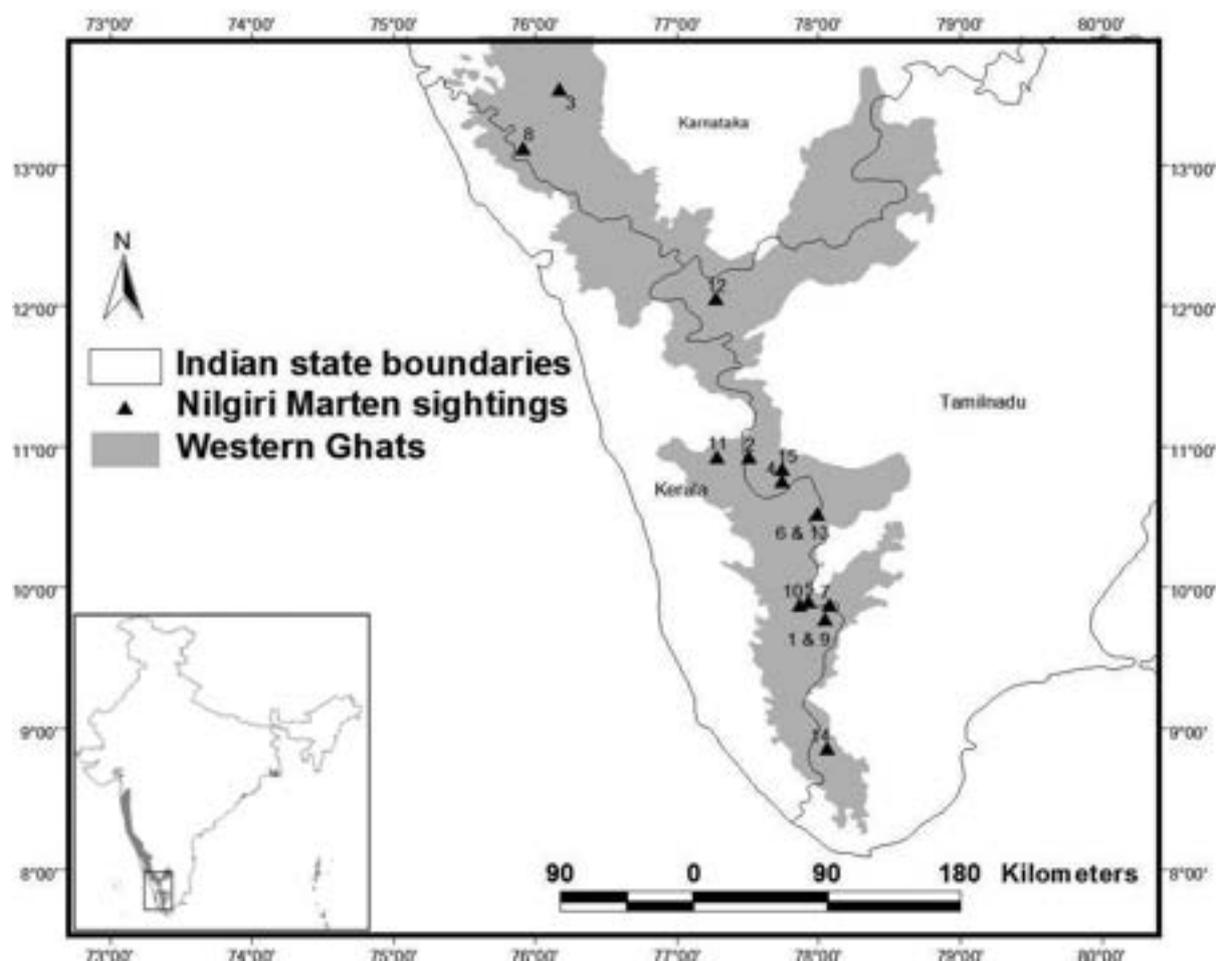


Fig. 2. Nilgiri Marten *Martes gwatkinsii* sightings in the Western Ghats outside the Palni hills. The numbers correspond to the sighting details as listed in Table 2.

through the canopy and disappeared. The first comprehensive compilation of Nilgiri Marten sighting records from the Palni hills is presented in Table 1 and Fig. 1.

Other Nilgiri Marten records in the Western Ghats

Information from published sources includes the following; three sightings in Eravikulam National Park (Rice 1990), six individuals in Indira Gandhi Wildlife Sanctuary (Sridhar *et al.* 2008) and one each from Talakaveri Wildlife Sanctuary (Kumara & Singh 2007), Upper Nilgiris (Shanker & Sukumar 1999) and Nelliampathy Hills (Kinloch 1923). In Table 2 and Fig. 2, we report 15 sightings from nine locations in the Western Ghats out of which three are first records for the respective area. Five sightings have been reported from Periyar Tiger Reserve, two from Indira Gandhi Wildlife Sanctuary and one each from Talakaveri Wildlife Sanctuary, Kalakad-Mundanthurai Tiger Reserve (KMTR), Nelliampathy Reserved Forest and Sandynallah in the Nilgiris. New records are from Pambadum Shola National Park in Kerala, Grass Hills National Park in Tamil Nadu and Bisale Reserve Forest which lies to the north of the Pushpagiri Wildlife Sanctuary and is situated in Karnataka. The Nilgiri Marten distribution extends up to the Charmadi Reserved Forest (13°00'–07'N, 75°23–28'E) (Niren Jain, Kudremukh Wildlife Foundation, India, verbally 2010). This area corresponds to the reported northernmost extent of the species at 13°N (Schreiber *et al.* 1989).

Discussion

Information presented in this paper reveals that although Nilgiri Martens have been recorded in the Palni hills, previous reviews of their distribution have overlooked these records. Despite being reported throughout the southern Western Ghats, Balakrishnan's (2005) surveys in KMTR and Palni hills were unsuccessful in locating evidence of Marten occurrence. Clearly, this species is highly cryptic or very rare. Targeted surveys for the Nilgiri Marten are extremely effort-intensive and have not been systematically carried out as yet.

Given that the species has been reported from the Indira Gandhi Wildlife Sanctuary (west of the Palni hills), and more recently from the Pambadum Shola National Park (southwest of the Palni hills) it is hardly surprising that the Palni hills harbours a Nilgiri Marten population. The Palni hills are not included in the protected area network of the country (Giriraj *et al.* 2008) despite belonging to the Western Ghats Biodiversity hotspot. Tourism, hunting by the local inhabitants and plantations of exotic species are threatening large tracts of this landscape (Giriraj *et al.* 2008, Meena Venkatraman *in litt.* 2010) with potentially detrimental effects on Nilgiri Marten populations. A proposal to confer protected status on some parts of the Palni hills may offer some hope to under-appreciated species such as the Nilgiri Marten.

The northernmost reported location in literature is the Sampaje-Shiradi Ghat area in Karnataka. Cryptic mammals like the

Brown Palm Civet *Paradoxurus jerdoni* were thought to be restricted to the southern Western Ghats but targeted surveys have shown their distributions to extend right into Goa (Rajamani *et al.* 2002). As there have not been any surveys for the Martens in areas north of their recorded distribution, it is likely that their occurrence has gone unnoticed by the scientific community. Local knowledge of the occurrence of the Marten north of its recorded range has not been fully tapped. As many forested areas in that region are open to some degree of human extraction, it is important that we establish the extent of occurrence of this species before human-induced disturbance modifies their range any further than it might have done already. Future surveys might throw up more surprises on Nilgiri Marten distribution.

Acknowledgements

The authors thank Divya Mudappa for initial encouragement and continued support throughout the writing of the manuscript. Uma Ramakrishnan, Romulus Whitaker, Robert Stewart, Tanya Balcar, Somasundaram, Suhel Quader, N. A. Naseer, Rohini Mann, Robin Vijayan, Anish Andheria, Ravi Kailas, Rajat Nayak, Malini Pittet, Arvind, Deepak, Satish, Niren Jain and Swapna Reddy kindly shared information. V. Srinivas provided the map layers and Devcharan Jathanna provided references. The authors thank the Palni Hills Conservation Council (PHCC) for providing access to their library. The authors thank Anna Bauman for her hospitality and providing key references. We are grateful to Nandini Rajamani and Meena Venkatraman for comments on an earlier draft. The authors thank Devcharan Jathanna, P. O. Nameer and an anonymous referee for comments that improved the manuscript.

References

- Balakrishnan, P. 2005. Recent sightings and habitat characteristics of the endemic Nilgiri Marten *Martes gwatkinsii* in Western Ghats, India. *Small Carnivore Conservation* 33: 14–16.
- Choudhury, A., Wozencraft, C., Muddapa, D. & Yonzon, P. 2008. *Martes gwatkinsii*. In IUCN 2010. *The IUCN Red List of Threatened Species. Version 2010.2*. <www.iucnredlist.org>. Downloaded on 14 July 2010.
- [DA-PHCC] Development Alternatives – Palni Hills Conservation Council 1991. *Sustainable development programme, Palni Hills, Tamil Nadu, India*. Planning for Interventions in the Palnis: Phase 1. Development Alternatives, New Delhi, India.
- Giriraj, A., Irfan-Ullah, M., Ramesh, B. R., Karunakaran, P. V., Jentsch, A. & Murthy, M. S. R. 2008. Mapping the potential distribution of *Rhododendron arboreum* Sm. ssp. *nilagiricum* (Zenker) Tagg (Ericaceae), an endemic plant using niche modeling. *Current Science* 94: 1605–1612.
- Gokula, V. & Ramachandran, N. K. 1996. A record of Nilgiri Marten (*Martes gwatkinsii* Horsfield). *Journal of the Bombay Natural History Society* 93: 82.
- Karanth, K. U. 1985. Ecological status of the Lion-tailed Macaque and its rainforest habitats in Karnataka. *Primate Conservation* 6: 73–84.
- Kinloch, A. P. 1923. The larger mammals of Nelliampathy Hills. *Journal of the Bombay Natural History Society* 29: 552–554.
- Kumar, A. & Yoganand, K. 1999. Distribution and abundance of small carnivores in Nilgiri Biosphere Reserve, India. Pp. 74–86 in Hussain, S. A. (ed.) *ENVIS Bulletin Vol 2(2): mustelids, viverrids and herpestids of India*. Wildlife Institute of India, Dehradun, India.
- Kumar, A., Chellam, R., Choudhury, B. C., Mudappa, D., Vasudevan, K., Ishwar, N. M. & Noon, B. R. 2002. *Impact of rainforest fragmentation on small mammals and herpetofauna in the Western Ghats, South India*. Wildlife Institute of India (WII–USFWS Collaborative Project Final Report), Dehradun, India.
- Kumara, H. N. & Singh, M. 2007. Small carnivores of Karnataka: distribution and sight records. *Journal of the Bombay Natural History Society* 104: 155–162.
- Madhusudan, M. D. 1995. Sighting of the Nilgiri Marten (*Martes gwatkinsii*) at Eravikulam National Park, Kerala, India. *Small Carnivore Conservation* 13: 6–7.
- Mathew, K. M. 1994. *A handbook of the Anglade Institute of Natural History, Shembaganur*. The Rapinat Herbarium, St. Joseph's College, Tiruchirapalli, India.
- Mathew, K. M. 1999. *The flora of the Palni hills, South India (part one)*. The Rapinat Herbarium, St. Joseph's College, Tiruchirapalli, India.
- Meena, V. 2002. Otter poaching in Palni hills. *Zoo's Print Journal* 17: 696–698.
- Mudappa, D. 1999. Lesser-known carnivores of the Western Ghats. Pp. 65–70 in Hussain, S. A. (ed.) *ENVIS Bulletin Vol 2(2): mustelids, viverrids and herpestids of India*. Wildlife Institute of India, Dehradun, India.
- Mudappa, D. 2002. Observations of small carnivores in the Kalakad-Mundanthurai Tiger Reserve, Western Ghats, India. *Small Carnivore Conservation*. 25: 4–5.
- Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B. & Kent, J. 2000. Biodiversity Hotspots for conservation priorities. *Nature* 403: 853–858.
- [PHCC] Palni Hills Conservation Council 1993. *Sustainable development programme, Palni Hills, Tamil Nadu, India*. Planning for Interventions in the Palnis. Palni Hills Conservation Council, Kodaikanal, Tamil Nadu, India.
- Rajamani, R., Mudappa, D. & Van Rompaey, H. 2002. Distribution and status of the Brown Palm Civet in the Western Ghats, South India. *Small Carnivore Conservation* 27: 6–11.
- Rice, C. G. 1990. Nilgiri Tahr, Eravikulam National Park, and conservation. Pp. 387–399 in Daniel, J. C. & Serrao, J. S. (eds) *Conservation in developing countries: problems and prospects*. Oxford University Press, New Delhi, India.
- Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses and their relatives: an action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.
- Shanker, K. & Sukumar, R. 1999. Synchrony in small mammal populations of montane forest patches in Southern India. *Journal of Applied Ecology* 68: 50–59.
- Sridhar, H., Raman, T. R. S. & Mudappa, D. 2008. Mammal persistence and abundance in tropical rainforest remnants in the southern Western Ghats, India. *Current Science* 94: 748–757.
- Wirth, R. & Van Rompaey, H. 1991. The Nilgiri Marten, *Martes gwatkinsii* (Horsfield, 1851). *Small Carnivore Conservation* 5: 6.

¹Centre for Ecological Sciences, Indian Institute of Science, Bangalore – 560012, Karnataka, India.

Email: chethikrishna@yahoo.com (corresponding author)

²Post Graduate Program in Wildlife Biology and Conservation, WCS India Program, National Centre for Biological Sciences, GKVK Campus, Bangalore – 560065, Karnataka, India.

Email: ecodivs@gmail.com

First camera-trap record of the European Badger *Meles meles* from Iran

Ehsan M. MOQANAKI*, Farshid JAFARZADEH, Elmira SHAERBAFI and Mohammad S. FARHADINIA

Abstract

A minimum sampling effort of 510 camera-trap nights at Anguran Wildlife Refuge led to the first camera-trap photograph of the European Badger *Meles meles* from Iran. This confirms the occurrence of the animal within Anguran Wildlife Refuge and is one of the few records of a free-living individual in Iran.

Keywords: Anguran Wildlife Refuge, camera-trapping, mountainous terrain, temperate semi-arid environment

The European Badger *Meles meles* has a wide distribution across western and central Eurasia from Scandinavia in the north to the Middle East in south, where it is considered to be naturally rare (Corbet 1978, Abramov 2003, Kranz *et al.* 2008). Although Neal & Cheeseman (1996) wrote that the species is “not uncommon” in Iran, there are few confirmed records of its occurrence in the country. Indeed, primary documentation comes mainly from Lay (1967), whose assessment has been often repeated without significant update (e.g. Harrington & Dareshuri 1976, Etemad 1985, Harrison & Bates 1991, Firouz 2005, Ziaie 2008). Thus, the point distribution map of the animal in Etemad (1985), using 12 records from Lay (1967) and only two subsequent ones, is the most detailed available data from Iran (Fig. 1). The species’s current status in Iran is therefore poorly known (Ziaie 2008).

This badger is listed globally as Least Concern by IUCN (Kranz *et al.* 2008) and is not endangered over most of the Western Palearctic, but there are large differences in European Badger population densities within its range. Also, the legal status of this

species in some Middle Eastern countries remains unclear (Hancox 1990, Griffiths & Thomas 1997, Kranz *et al.* 2008).

The study area was located in Zanzan province, northwestern Iran (36°29–43°N, 47°42–47°E) in the Zagros Mountains (Fig. 1). Covering 298 km², Anguran Wildlife Refuge is covered mainly by mountainous rolling lands and ridges with elevations from 1,260 to 3,333 m. The refuge’s temperate semi-arid climate is a result of mean annual precipitation and temperature of 400 mm and 10 °C (Darvishsefat 2006). *Astragalus* spp.–*Festuca* spp. and agricultural plants are the dominant vegetation types of the area (Anon. 1995). Qareh Buq Core Zone, in the western part of the refuge, has had continuous sampling using six to eight camera-traps (DeerCam DC-200 and StealthCam MC2-GV) from January 2010 as a larger study on the Eurasian Lynx *Lynx lynx* and Grey Wolf *Canis lupus*.

The total sampling effort from the beginning of the study until July 2010 was 510 camera-trap nights. The picture of the European Badger was obtained in late July 2010 at 04h00 (Fig.



Fig. 1. Iran, showing location of Anguran Wildlife Refuge (black polygon) and confirmed records of the European Badger *Meles meles* (white dots) by Etemad (1985).

2) from a station with minimum sampling effort of 33 camera-trap nights (36°37'N, 47°41'E). The camera was placed near the boulder-strewn top of a mountain following a dirt trail at a recorded elevation of 1,792 m, covered mainly with two vegetation communities, *Astragalus* spp.–annual grasses and *Artemisia* spp.–*Festuca* spp. Pictures of Wild Cat *Felis silvestris*, Eurasian Wild Pig *Sus scrofa* and Wild Sheep *Ovis (aries) orientalis* were also taken at this location.

To our knowledge, this is the first confirmed record of a European Badger from Anguran Wildlife Refuge. However, footprints consistent with this species were observed in October 2009 along the main stream in the northern portion of Qareh Buq Core Zone (Fig. 3). Furthermore, Lay (1967) reported a European Badger skin purportedly from Zanjan province. Our observation is one of the few records of a free-living European Badger in its natural habitat in Iran by the animal has rarely been observed alive in the country by biologists, and the lack of scientific knowledge in the country is similar to that asserted by several authors for the Asian Badger *Meles leucurus* in comparison with European populations (e.g. Murdoch & Buyandelger 2010).

Like other members of Mustelidae, the European Badger is



Fig. 2. Camera-trap picture of the European Badger *Meles meles* at Anguran Wildlife Refuge, Iran, July 2010 (Photo: Iranian Cheetah Society).

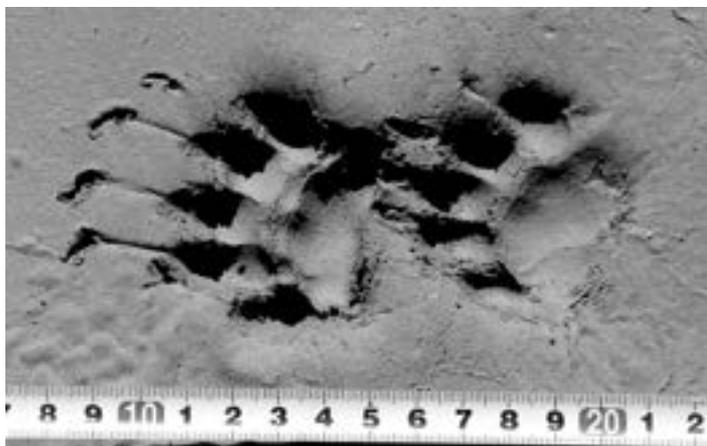


Fig. 3. Footprints consistent with European Badger *Meles meles* along the riverside in Qareh Buq Core Zone of Anguran Wildlife Refuge, Iran (Photo: M. S. Farhadinia/Iranian Cheetah Society).

legally Not Protected in Iran which may not be appropriate based on the absence of any status assessment for this species in the country. Sporadic anecdotal reports of this species's occurrence at new sites throughout the country indicate the need to verify these reports and update its distribution. Finally, we believe ecological investigations are needed to understand the status of European Badger in Iran.

References

- Anon. 1995. *Plants of Zanjan province*. Shabak Engineers Co., Zanjan, Iran (unpublished report). (In Persian.)
- Abramov, A. V. 2003. The head colour pattern of the Eurasian badgers (Mustelidae, *Meles*). *Small Carnivore Conservation* 29: 5–7.
- Corbet, G. B. 1978. *The mammals of the Palaearctic region: a taxonomic review*. British Museum (Natural History), London, U.K.
- Darvishsefat, A. A. 2006. *Atlas of protected areas of Iran*. University of Tehran Press, Tehran, Iran.
- Etemad, E. 1985. *Mammals of Iran*, vol. 2. Iranian Department of the Environment, Tehran, Iran. (In Persian.)
- Firouz, E. 2005. *The complete fauna of Iran*. I.B. Tauris, London, U.K.
- Griffiths, H. J. & Thomas, D. H. 1997. *The conservation and management of the European Badger*. Nature and Environment No. 90. Council of Europe Publishing, Strasbourg, France.
- Hancox, M. 1990. *The Eurasian Badger: status and legislative protection*. *Small Carnivore Conservation* 3: 18.
- Harrington, F. A. & Dareshuri, B. F. 1976. *A guide to the mammals of Iran*. Iranian Department of the Environment, Tehran, Iran. (In Persian.)
- Harrison, D. L. & Bates, P. J. J. 1991. *The mammals of Arabia*, 2nd ed. Harrison Zoological Museum, Sevenoaks, U.K.
- Kranz, A., Tikhonov, A., Conroy, J., Cavallini, P., Herrero, J., Stubbe, M., Maran, T., Fernades, M., Abramov, A. & Wozencraft, C. 2008. *Meles meles*. In: IUCN 2010. *IUCN Red List of Threatened Species*. Version 2010.2. <http://www.iucnredlist.org>. Downloaded on 13 August 2010.
- Lay, D. M. 1967. A study of the mammals of Iran resulting from the Street expeditions of 1962–63. *Fieldiana, Zoology* 54: 1–282.
- Murdoch, J. & Buyandelger, S. 2010. An account of badger diet in an arid steppe region of Mongolia. *Journal of Arid Environments* 47: 1348–1350.
- Neal, E. & Cheeseman, C. 1996. *Badgers*. T and A. D. Poyser, London, U.K.
- Ziaie, H. 2008. *A field guide to the mammals of Iran*, 2nd ed. Iranian Wildlife Center, Tehran, Iran. (In Persian.)

Iranian Cheetah Society (ICS), Tehran 14155-8549, Iran
*Corresponding author email: emoqanaki@wildlife.ir

Status of Red Panda *Ailurus fulgens* in Neora Valley National Park, Darjeeling District, West Bengal, India

Jayanta Kumar MALLICK

Abstract

Temperate forests, above 2,100 m asl, in the upper Neora Valley National Park, Darjeeling District, West Bengal, India, have a dense canopy and thick undergrowth of *Abies*, *Acer*, *Juniperus*, *Lithocarpus*, *Magnolia*, *Quercus*, *Rhododendron*, *Yushania* and *Arundinaria*, which form prime habitat of Red Panda *Ailurus fulgens*. But this Vulnerable species is poorly known in this park, where only one preliminary survey has been conducted: by the Ashoka Trust For Research in Ecology and the Environment (ATREE) during 2006–2007. In 2009, a study was conducted to identify and evaluate Red Panda habitat in this short-listed World Heritage Site, involving literature review, questionnaire and ground surveys. Out of twenty-five forest compartments surveyed, Red Panda was sighted eleven times in five compartments (20%) within 2,350–3,170 m asl. Surveys of Red Panda, inclusion of contiguous Red Panda habitats in the park and joint park management, are specially recommended.

Keywords: conservation, habitat, survey, sighting, signs, threats

নেওড়া উপত্যকা জাতীয় উদ্যান, দার্জিলিং জেলা, পশ্চিমবঙ্গ, ভারতে লাল পান্ডা আইলিউরাস্ ফাল্জেসের অবস্থান

সারাংশ: উচ্চ নেওড়া উপত্যকা জাতীয় উদ্যান, দার্জিলিং জেলা, পশ্চিমবঙ্গ, ভারতে সমুদ্রপৃষ্ঠ থেকে ২,১০০ মিটার ওপরে অবস্থিত অ্যাবিস, আসার, জুনিপার, লিথোক্যারপাস, ম্যাগনোলিয়া, কোয়ারকাস, রডোডেনড্রন, ইউশানিয়া ও আরকুণ্ডিনারিয়ার ঘন আচ্ছাদন ও গভীর ঝোপ-সমৃদ্ধ নাতিশীতোষ্ণ অরণ্য লাল পান্ডা আইলিউরাস্ ফাল্জেসের প্রধান আবাস। কিন্তু উদ্যানের এই বিপন্নপ্রায় প্রজাতিটি সম্পর্কে তথ্য অপ্রতুল। ২০০৬ ও ২০০৭ সালে আটটি সংস্থা এখানে একবার প্রাথমিক নিরীক্ষার ব্যবস্থা করে। এই তালিকাভুক্ত আন্তর্জাতিক ঐতিহ্যময় স্থানে পান্ডাবাস চিহ্নিতকরণ ও মূল্যায়নের উদ্দেশ্যে ২০০৯ সালে সাহিত্য সমালোচনা, প্রশ্নমালা ও এলাকাভিত্তিক নিরীক্ষার মাধ্যমে একটি গবেষণা অনুষ্ঠিত হয়। নিরীক্ষিত ২৫টি বন কম্পার্টমেন্টের মধ্যে পাঁচটিতে (২০ শতাংশ) ২,৩৫০-৩,১৭০ মিটার উচ্চতায় মোট ১১ বার পান্ডা দেখা গেছে। লাল পান্ডা সুমারি, সংলগ্ন পান্ডাবাসের উদ্যানে অন্তর্ভুক্তি এবং যৌথ উদ্যান পরিচালন ব্যবস্থা গড়ে তোলার বিশেষ সুপারিশ করা হয়েছে।

মুখ্য শব্দাবলী: আবাস, নিরীক্ষা, দর্শন, চিহ্ন, ক্ষতিকারক সংকেত, সংরক্ষণ।

Introduction

Red Panda *Ailurus fulgens* is a flagship species in worldwide *in situ* and *ex situ* conservation (Glatston in press). The western, nominate, race is endemic to Eastern Himalayas, the range forming a crescent from Nepal, Tibet, Bhutan, north-eastern India (northern West Bengal, Sikkim, Arunachal Pradesh and, apparently, Meghalaya) up to western Yunnan province in China and northern Myanmar (Choudhury 2001). In northern West Bengal, the Vulnerable Red Panda is found in two national parks (NP), Singalila and Neora Valley, of Darjeeling District (Saha & Singhal 1996, Ghose *et al.* 2007). Red Panda also inhabited Senchal Wildlife Sanctuary (Darjeeling District) in the past (Bahuguna & Mallick 2010: 196).

Study area

Being located in the Kalimpong subdivision, Neora Valley NP (88 km²) lies within 26°52'–27°7'N, 88°45'–88°50'E, falling under Bio-geographic Province 2C, the Central Himalayas, as classified by Wildlife Institute of India (Fig. 1). The park authorities divided Neora Valley into two ranges, Upper (Headquarters: Lava, the western entry point) and Lower (Headquarters: Samsing, the eastern entry point). The highest point is Rachila *danda* (peak) (3,170 m asl), which borders Sikkim to the north.

The park has a wide altitudinal range (183–3,170 m asl) and climatic conditions (tropical/sub-tropical in its lower range and temperate in its higher range). Asian Elephants *Elephas maximus* used to migrate up to Rishila (on the north-west of Rachila) on the Sikkim and Bhutan border (O'Malley 1907) and *Hathi danda* or



Fig. 1. Location of Neora Valley National Park.

'elephant peak' (27°07'N, 88°44'E, altitude 3,159 m asl) in Rhenock block till 1940 (Anon. 2010). Until a December 1982 biological expedition, the rich biodiversity of Neora Valley NP was poorly known (Chowdhury 1983). Thereafter, Neora Valley was notified

as a protected area in April 1986 and finally gazetted in December 1992. Neora Valley NP was short-listed as a World Heritage Site on 26 May 2009 (UNESCO World Heritage Centre 2009).

Methods

A study was conducted in 2009 by the author along with S. S. Giri, Officer-in-Charge, Upper Neora Range (Lava) and the subordinate field staff of that Range, to identify and evaluate Red Panda habitat in Neora Valley NP under Wildlife Division-II and two adjoining blocks of reserve forests of Kalimpong Division, based on a literature review, questionnaire survey and forest trail survey for direct sighting and signs like faecal pellets. The author himself conducted the questionnaire survey and supervised the progress of field work at site during the third week of February, May, October and December respectively.

Questionnaire survey

The questionnaire survey was conducted on a set *pro forma* (Table 1) among forest officials and camp staff, researchers, tourists/guides, the villagers of Mithuntar, Bhotetar, Mulkharg, Kolbong and Sakam including Eco-development and Forest Protection Committee members, and graziers and cultivators living in and around the park. These latter have very rarely entered the upper range since notification of the park. Colour photographs of eight species of small carnivores recorded in the park (Singhal & Mukhopadhyay 1998), namely Clouded Leopard *Neofelis nebulosa*, Marbled Cat *Pardofelis marmorata*, Hog Badger *Arctonyx collaris*, Masked Palm Civet *Paguma larvata*, Yellow-throated Marten *Martes flavigula*, Beech Marten *Martes foina*, Stripe-backed Weasel *Mustela strigidorsa* and Red Panda, were shown to the villagers for identification of Red Panda. No confusion was evident with any villager concerning Red Panda and any other species. Another possible confusion species, Common Palm Civet *Paradoxurus hermaphroditus* is believed to live up to only 1,500 m asl in the park and

was not included. To overcome the language barrier, the help of a local interpreter was taken. Seven field stations, six in the upper and one in the lower range (Table 2), created for protection of the park, were visited for questionnaire survey among the staff posted there.

Ground survey

The dense forest on rugged terrain prevented straight-line transects. Four one-way trail-cum-trekking routes (combined length 53 km), three in Upper Neora and one in Lower Neora Range (Table 3), were walked in search of live Red Pandas. The study team conducted the ground survey during the pre-monsoon (February–May) and post-monsoon periods (October–January) and in the rainy season during clement weather. During the study, approximately 288 hours, equivalent to 36 person-days (excluding inclement weather conditions [stormy, rainy, foggy, frosty and snowy], unproductive traversing and holidays) were used for habitat evaluation, direct Red Panda sighting, collection of its faeces and plant-parts eaten, and questionnaire survey.

Habitat

Neora Valley NP has three altitudinal zones of vegetation: lower hill, middle hill and upper hill forests. Tropical lower hill forest, mostly deciduous and semi-evergreen, extends up to about 750 m asl. Sub-tropical middle hill forest is found over 750–1,700 m asl, with abundant evergreen trees, dense canopy and undergrowth. Temperate upper hill forests (1,700–3,200 m asl) are also distinguished by the predominance of Lauraceae, *Quercus lamellosa*, *Q. lineata*, *Q. spicata*, *Elaeocarpus lanceaefolius*, *Echinocarpus* and *Acer campbelli* (Buk-Oak mixed vegetation) and *Lithocarpus* (High-level Oak) forests. The lower limit of upper hill forest, i.e. Lauraceous (*Machilus–Michelia*) forest occurs between 1,650 m asl and 2,100 m asl. Deep valleys have diverse shrubby (understorey) species forming mixed and mesophyll communities. Pure stands

Table 1. Data collection sheet for questionnaire survey on Red Panda *Ailurus fulgens* in Neora Valley NP and Kalimpong Division.

Name of Respondent:	Designation/Identity:
Date and Time of sighting evidences of the Panda:	
Protected Area (PA)/Reserve Forest (RF) (specify):	
Location (Block/Compartment):	
Altitude/Topography:	
General vegetation type:	
Tree data:	Canopy cover %
Dominant tree species:	Tree species used by Red Panda:
Shrub data:	Shrub cover %
Dominant shrub species:	Shrub species used by Red Panda:
Herb data:	Herb cover %
Dominant herb species:	Herb species used by Red Panda:
Bamboo data:	Bamboo cover %
Dominant bamboo species:	Bamboo species used by Red Panda
Direct sighting of Red Panda: Yes/No	
Number:	Sex:
	Adult/Sub-adult/young:
Indirect evidences: Foot prints/Faecal pellets/Feeding signs/Dead animal/Any other (Specify):	
Perceptible threats (natural/anthropological like presence of <i>gothhs</i> or grazing inside forest/collection of forest produces/hunting/others (Specify):	

Table 2. Field stations (protection camps) visited for questionnaire survey in Neora Valley National Park, 2009.

Name	Block/ Compartment	Location	Lat	Long	Recorded altitude (m asl)	Range	Forest type	Recent Panda sighting
Red Panda	Rashet 3	Chaudapheri	27°05'N	88°42'E	2,358	Upper hill	<i>Quercus–Lithocarpus</i> , plantations, <i>Yushania–</i> <i>Arundinaria</i>	Yes
Black Bear	Pankhasari 2	Doley	27°04'N	88°42'E	2,052	Upper hill	<i>Machilus–Michelia</i>	No
Betula	West Nar 7	Betula	26°59'N	88°44'E	981	Lower hill	<i>Engelhardtia–Schima–</i> <i>Castanopsis–Betula</i>	No
Maple	Thosum 1	Bhote khola	27°03'N	88°46'E	1,950	Upper hill	<i>Machilus–Michelia</i>	No
Orchid	Thosum 3	Near Ruka	27°07'N	88°46'E	2,278	Upper hill	<i>Quercus–Lithocarpus</i> , <i>Yushania–Arundinaria</i>	Yes
Tiger	Rachila 13	Rachila	27°06'N	88°45'E	2,782	Upper hill	<i>Quercus–Lithocarpus</i> , <i>Yushania, Rhododendron</i>	Yes
Serow	Rachila 14	Alubari	27°07'N	88°43'E	2,538	Upper hill	<i>Quercus–Lithocarpus</i> , <i>Yushania</i>	Yes

Table 3. Trails surveyed in Neora Valley National Park, 2009.

Starting point	Altitude (m asl)	Via	Terminal point	Altitude (m asl)	Length	Range	Recent Panda sighting
Lava Town	2,100	Lava forests	Chaudapheri	2,358	14 km	Upper	No
Chaudapheri	2,358	Zero Point, PHE source	Alubari	2,538	16 km	Upper	Yes
Alubari	2,538	Rachila	Jorepokhri	3,170	5 km	Upper	Yes
Mouchowki	1,170	Bhote Khola	Bhote Kharka	1,950	18 km	Lower	No

* Altitude of the walked length includes stretches higher or lower than the start and end points.

of the dwarf bamboo *Yushania* (= *Arundinaria*) *maling* occur in small stretches of almost flat lands, particularly in the middle hills (Singhal & Mukhopadhyay 1998).

Red Panda was once recorded as low as 1,170 m asl, but now it is found only above 2,100 m asl in the upper Neora Valley NP (Ghose *et al.* 2007). Habitat here is composed of the bamboo, rhododendron, mixed deciduous and coniferous forests with dense canopy and hollow tree understorey (Sharma 1990). Here, the minimum density of vegetation is greater than 40% canopy coverage except at Rachila Chawk, which was deforested in 1879 and brought under a regeneration programme in 1996 and 1997 (Singhal & Mukhopadhyay 1998). In the Buk-Oak mixed forest at 2,100–2,400 m asl, *Quercus lamellosa* dominates, with associates like *Q. lineata*, *Q. spicata*, *Castanopsis tribuloides*, *Acer campbelli*, *Machilus odoratissima*, *M. gammieana* and *Elaeocarpus*, *Michelia excelsa* and *Bucklandia*.

In the High-level Oak forest over 2,400–2,750 m asl, mainly in Rashet and Rachila blocks, *Lithocarpus pachyphylla* predominates, with common associates like *Q. lamellosa*, *Acer campbelli* and *Magnolia campbelli*. *Yushania maling* is found scattered all over *Quercus* and *Lithocarpus* forests.

Further higher zone (coniferous forest) harbours pure patches of *Tsuga* and undergrowth of bamboos and *Rhododendron*. The block or compartment data pertaining to the Red Panda habitat in the park is given in Table 4.

Literature review

The 1982 expedition did not report any Red Panda sighting in Ne-

ora Valley. The first specific mammal survey in the higher elevations of the park (1994–1996) recorded 31 species, including Red Panda in the dense forest dominated by bamboo, at Pankhasari and Rachila (Biswas *et al.* 1999). In 2006 and 2007, a preliminary survey of Red Panda was conducted in six transects (17.33 km²) in Neora Valley NP (ATREE 2008). Anon. (2008) briefed the findings of this survey. Various websites, such as of Wildlife Division II [www.jalpaiguriwildlife.org (2007)], Forest Directorate [www.westbengalforest.gov.in (2008)], Wildlife Wing [www.wildbengal.com (2009)] and Tourism Development Corporation (www.westbengaltourism.gov.in) and booklets published by them have popularised in the state during the last decade, in general terms, the Red Pandas in Neora Valley NP.

Results

In all, 94 people (30 researchers, forest staff and officers having working experience in the park, 48 villagers living in and around the park and 16 tourists/guides) responded to the questionnaire survey. Only 23 respondents (24%), mostly field staff, had sighted Red Panda in the park. Statements of respondents unable to remember both the exact location and time of the encounter were not recorded.

In the study area, 34 sightings of Red Panda (31 in upper Neora Valley NP under Wildlife Division-II and three in contiguous Kalimpong Forest Division) during a period of 11 years, i.e. 1999–2009, were registered (Table 5). In 2009, Red Pandas were sighted on eleven occasions, giving the highest annual total dur-

Table 4. Survey of blocks/compartments in Red Panda habitat of upper Neora Valley NP*, 2009.

Block	Compartments surveyed (total)	Compartments with evidence (total)	Area (ha)	Latitude	Longitude	Altitude (m asl)
Rachila	1–17 (17)	2, 11, 12, 13, 14 (5)	1,759	27°05'–27°07' N	88°43'–88°45' E	1,400–3,150
Thosum	1–4 (4)	3 (1)	979	27°04'–27°05' N	88°45'–88°46' E	1,250–3,050
Rhenock	4b–5 (2)	4b (1)	691	27°07' N	88°43' E	1,200–3,000
Rashet	3–4 (2)	3, 4 (2)	299	27°05'–27°07' N	88°42'–88°44' E	1,450–2,650
4	25	9	3,728	27°04'–27°07' N	88°42'–88°46' E	1,200–3,150

*Rachila Chawk (Khasmahal area): 111 ha and strips on two sides of the park were not included.

Table 5. Sighting records of Red Panda in Neora Valley NP and adjacent Kalimpong Division.

Date/Month/Year	Location	Source	Remarks
December 1999	Upper range	Questionnaire survey: forest staff	First rescue during Tiger census, sent to Darjeeling Zoo for treatment.
March 2000	Upper range	Questionnaire survey: forest staff	Second rescue, sent to Darjeeling Zoo, but died on the way.
25 November 2002 (morning)	Rashet 3	Prince 2003	Panda bounding along the track, disappeared into the bamboo grove.
March 2004	Rashet 3	D. Ghose	Near Chaudapheri Red Panda camp.
April 2005	Rashet 3	D. Ghose	1st Mile Road on the Pankhasari ridge. Miscellaneous tree species.
April 2005	Rashet 3	Questionnaire survey: forest staff	Plantation area.
April 2006	Rahset 3	Questionnaire survey: forest staff	Plantation area.
May 2006	Rachila 11	D. Ghose	Upward trail from Rashet 3 to Rachila 11, then downward slope to Zero Point.
6 September 2006	Rashet 4	ATREE 2008	Panda eating bamboo leaves / shoots in mixed vegetation with 60% bamboo undergrowth.
8 March 2007	Rashet 4	Questionnaire survey: forest staff	1st mile on Pankhasari ridge. Mixed vegetation.
2 April 2007	Ruka 4	Questionnaire survey: forest staff	Mostly <i>Y. maling</i> with scattered patches of <i>Rhododendron</i> . On the eastern slope of Thosum La <i>Lithocarpus</i> is found.
8 April 2007	Rachila 11	Questionnaire survey: forest staff	Broadleaved forest and bamboo thicket- <i>Rhododendron</i> , <i>Michelia</i> , <i>Alnus nipalensis</i> , <i>Q. lamellosa</i> , undergrowth <i>Arundinaria racemosa</i> , <i>Eupatorium adenophorum</i> , <i>Maesa chisia</i> , <i>Aesculus</i> , also ferns and mosses.
18 May 2007 (within 15h30–16h55)	Alubari towards Hathidanda	ATREE 2008	Panda, sitting on an oak tree, photographed.
14 August 2007	Ruka 4	Questionnaire survey: forest staff	Beyond 100–200 m wide strip in the eastern boundary of the park.
5 November 2007	Rachila 13	Questionnaire survey: forest staff	Erstwhile forest village, evacuated and brought under plantation programme.
2 February 2008	Rashet 4	Questionnaire survey: forest staff	Above 2,200 m <i>Quercus</i> , <i>Rhododendron</i> , mixed with <i>Lithocarpus</i> and <i>Yushania</i> are found; <i>Y. maling</i> covers about 70% of the area above 2,300 m. <i>Arundinaria</i> occurs elsewhere. A large area along the Pankhasari ridge is unproductive.
10 March 2008	Rashet 4	Questionnaire survey: forest staff	Mixed vegetation.
17 April 2008	Rashet 3	Questionnaire survey: forest staff	Mixed plantation of native hardwoods.
11 May 2008	Pankhasari-1 (Kalimpong Division)	Questionnaire survey: forest staff	Mixed vegetation. Carcass of an adult male found. Post mortem report not available.
22 November 2008	Near Tiger Camp	J. Das	Sighted during Tiger census operation. <i>Lithocarpus</i> forest and scattered pure bamboo.

Date/Month/Year	Location	Source	Remarks
22 November 2008	Rachila 13	M. Roy	Oak forest and pure bamboo thickets. During Tiger census a Panda was sighted on a tree near Jorepokhri (3,128 m asl; on the way from Alubari), from 08h43 for 45 minutes.
12 December 2008	Rachila 2	Questionnaire survey: forest staff	<i>Lithocarpus</i> predominates, changing to <i>Rhododendron</i> and <i>Y. maling</i> above 2,800 m asl.
15 December 2008	Rhenock 4b	Questionnaire survey: forest staff	<i>Y. maling</i> covers about two-thirds of the area. <i>Rhododendron</i> is also found mixed with <i>Lithocarpus</i> and <i>Quercus</i> .
Early January 2009	Rashet 3	A British tourist	The Panda was sitting on a tree (Anon. 2009).
5 May 2009	Rachila 11	Study team	Miscellaneous tree species; some plantations.
7 May 2009	Rashet 3	Study team	Mixed plantation (<i>Rhododendron</i> and <i>Lithocarpus</i> [native species]) area.
23 May 2009	Rashet 3	Study team	Eating acorns, sat on branch of an oak.
3 June 2009	Rachila 12	Study team	Sitting on a tree by Zero Point–Alubari trail.
9 June 2009	Rhenock 4b	Study team	Dwarf bamboo, <i>Rhododendron</i> mixed with oak and Buk-Oak.
12 June 2009	Rhenock 4b	Study team	Dwarf bamboo, <i>Rhododendron</i> mixed with oak and Buk-Oak.
24 July 2009	Rachila 11	Study team	Miscellaneous tree species; some plantations.
20 October 2009	Rashet 4	Study team	Miscellaneous tree species.
17 November 2009	Rashet 3	Study team	Mixed plantation area.
8 December 2009	Rachila 11	Study team	Miscellaneous tree species; some plantations.

ing the last eleven years. This no doubt reflects the better recall of interviewees for more recent sightings. There were three during pre-monsoon (May), four during rainy season (June–July) and four during post-monsoon (October–January). Red Pandas were sighted mostly in the early morning and late afternoon. On all occasions, only a single Red Panda was sighted.

During the ground survey itself, Red Panda faeces (no other form of sign was recorded) were found at six locations. In all six, Red Panda was also sighted: Upper and Lower Choudapheri, Zero Point, Alubari, Rhenock and Rachila. Faeces were mostly on *Abies densa* and *Lithocarpus pachyphylla*, followed by *Magnolia campbelli* and *Rhododendron*, especially those with mossy trunks, *Betula utilis*, followed by *Ilex hookeri*, *Osmanthus* and *Sorbus cuspidata*.

During 2009, Red Panda was found in five of the 25 compartments surveyed (20%), mostly in Rashet 3 (four records) and Rachila 11 (three records) compared with Rhenock 4b (two records), Rashet 4 (one record) and Rachila 12 (one record). The highest altitude record was at 3,170 m asl in Jorepokhri, the lowest at 2,350 m asl in Chaudapheri. There were no 2009 sightings from the two adjoining blocks of Kalimpong Forest Division.

Twelve samples of plants consumed by Red Pandas sighted during the study were collected. They were identified by A.B. Chaudhuri, retired Director, Forest Survey of India (Fig. 2; Table 6).

Discussion

Neora Valley is one of the oldest reserve forests in India, established in 1881 and under strict protection (free from commercial exploitation) since. Its upper range is recognised as the last virgin wilderness in West Bengal (UNESCO World Heritage Centre 2009).

ATREE, conducting the first Red Panda survey in upper Neora Valley NP, visited three forest camps and five villages, sighted two Red Pandas, one each in 2006 and 2007, photographed one of them and collected their pellets in six transects. They estimated a population of 28–32 Red Pandas in the upper Neora Valley by

extrapolating their probable density in the surveyed transects to the rest of the area.

The present study found Red Pandas only in high, dense, moist temperate forest with thick undergrowth, where many trees are ancient and hollow, especially in the less accessible areas. However, Red Pandas were neither sighted nor reported in the Lauraceous high forest. The park's other two habitats, the subtropical forests in the middle hills and the tropical forests in the lower hills, do not support Red Pandas.

In dense canopy and thick undergrowth (visibility not more than 5–10 m, often less than 2 m), direct Red Panda sighting was very limited. Sighting in the *Quercus*–*Lithocarpus* forest with undergrowth of *Yushania* (2,100–2,400 m asl) was also not frequent. Most sightings were recorded in the second storey of the high forests, generally occurring above 2,400 m asl, particularly in Rashet and Rachila blocks, where *Lithocarpus pachyphylla* is the predominant tree species. Red Panda was often sighted in the plantations of native hardwood species (comparatively younger trees) in Rashet 3 compartment.

Red Panda sightings were confined to four forest blocks of the park, spread over 37 km² (Table 4). These four forest blocks account for about 43% of the total area of Neora Valley NP.

Even though there were no 2009 records, Red Panda was also reported during the questionnaire survey from outside the park in two adjoining blocks of Kalimpong Division, i.e. Pan-khasari (48 km²), south of Rashet (Chaudapheri) block and Ruka (18 km²), east of Rachila block. Only three sightings of Red Panda in these two Reserve Forests, in 2007 and 2008, were reported by the questionnaires. The combined Red Panda habitat in Neora Valley NP and these adjoining blocks of Kalimpong Division is about 103 km².

Prior to notification of the park, Red Panda was also recorded in Mouchowki forests (9.57 km²) under East Nar block, at an altitude of 1,311 m asl, in the lower Neora Valley NP (Sharma 1990). The cause of its disappearance is not clear. Red Panda has never been known in the entire West Nar block of the Lower Range

(Sharma 1990).

The present study gave no concrete evidence of seasonal migration of Red Panda in Neora Valley NP, but the methods used and overall small sample would not necessarily pick it up. Ghose *et al.* (2007: 9) observed that “during spring the Red Pandas are everywhere [whether Singalila NP or Neora Valley NP or both, was not specified] but during the monsoon they are only found in small patches”. This statement warrants further investigation.

Threats

The core Red Panda habitat in the upper hills is least affected of all the park’s habitats by anthropogenic threats because exploitation of forest resources and human movement are controlled there. Nonetheless, four direct and indirect threats to Red Panda and its habitat were identified.

Hunting: there were a few reports of hunters coming into Neora Valley NP from neighbouring areas (Ghose *et al.* 2007).

Conversion of natural high forests into plantations: starting in 1962, Kalimpong Division clear-felled high forest (except a few good quality patches in Neora Valley NP) for replacement by exotics like *Cryptomeria japonica*, *Cupressus cashmeriana*, *Pinus patula* and others, mixed with indigenous hardwood (broad-leaved) species. These stands remain in East Nar Block of lower Neora Valley NP. Up to 1992 (30 years), over 26 km² of suitable Red Panda habitat in the contiguous blocks of the park (Pankhasari and part of Rashet) was lost. In 1996, the Supreme Court of India has imposed a ban on exploitation and collection in Reserve Forests, National Parks and Wildlife Sanctuaries. Since then, this practice was discontinued.

Encroachments: before notification of the park, many neighbouring villagers used to spend several dry-season months in deep forests, making temporary cattle sheds (*gothh*) to facilitate cattle grazing. Moreover, there were a number of age-old forest villages inside the park. After notification, all forest villages in the upper range were shifted into the fringe areas and the land was regenerated through plantation of native species. For example, Rachilach-

awk was evacuated in 1996 and the village land was placed under a plantation programme with native species. During the ground survey, Red Panda was sighted in this area.

Expansion of tourism facilities: due to difficult terrain and lack of communication facilities, only adventurous trekkers usually visit the park with an approved guide. Beginning in 2008, more facilities are being opened up at Choudapheri (Red Panda camp). Construction of an all-weather road beyond Choudapheri, increased vehicular traffic and tourists in this prime Red Panda habitat may lead to environmental pollution and cause disturbance to Red Pandas.

Recommendations

While periodic surveys were carried out in Neora Valley NP in 2002 and 2004 for Tiger *Panthera tigris*, Himalayan Black Bear *Ursus thibetanus*, Gaur *Bos gaurus* and many even-toed ungulate species (e.g. deer), no such survey of Red Panda has been undertaken. A systematic survey might help in planning their conservation and management programmes.

The park authorities should maintain a Red Panda database (time, locality where found including vegetation, physical characteristics of the animal, disease and treatment, post mortem, etc.) for future studies.

Due to ban on felling in the protected areas by the Supreme Court of India, felling of exotic plantations within Neora Valley NP to allow natural forest regeneration is not practicable. The Red Panda habitats in two contiguous reserve forests (Ruka and Pankhasari blocks) of Kalimpong Division should be included within the park for implementation of the Wildlife (Protection) Act 1972, better management and conservation of Red Panda.

The local Forest Protection Committees and Eco-development Committees should also be motivated to actively participate in the joint protected area management.

The forest staff in the park should also be provided with



Fig. 2 (left to right). Red Panda near Jorepokhri, 22 November 2008; Dwarf bamboo *Yushania malingi*; *Rhododendron* sp. (Photos: M. Roy).

Table 6. Plants/parts consumed by Red Panda in Neora Valley National Park.

Scientific name	Local name	Parts consumed
<i>Yushania maling</i>	Maling bamboo	Tender leaves and shoots
<i>Arundinaria hookeriana</i>	Pareng bamboo	Tender leaves and shoots
<i>Arundinaria aristata</i>	Ratonigalo bamboo	Tender leaves and shoots
<i>Actinidia strigosa</i>	Thekiphal	Fruits
<i>Rosa sericea</i>	Khorsanay kara or Sisi chigehung	Seeds and sheaths
<i>Schisandra grandiflora</i>	Singauto lahara (climber of the high hills)	Flowers and fruits
<i>Brassaiopsis</i>	Chille Phutta	Fruits
<i>Sorbus cuspidata</i>	Tenga lahara (tree of high hills)	Fruits
<i>Sorbus thomsonii</i>	Pasi (tree of high hills)	Fruits
<i>Lithocarpus pachyphylla</i>	Oak tree	Acorns
Epiphytic moss	—	Whole
Wild mushroom (macro fungi)	—	Whole

modern equipment and training.

Conservation of this flagship species will assist the rich biodiversity in the study area as a whole.

Acknowledgments

I am specifically grateful to S.S. Giri and his field personnel for conducting the ground survey and also to I. Mitra, S. Chakraborti, S. Pal Chowdhury, A. B. Chaudhuri, N. C. Bahuguna, T. Das, D. Ghose, M. Roy, J. Das, M. Prince, ATREE, all the respondents to questionnaire survey and, finally, all the referees for their constructive comments.

References

- Anon. 2008. Red Panda survey in Neora Valley National Park. *Red Panda* 1(2): 1.
- Anon. 2009. A walk through Lava and Lolegaon. *India Digest* (High Commission of India, London) 281: 8.
- Anon. 2010. *Protected areas of West Bengal*. Wildlife Wing, Government of West Bengal, Kolkata, West Bengal, India.
- [ATREE] Ashoka Trust For Research in Ecology and the Environment 2008. *Status survey of Red Panda (Ailurus fulgens) in the Neora Valley National Park, Darjeeling, West Bengal*. ATREE Eastern Himalaya Programme, Darjeeling, West Bengal, India (draft interim report submitted to Forest Department, Government of West Bengal).
- Bahuguna, N. C. & Mallick, J. K. 2010. *Handbook of the mammals of South Asia*. Natraj Publishers, Dehradun, India.
- Biswas G. G., Das, D. & Mukhopadhyay, A. 1999. Richness of mammalian species in the higher elevations of Neora Valley National Park. *Zoo's Print Journal* 14(4): 10–12.
- Choudhury, A. U. 2001. An overview of the status and conservation of the Red Panda *Ailurus fulgens* in India, with reference to its global status. *Oryx* 35: 250–259.
- Chowdhury, K. 1983. *First biological expedition to Neora Valley*. WWF–India, Eastern Region, Kolkata, West Bengal, India (unpublished report).
- Ghose, D., Molur, S. & Leus, K. 2007. *Report of the Red Panda pre-PHVA meeting, 17–19 Feb, 2007*. WWF-India, Deorali, Gangtok, Sikkim, India.
- Glatston, A. R. (ed.) in press. *Red Panda: biology and conservation of the first panda*. Academic Press, London, U.K.
- O'Malley, L. S. S. 1907. *Bengal district gazetteer: Darjeeling*. Gyan Publishing House, New Delhi, India.
- Prince, M. 2003. *Birding trip report North Bengal, India; November 2002*. <<http://www.kolkatabirds.com/mikereport.pdf>>. Downloaded on 3 January 2009.
- Saha, S. S. & Singhal, N. 1996. *Mammalian specimens of Bengal Natural History Museum, Darjeeling*. Department of Forest (Wildlife Wing), Government of West Bengal, Darjeeling, India.
- Sharma, B. R. 1990. *First management plan for the Neora Valley National Park in Darjeeling District, West Bengal, for the period 1990–1991 to 2000–2001*. Directorate of Forests, Government of West Bengal, Darjeeling, India.
- Singhal, N. & Mukhopadhyay, A. 1998. *Management plan of Neora Valley National Park, West Bengal for the period 1998–99 to 2007–08*. Wildlife Circle, Government of West Bengal, Darjeeling, India.
- UNESCO World Heritage Centre 2009. *Neora Valley National Park*. <<http://whc.unesco.org/en/tentativelists/5447>>. Downloaded on 29 July 2009.

Wildlife Wing, Directorate of Forests, Government of West Bengal, Bikash Bhawan, North Block, Salt Lake City, Kolkata 700 091, West Bengal, India.
Email: jayantamallick2007@rediffmail.com

Range extension and sociality of Bushy-tailed Olingo *Bassaricyon gabbii* in Costa Rica

José F. GONZÁLEZ-MAYA¹ and Jerrold L. BELANT²

Abstract

The Bushy-tailed Olingo *Bassaricyon gabbii* is an uncommon solitary carnivore distributed from Nicaragua to Bolivia. In Costa Rica it is known from areas below 1,700 m, almost only in the Caribbean slopes. We present the first record for this species in the northern Pacific slope, about 84 km west of the species's current known distribution. From this observation, we provide new information on group size and social behaviour of this species. We recommend additional surveys to improve our understanding of the distribution and ecology of Bushy-tailed Olingo.

Keywords: behaviour, Central America, distribution, Procyonidae, Rincón de la Vieja

Extensión de distribución y comportamiento social del Olingo de Cola Peluda *Bassaricyon gabbii* en Costa Rica

Resumen

El Olingo *Bassaricyon gabbii* es un carnívoro solitario poco común que se distribuye desde Nicaragua hasta Bolivia. En Costa Rica la distribución de la especie se conoce por debajo de los 1700 msnm y probablemente sólo en la vertiente Caribe del país. Se presenta el primer registro de la especie en la vertiente del Pacífico Norte aproximadamente 84 km al oeste de la distribución conocida hasta el momento. A partir de esta observación se reporta nueva información acerca de su comportamiento social y tamaño de grupo a través de su ámbito de distribución. Se recomiendan evaluaciones extensivas para aumentar el conocimiento sobre la ecología y distribución de la especie en el país.

Palabras clave: Centroamérica, distribución, Olingo, Procyonidae, Rincón de la Vieja

Olingos *Bassaricyon* are solitary procyonids (Reid 1998, Ramírez & Valencia 2007) distributed from south-central Nicaragua to the Andes Mountains of South America southward to Bolivia (Emmons & Feer 1990). Olingos are poorly known, including even differences between authors over whether they represent one or several species (Reid & Helgen 2008). The Bushy-tailed Olingo *B. gabbii* Allen, 1876 is an arboreal small carnivore distributed from central Nicaragua to western Colombia, Ecuador and Bolivia (De La Rosa & Nocke 2000, Carrillo *et al.* 2002). Described in 1874 from the Talamanca Mountains in Costa Rica (National Museum of Natural History voucher U.S. National Museum A 14214), little is known of its ecology, natural history and occurrence within its distribution (Glatson 1994). Although specimens of Bushy-tailed Olingo are apparently well represented in museum collections from Colombia and Panamá, few records exist from Costa Rica (e.g., American Museum of Natural History specimen M-140334) and no specimens are held by national museums (F. Durán, National Museum of Costa Rica, verbally 2010; B. Rodríguez-Herrera, Zoology Museum–Universidad de Costa Rica, verbally 2010). Bushy-tailed Olingos in Costa Rica are reportedly restricted to areas below 1,700 m elevation on the Caribbean slope of the country (Carrillo *et al.* 2002, Rodríguez-Herrera *et al.* 2005). Considered locally common in the Western Amazon (Reid & Helgen 2008), in Central America they are considered rare or uncommon (De La Rosa & Nocke 2000, Carrillo *et al.* 2002). However, because olingos are easily confused with Kinkajou *Potos flavus*, actual abundance of this species is unknown. Some authors (De La Rosa &

Nocke 2000), authorities (L. Albuja pers. comm. to Reid & Helgen 2008), and the authors' experience suggest it may be more threatened than currently listed, with populations lower than estimated. However, others consider the species common in some areas of its distribution (L. Emmons pers. comm. to Reid & Helgen 2008).

The Bushy-tailed Olingo is generally considered solitary (Emmons & Feer 1990, Reid 1998, De La Rosa & Nocke 2000, Carrillo *et al.* 2002, Mendes-Pontes *et al.* 2002); however, some accounts reported sightings of up to six individuals (Berger & Yahnke 2004, Magalhães Pinto *et al.* 2009). Among olingos, group social behaviour has only been confirmed for Beddard's Olingo *B. beddardi* in Brazil (Mendes-Pontes *et al.* 2002). Additionally, there are no known reports of Bushy-tailed Olingo group composition. Previous observations suggest that Bushy-tailed Olingo inhabits undisturbed tropical rainforests (Glatson 1994, De La Rosa & Nocke 2000) and wet forests (Emmons & Feer 1990) as well as forest edges, secondary forests and plantations (Reid & Helgen 2008), preferring the upper canopy (Mendes-Pontes & Chivers 2002, Nowak 2005) and it is considered of high vulnerability due to its arboreal habits (Daily *et al.* 2003).

We present the first documented record of Bushy-tailed Olingo for the Pacific slope of northern Costa Rica, with information on habits and social behaviour. Earlier, Daily *et al.* (2003) suggested that they had recorded this olingo in the Pacific slope of far southern Costa Rica; however, no details of identification were given and the location was omitted from Reid & Helgen (2008). During primate surveys between January and March 2004, on 14 February a group of nine Bushy-tailed Olingos was observed in a fig tree *Ficus velutina* (a genus previously reported in olingo diet;

Kays 2000) about 84 km west of the current known distribution. Group composition was five females, three males and one juvenile of undetermined sex, all feeding on figs. The group was first observed at 21h00 and remained in the tree until about 01h00, when the olingos started moving through the canopy and we lost sight of the group. The reason for their departure was unknown and did not appear related to our presence. The main activity was feeding, with some interactions among individuals, including playing, territoriality signs and space defence. No aggression or mating was recorded; but feeding, movement along branches and resting were observed in all individuals. The juvenile was considerably more active than adults, and females were more active than males. The observation was by one of the authors during night surveys from a 28 m elevated platform (used for zip-lining) with direct close sightings (some less than 7 m) of most of the individuals. The platform was located in the same fig tree as the foraging Olingo group, where the main branches formed. Using 2,000,000 candlepower lights, all individuals were clearly observed by two observers, close enough to identify sex and age. Olingos were clearly identified by their short pointed muzzles and long tails that were slightly banded and bushy but not tapered or prehensile. The observer has previous experience in identification of olingos and Kinkajou from fieldwork, inventories and mammal ecology studies across Costa Rica, from captive animals, and from extensive photo-capturing. In the same tree two Black-eared Opossums *Didelphis marsupialis* were also observed.

The observation occurred in a heavily disturbed and fragmented semi-deciduous pre-montane moist forest (Holdridge 1979) on the Rincon de la Vieja volcanic slopes (10°47'55.94"N, 85°24'7.64"W) in Guanacaste province, Liberia, Costa Rica, at about 760 m asl (Fig. 1). This area was previously logged with timber currently harvested for domestic use, and is generally isolated by cattle pastures and annual food crops. The area is heavily used by tourists for hiking and zip-lining (locally known as

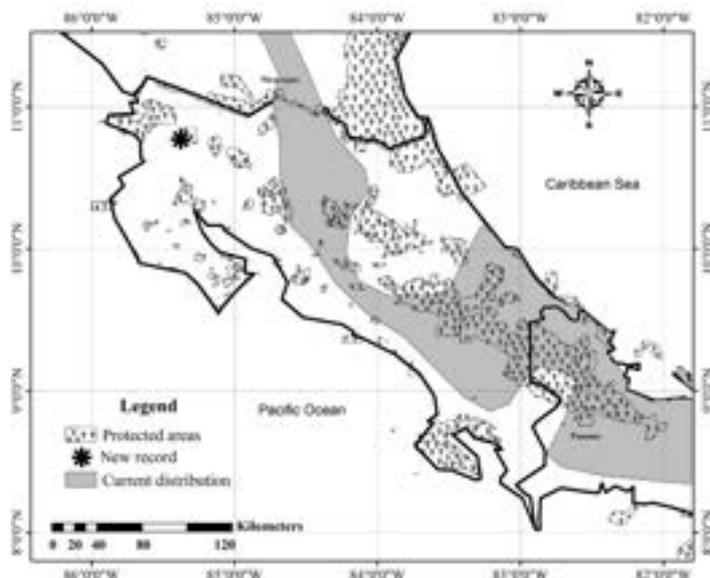


Fig. 1. Location of new distribution record for the Bushy-tailed Olingo *Bassaricyon gabbii* in relation to the current presumed distribution (from Reid & Helgen 2008) and protected areas in Costa Rica. Solid black lines represent Costa Rica and adjacent parts of Panama (southeast) and Nicaragua (north).

Canopy Tour), and contains a water slide. The fig tree in which the Bushy-tailed Olingos were observed, supporting one of the zip-line circuit platforms, is used by about 100 people each day (González-Maya & Aguilar 2004). The immediate area currently includes about 300 ha of forest fragments, with the largest fragment about 150 ha, and is located about 4 km west of the Rincon de la Vieja National Park main forest patch (around 3,000 ha of secondary growth). The area between the park and the property of the observation includes few forest fragments and forested strips along rivers, but mostly cattle pastures and crops.

This record represents the first confirmed observation of group behaviour of Bushy-tailed Olingos and extends the reported distribution in Costa Rica by 84 km. The observation increases the potential distribution by about 4,500 km² in northern Costa Rica assuming a reasonable polygon extending to the new point, indicating a wider nationwide distribution of Bushy-tailed Olingo in Costa Rica than hitherto assumed. If the potential record by Daily *et al.* (2003), lacking identification details, were confirmed, the species's range would also be greatly increased. There are several additional areas of comparable forests within this potential distribution also connected with the Caribbean slope that represents potential habitat for this species. Several of these potentially suitable areas are protected and are thus potential conservation measures in place for the species. Additional surveys are suggested to document the species's geographic distribution and abundance, evaluate conservation status, and improve our understanding of its ecology and social behaviour.

Social behaviour of many carnivore species is well described (Macdonald 1983), with examples of procyonids demonstrating complex sociality (Gompper & Decker 1998, Kays & Gittleman 2001, Hauver 2008). As demonstrated for Beddard's Olingo, we suggest the large group size and social behaviour observed was in response to food availability (Mendes-Pontes *et al.* 2002), but other factors could explain this apparently unusual behaviour. Based on our observation, however, group foraging sometimes occurs, with group composition corroborating previous suggestions of a lack of territoriality in this species (De La Rosa & Knock 2000). Our observation may reflect behavioural plasticity to a restricted but abundant food source, similar to other carnivore species (Karanth & Sunquist 1995, Weaver *et al.* 1996).

Little is known about the effects of timber harvesting and agriculture production or human disturbance on olingos. Although most observations of olingos have occurred in undisturbed forests, where most surveys probably occur (Emmons & Feer 1990, Glatston 1994, Reid & Helgen 2008), olingos have been suggested to be as tolerant to human disturbance as are Kinkajous (Glatston 1994). However, additional evidence is needed to understand habitat associations and whether undisturbed forests are critical for species conservation, as previously considered (De La Rosa & Knock 2000). Although these olingos were observed at night after human activities ceased, our observation documents their use of fragmented forests with moderate human activity.

The Bushy-tailed Olingo is categorised as Least Concern (LC) by *The IUCN Red List of Threatened Species*, and in Costa Rica is listed on Appendix III of CITES (Reid & Helgen 2008). Nevertheless, the population trend of this species is presently unknown (Reid & Helgen 2008), and we lack reliable information on distribution and basic habitat associations. As an arboreal species, Bushy-tailed Olingos intrinsically possesses a high risk of extinction (Davidson *et al.* 2009). Consequently, we recommend con-

ducting systematic surveys to better document Olingo distribution and abundance to provide baseline data for conservation efforts.

Acknowledgements

We thank Marco Aguilar and Marcela Aguirre for their support during fieldwork. Our gratitude to the entire staff at Buena Vista Lodge, especially Gerardo Ocampo, for providing logistics and information related to this record. Thanks to Ricardo Kriebel from Instituto Nacional de Biodiversidad INBio for his support on plant identification and information. To Dolly Maya, Pastor González, Paula González, Mauricio González and Amancay Cepeda for their support during this entire process.

References

- Berger, L. & Yahnke, C. 2004. *Bassaricyon gabbii*. In *Animal diversity web*. <<http://animaldiversity.ummz.umich.edu/>>. Downloaded on 19 August 2010.
- Carrillo, E., Wong, G. & Saenz, J. 2002. *Mamíferos de Costa Rica*. Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Heredia, Costa Rica.
- Daily, G., Ceballos, G., Pacheco, J., Suzán, G. & Sánchez-Azofeifa, A. 2003. Countryside biogeography of Neotropical mammals: conservation opportunities in agricultural landscapes of Costa Rica. *Conservation Biology* 17: 1814–1826.
- Davidson, A., Hamilton, M. J., Boyerb, A. G., Brown, J. H. & Ceballos, G. 2009. Multiple ecological pathways to extinction in mammals. *Proceedings of the National Academy of Sciences* 106: 10702–10705.
- De La Rosa, C. & Knock, C. 2000. *A guide to the carnivores of Central America*. University of Texas Press, Austin, Texas, U.S.A.
- Emmons, L. H. & Feer, F. 1990. *Neotropical rainforest mammals: a field guide*. University of Chicago Press, Chicago, Illinois, U.S.A.
- Glatston, A. R. 1994. *The Red Panda, olingos, coatis, raccoons, and their relatives. Status survey and conservation action plan for procyonids and ailurids*. IUCN/SSC Mustelid, Viverrid and Procyonid Specialist Group, Gland, Switzerland.
- Gompper, M. E. & Decker, D. M. 1998. *Nasua nasua*. *Mammalian Species* 580: 1–9.
- González-Maya, J. F. & Aguilar, M. 2004. *Ámbito de hogar, uso de hábitat, movimientos diarios, dieta y comportamiento de una tropa de Alouatta palliata Gray, 1849 (Primates: Atelidae), en un Bosque Húmedo Premontano de Costa Rica*. BSc thesis. Biological Sciences School, Universidad Latina de Costa Rica, San Pedro de Montes de Oca, San José, Costa Rica.
- Hauver, S. 2008. *Genetic determinants of Raccoon social behaviour in a highly urbanized environment*. MSc Thesis. Ohio State University, Columbus, Ohio, U.S.A.
- Holdridge, L. 1979. *Ecología: basada en zonas de vida*. Instituto Interamericano de Ciencias Agropecuarias (IICA), San José, Costa Rica.
- Karanth, K. U. & Sunquist, M. E. 1995. Prey selection by Tiger, Leopard and Dhole in tropical forests. *Journal of Animal Ecology* 64: 439–450.
- Kays, R. W. 2000. The behavior and ecology of Olingos (*Bassaricyon gabbii*) and their competition with Kinkajous (*Potos flavus*) in central Panama. *Mammalia* 64: 1–10.
- Kays, R. W. & Gittleman, J. L. 2001. The social organization of the Kinkajou *Potos flavus* (Procyonidae). *Journal of Zoology, London* 253: 491–504.
- Macdonald, D. 1983. The ecology of carnivore social behaviour. *Nature* 301: 379–384.
- Magalhães Pinto, R., Knoff, M., Queiroga Gonçalves, A., Sanches, M. & Noronha, D. 2009. First report of *Taenia mustelae* (Eucestoda, Taeniidae) parasitizing the Bushy-tailed Olingo, *Bassaricyon gabbii* (Carnivora, Procyonidae) in South America with an updated checklist of cestodes from other American procyonid hosts. *Neotropical Helminthology* 3: 7–14.
- Mendes-Pontes, A. & Chivers, D. 2002. Abundance, habitat use and conservation of the olingo *Bassaricyon* sp. in Maraca Ecological Station, Roraima, Brazilian Amazonia. *Studies on Neotropical Fauna and Environment* 37: 105–109.
- Mendes-Pontes, A. R., Rosas Ribeiro, P. F. & Mendonça, T. M. 2002. Olingos, *Bassaricyon beddardi* Pocock, 1921, in Brazilian Amazonia: status and recommendations. *Small Carnivore Conservation* 26: 7–8.
- Nowak, R. M. 2005. *Walker's carnivores of the world*. Johns Hopkins University Press, Baltimore, Maryland, U.S.A.
- Ramírez, A. & Valencia, F. 2007. *Guía de identificación de fauna silvestre*. Área Metropolitana del Valle de Aburra, Medellín, Antioquia, Colombia.
- Reid, F. A. 1998. *A field guide to the mammals of Central America and Southeast Mexico*. Oxford University Press, New York, New York, U.S.A.
- Reid, F. & Helgen, K. 2008. *Bassaricyon gabbii*. In *IUCN Red List of Threatened Species. Version 2010.2*. <www.iucnredlist.org>. Downloaded on 19 August 2010.
- Rodríguez-Herrera, B., Wilson, D. E., Fernández, M. & Pineda, W. 2005. La mastozoología en Costa Rica: historia, recolecta, localidades y composición de especies. *Brenesia* 63&64: 89–112.
- Weaver, J. L., Paquet, P. C. & Ruggiero, L. F. 1996. Resilience and conservation of large carnivores in the Rocky Mountains. *Conservation Biology* 10: 964–976.

¹Proyecto de Conservación de Aguas y Tierras, ProCAT Internacional/Colombia. Calle 100 # 11A – 07, Ofi. 501, Bogotá, Colombia.
Corresponding author email: jfgonzalez@procat-conservation.org.
²Carnivore Ecology Laboratory, Forest and Wildlife Research Center, Mississippi State University, Mississippi State, Mississippi, U.S.A.

Sighting of Spotted Linsang *Prionodon pardicolor* at Nameri Tiger Reserve, Assam, India

Jimmy BORAH

Abstract

A rarely recorded small carnivore, Spotted Linsang *Prionodon pardicolor* is found throughout much of south-eastern Asia. I report here the sighting of a Spotted Linsang in daytime at Nameri Tiger Reserve, Assam, India. Further research and surveys are needed to ascertain its status and distribution, particularly in the western part of its range in India.

Keywords: day-time activity, distribution record, habitat, North-east India, small carnivore

নামেৰিৰ স্পটেড লিনচাঙ্গ (Spotted Linsang) প্ৰত্যক্ষ দৰ্শন

সাৰাংশ : স্পটেড লিনচাঙ্গ (Spotted Linsang) এবিধ অতি বিৰল আৰু সৰু আকাৰৰ মাংসভোজী জন্তু। ইহতক সমগ্ৰ দক্ষিণ পূব এচিয়াত পোৱা যায়। মই উক্ত জন্তু বিধ নামেৰি ৰাষ্ট্ৰীয় উদ্যানত কৰ্মৰত অৱস্থাত দিনৰ ভাগত দেখা পাইছিলো আৰু প্ৰতিবেদন দাখিল কৰিছো। নামেৰি ৰাষ্ট্ৰীয় উদ্যানত এই জন্তু বিধৰ প্ৰকৃত অৱস্থিতি আৰু বিচৰণৰ তথ্য আহৰণৰ বাবে অধিক অধ্যয়নৰ প্ৰয়োজন আছে।

মূলশব্দ : মাংসভোজী, লিনচাঙ্গ (Linsang), উত্তৰপূব ভাৰত

The Spotted Linsang *Prionodon pardicolor* is found throughout much of south-eastern Asia, including Nepal, India, Myanmar, Thailand, Lao PDR, Cambodia, Vietnam and China (Van Rompaey 1995, Zhang *et al.* 1997, Walston 2001, Holden & Neang 2009, Duckworth *et al.* in prep.). It has been recorded in lowland, hill and mountain forest, bamboo forest, secondary growth, dense grassland and along rivers (Sunquist 1982, Pham 1992, Van Rompaey 1995, Tizard 2002). It is partly arboreal and preys mostly on small vertebrates (Lekagul & McNeely 1977, Van Rompaey 1995). Historical and recent records from across the species range are collated in Duckworth *et al.* (in prep.).

North-east India, comprising the states of Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya and Tripura is one of the biodiversity hotspots of the world (Myers 1988, 1991) and forms part of a rich bio-geographic unit. Seven species of civet and linsang have been reported from the region (Choudhury 1999) and Spotted Linsang is among those sighted least often.

Nameri Tiger Reserve (TR), Assam, India (26°50'–27°02'N, 92°38'–93°00'E), nestled at the foothills of Eastern Himalayas, is located along the north bank of the Brahmaputra River in the district of Sonitpur and covers an area of 200 km². Nameri TR contains Eastern alluvial secondary semi-evergreen forest, low alluvial savannah woodland, Eastern *Dillenia* swamp forest and wet bamboo forest, with areas of cane brakes formed by *Calamus tenuis* (Champion & Seth 1968).

As a part of the collaborative study on monitoring Tiger *Panthera tigris* and other associated species by WWF-India's North Bank Landscape Conservation Programme and the Assam Forest Department, I sighted a Spotted Linsang on 1 February 2010 at 11h34, when I was traversing on an Asian Elephant *Elephas maximus* to set a camera trap. The animal was sitting on the ground under an *Albizia procera* tree. As soon as it heard our presence it rushed off to nearby *Erianthus* grasslands and disappeared. The

sighting lasted about 8–10 seconds. The distinct dark patches on its coat were quite clear and unmistakable. I saw the short animal with its slender body, pointed head and small limbs. The tail was long and fluffy and had many alternating dark and pale (white or cream) rings. The head was not seen clearly.

The animal was in Assam Valley Tropical Evergreen Forest with narrow strips of open grassland, at 26°55'24.2"N, 92°49'46.4"E, at an altitude of 80 m a.s.l. The precise spot was a leaf-littered forest floor, covered mostly with *Albizia lucida* and *A. procera*, other trees mainly comprising *Terminalia myriocarpa*, *Bombax ceiba* and *Dillenia indica*.

Spotted Linsang occurs in dense moist tropical forests, but has also been observed in drier areas (Sunquist 1982). It is usually active at night, although daytime sightings have been recorded before (e.g. Long & Minh 2006). The species was previously feared to be threatened by habitat loss and degradation, hunting and trade across much of its range (Schreiber *et al.* 1989), but, although the impacts of these factors on populations are largely unknown, the relatively large number of records from small, degraded, and heavily hunted areas of at least Lao PDR and China (Lau *et al.* 2010, Duckworth *et al.* in prep.) indicate that the species is actually rather resilient. Further research is necessary to understand better the status, distribution and behaviour of this enigmatic animal, particularly in the Indian part of its range.

Acknowledgements

I wish to express my thanks to Mr S. Vasisth, Divisional Forest Officer, Nameri TR, for the requisite permission to carry out the field work. I also acknowledge the staffs and colleagues of WWF-India's field office at Tezpur and head office at New Delhi for their kind support and encouragement. I am grateful to Kashmira Kakati and William Duckworth for their thoughtful suggestions and comments on the manuscript. Thanks to Hiten Baishya for working on Assamese abstract. The Tiger monitoring work at Nameri TR is supported by grants from Aircel.

References

- Champion, H. G. & Seth, S. K. 1968. *A revised survey of the forest types of India*. Government of India Publications, New Delhi, India.
- Choudhury, A. U. 1999. Mustelids, viverrids and herpestids of northeastern India. *ENVIS Bulletin: Wildlife and Protected Areas* 2 (2): 43–47.
- Duckworth, J. W. *et al.* in prep. A global conservation status review of the Spotted Linsang *Prionodon pardicolor*.
- Holden, J. & Neang T. 2009. Small carnivore records from the Cardamom Mountains, southwestern Cambodia. *Small Carnivore Conservation* 40: 16–21.

- Lau, M. W.-N., Fellowes, J. R. & Chan B. P. L. 2010. Carnivores (Mammalia: Carnivora) in South China: a status review with notes on the commercial trade. *Mammal Review* 40: 247–292.
- Lekagul, B. & McNeely, J. A. 1977. *Mammals of Thailand*. Bangkok: Association for the Conservation of Wildlife (1988 printing).
- Long, B. & Minh H. 2006. Recent records of and notes on the conservation of small carnivores in Quang Nam province, Central Vietnam. *Small Carnivore Conservation* 34&35: 39–46.
- Myers, N. 1988. Threatened biotas: “Hotspots” in tropical forests. *Environmentalist* 8: 1–20.
- Myers, N. 1991. The biodiversity challenge: expanded “Hotspots” analysis. *Environmentalist* 10: 243–256.
- Pham T. A. 1992. Carnivores of North Vietnam. Pp. 81–132 in Sovolov, V. E. (ed.) *Zoological studies in Vietnam*. Nauka, Moscow, Russia. (In Russian.)
- Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives. An action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.
- Sunquist, M. E. 1982. Incidental observations of the Spotted Linsang (*Prionodon pardicolor*). *Journal of the Bombay Natural History Society* 79: 185–186.
- Tizard, R. 2002. Records of little known small carnivores from Thailand, Lao PDR and southern China. *Small Carnivore Conservation* 26: 3.
- Van Rompaey, H. 1995. The Spotted Linsang, *Prionodon pardicolor*. *Small Carnivore Conservation* 13: 10–13.
- Walston, J. L. 2001. Mammals of Cambodia. Pp. 135–152 in Smith, J. D. (ed.) *Biodiversity, the life of Cambodia – Cambodian biodiversity status report 2001*. Cambodia Biodiversity Enabling Activity, Food and Agriculture Organisation, Phnom Penh, Cambodia.
- Zhang, Y. Z., Jin, S. K., Quan, G. Q., Li, S. H., Ye, Z. Y., Wang, F. G. & Zhang, M. L. 1997. *Distribution of mammalian species in China*. CITES Management Authority of China, China Forestry Publishing House, Beijing, China.

c/o WWF-India, Parbati Nagar, Tezpur-784001, Assam, India.
Email: jimmyborah@gmail.com

1ST BORNEO CARNIVORE SYMPOSIUM

Borneo
Carnivore
Symposium:
Road Towards
Conservation
Action Plans

1st Borneo Carnivore Symposium to be held in Malaysia in June 2011

With 25 species, Borneo harbours a diverse carnivore community. The distribution of several species is restricted to this island and Borneo is a priority area for carnivore conservation. At the same time, the destruction of Borneo’s forest habitat due to timber extraction, oil palm plantations, and mining continues. As a consequence, 11 of Borneo’s carnivores are listed on *The IUCN Red List of Threatened Species*. Information on the conservation status and distribution of Borneo’s carnivores is fundamental for the development of conservation strategies. However, existing information about these aspects is very limited and dispersed across many countries and institutions.

To advance the conservation of Borneo’s carnivores, the Sabah Wildlife Department, the IUCN/SSC Small Carnivore Specialist Group, Cat Specialist Group and Otter Specialist Group, and the Leibniz Institute for Zoo and Wildlife Research will organise the *1st Borneo Carnivore Symposium – Road towards conservation action plans*. The symposium will take place from 18 to 24 of June 2011 in Kota Kinabalu, Malaysia, and bring together researchers, governmental authorities and local stakeholders from the three range countries of Borneo, to discuss the status and conservation needs of this threatened group of mammals. The event aims to synthesise our current state of knowledge on Borneo’s carnivores and to identify priority sites and issues for their conservation.

So far, the event is being sponsored by the Nashville Zoo, Houston Zoo, Mississippi State University - College for Forest Resources, WWF-Germany, Clouded Leopard Project, Shared Earth Foundation, British Ecological Society, and the Chester Zoo.

For more information about the event or to register, please visit the symposium website at <http://www.fwrc.msstate.edu/borneocarnivoresymposium>. For further enquiries about the symposium, feel free to contact us at bcs2011@izw-berlin.de



Leibniz-Institut für Zoo- und Wildtierforschung

First record of Small Indian Civet *Viverricula indica* in the Kashmir Himalaya, India

S. A. CHAROO¹, L. K. SHARMA¹, S. SATHYAKUMAR^{1*} and R. Y. NAQASH²

Abstract

The Small Indian Civet *Viverricula indica* is distributed throughout India apparently excepting the high and trans-Himalayan regions. Although previously reported to be distributed up to the Shiwaliks in the Jammu region of Jammu and Kashmir State and not across the Pir Panjal mountain range, we camera-trapped a Small Indian Civet in Dachigam National Park. This confirms its distribution further north than the Pir Panjal, up into the Kashmir region of Jammu and Kashmir State.

Key words: camera-trap, Dachigam National Park, extension of known range, habitat use

The Small Indian Civet *Viverricula indica* is one of the most widely distributed and adaptable civets in the Indian subcontinent (Roberts 1997). It is reported to be continuously distributed from the Indus valley in Pakistan east through India and south China (north to Sichuan and the lower Yangtze), south through Indochina to West Malaysia, and on Sumatra, Java, Hainan, Taiwan, Sri Lanka and various small islands. It has been introduced to Madagascar, the Comoro Islands and Socotra (Corbett & Hill 1992). The species is listed as Least Concern in the *The IUCN Red List of Threatened Species* (IUCN 2010), in Appendix III (India) of CITES and in Schedule II, Part II, of the Indian Wildlife (Protection) Act 1972 as amended in 2003.

In India, the Small Indian Civet is reported almost throughout the country (Prater 1980, Johnsingh 1986, Mudappa 2002, Menon 2003), apparently excepting the Kashmir portion of Jammu and Kashmir State in the north-west of the country (Chakraborty 1983). Modern information on distribution and ecology of Small

Indian Civet in India is rather limited except for in the Western Ghats (e.g. Johnsingh 1986, Xavier 1994, Mudappa 1998, 2002). It is reported to occur in various forest types of India ranging from tropical rainforests, scrubland and savannas to bamboo forests (Mudappa 2002).

The Dachigam National Park (34°05'–11'N, 74°54'–75°09'E) is located in the Zabarwan Hills, Zaskar mountain range of the Greater Himalaya (Fig. 1). Earlier surveys and studies at the park (Schaller 1969, Holloway *et al.* 1971, Kurt 1978, Iqbal *et al.* 2005, Ahmad 2006) did not report Small Indian Civet; but they were mostly confined to mammals larger than small carnivores, so this may not be particularly significant.

During our research on Asiatic Black Bear *Ursus thibetanus* in Dachigam National Park (2007–2010), we used camera-traps for the first time in this area. They were placed at hair-snare stations used for population estimation studies for bears, based on individual identification and non-invasive genetic sampling. We had 23 such camera- and hair-trap stations placed in a grid (cells of 4 km²) of the Lower Dachigam area (about 90 km²). In each hair-snare station, we placed honey as bait in an earthen container to attract bears.

We got one photo capture of a Small Indian Civet in riverine forest of the Lower Dachigam (34°07'57"N, 74°56'15"E; 1,770 m) on 16 July 2008 at 22h25 (Fig. 2). The characteristic streaks on the back and croup and presence of distinct ringed tail (Prater 1980, Menon 2003) confirm it to be a Small Indian Civet. Vegetation of the Lower Dachigam is classified as Himalayan Moist Temperate Forest (Champion & Seth 1968). The riverine forest is composed of a mixture of *Parrotiopsis jacquemontiana* and *Prunus* with a tree cover of about 80% and with shrubs such as *Rosa* and *Rubus* (Charoo *et al.* 2009). Ground cover at the photo capture site was represented by species such as *Dipteracanthus* spp. and *Hemorcalus fulva* (70%), rock cover (20%) and the remaining was litter cover. Dachigam experiences an irregular climate, with variation in annual precipitation and in seasonal occurrence, and the length of dry periods. Conditions are sub-Mediterranean, with, generally, two dry periods in June and September–November, and high precipitation in winter with an average snow depth of at least 1 m.

In parts of India, Small Indian Civet is farmed (e.g. Balakrishnan & Sreedevi 2007); however there are no such farms in Kashmir. This photo capture of Small Indian Civet is the first record of this species in Kashmir region of Jammu and Kashmir State, although it occurs in the plains and foothills (< 1,000 m) of Jammu, to the south of Kashmir. The Jammu and Kashmir re-

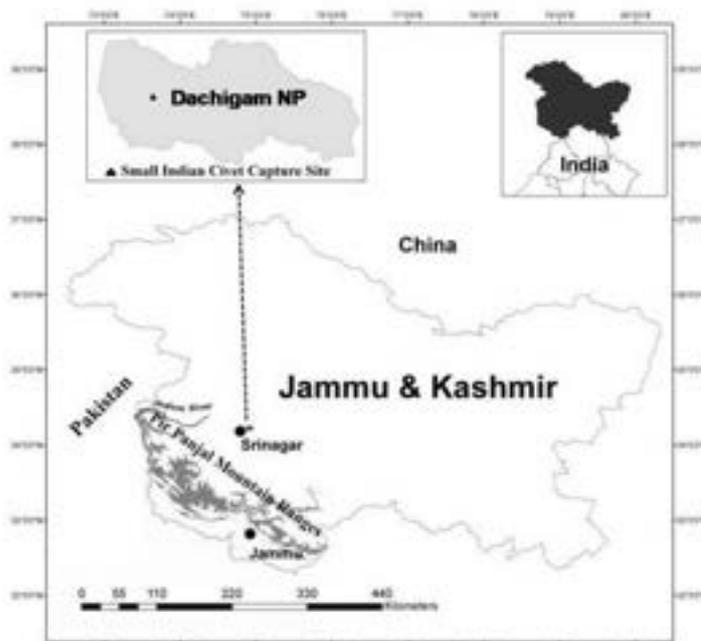


Fig. 1. Jammu and Kashmir State, showing Jammu, Srinagar, and the Dachigam National Park along with the location of the Small Indian Civet *Viverricula indica* photo capture.



Fig. 2. Camera-trap picture of Small Indian Civet *Viverricula indica* at Dachigam National Park, Jammu and Kashmir, India.

regions are separated by the Pir Panjal mountain range which has an average altitude of over 3,000 m. In adjoining Pakistan, Roberts (1997) reported that there was no evidence of Small Indian Civet in the Himalayan regions of Pakistan and indicated its distribution up to where the River Chenab enters Pakistan (about 34°N). We propose that exclusive surveys for small carnivores be carried out using camera-traps in this region to gather further information on their status and distribution considering the fact that the information is very scarce for small carnivores in this region.

References

- Ahmad, K. 2006. *Aspects of ecology of Hangul (Cervus elaphus hanglu) at Dachigam National Park, Kashmir, India*. Forest Research Institute University (Ph.D. thesis), Dehradun, India.
- Balakrishnan, M. & Sreedevi, M. B. 2007. Husbandry and management of the Small Indian Civet *Viverricula indica* (É. Geoffroy Saint-Hilaire, 1803) in Kerala, India. *Small Carnivore Conservation* 36: 9–13.
- Chakraborty, S. 1983. Contribution to the knowledge of the mammalian fauna of Jammu and Kashmir, India. *Records of the Zoological Survey of India (miscellaneous publications, occasional papers)* 38: 1–129.
- Champion, H. G. & Seth, S. K. 1968. *A review survey of the forest types of India*. Government of India Publication, Delhi, India.
- Charoo, S. A., Sharma, L. K., & Sathyakumar, S. 2009. *Asiatic Black Bear – Human conflicts around Dachigam National Park, Kashmir. Technical Report*. Wildlife Institute of India, Dehradun, India.
- Corbett, G. B. & Hill, J. E. 1992. *The mammals of Indomalayan Region: a systematic review*. Oxford University Press, Oxford, U.K.
- Holloway, C. W., Schaller, G. B. & Wani, A. R. 1971. Dachigam Wildlife Sanctuary, Kashmir, with special reference to the status and management of Hangul. *IUCN Publications New Series* 19: 109–112.
- Iqbal, S., Qureshi, Q., Sathyakumar, S. & Inayat Ullah, M. 2005. *Predator–prey relationship with special reference to Hangul (Cervus elaphus hanglu) in Dachigam National Park. Final Report*. Department of Wildlife Protection, Jammu & Kashmir Government, Srinagar, and Wildlife Institute of India, Dehradun, India.
- IUCN 2010. *IUCN Red List of Threatened Species*. Version 2010.2. <www.iucnredlist.org>. Downloaded on 10 August 2010.
- Johnsingh, A. J. T. 1986. Diversity and conservation of carnivorous mammals in India. *Proceedings of the Indian Academy of Sciences (Animal Sciences/Plant. Sciences)* Supplement: 73–89.
- Kurt, F. 1978. Kashmir Deer (*Cervus elaphus hanglu*) in Dachigam. Pp. 87–108 in Scott, P. (ed.) *Threatened deer*. IUCN, Morges, Switzerland.
- Menon, V. 2003. *A field guide to Indian mammals*. Dorling Kindersley (India), Delhi, India.
- Mudappa, D. 1998. Use of camera-traps to survey small carnivores in the tropical rainforest of Kalakad-Mundanthurai Tiger Reserve, India. *Small Carnivore Conservation* 18: 9–11.
- Mudappa, D. 2002. Observations of small carnivores in the Kalakad-Mundanthurai Tiger Reserve, Western Ghats, India. *Small Carnivore Conservation* 27: 4–5.
- Prater, S. H. 1980. *The book of Indian animals*. Bombay Natural History Society and Oxford University Press, New Delhi, India.
- Roberts, T. J. 1997. *The mammals of Pakistan*. Oxford University Press, Oxford, U.K.
- Schaller, G. B. 1969. Observations on the Hangul or Kashmir Stag (*Cervus elaphus hanglu* Wagner). *Journal of Bombay Natural History Society* 66: 1–7.
- Xavier, F. 1994. *A study on Small Indian Civet (Viverricula indica) as a sustainable wildlife resource*. University of Kerala (Ph.D. thesis), Thiruvananthapuram, India.

¹Wildlife Institute of India, P.O. Box 18, Chandrabani, Dehradun 248 001, Uttarakhand, India

²Department of Wildlife Protection, Government of Jammu & Kashmir, Pollution Control Board Campus, Rajbagh, Silk Factory Road, Srinagar 190001, Jammu and Kashmir, India.

*Corresponding author email: ssk@wii.gov.in

Southward extension of known range of Owston's Civet *Chrotogale owstoni* in Vietnam

DANG Ngoc Can¹ and LE Trong Trai²

Abstract

Owston's Civet *Chrotogale owstoni* was recently recorded twice in Chu Yang Sin National Park, Dak Lak province, Vietnam: in 2002 (dead animal recovered from a poacher's snare-line) and 2009 (field sighting). These are about 200 km south of the previously known range in the country, and the species has not been recorded at all in Cambodia, the only other country in which it might occur that far south. Chu Yang Sin National Park offers protection to one of the largest contiguous tracts of forest in Vietnam's Tay Nguyen highlands, and contains many other wildlife species of high global conservation importance, yet faces a battery of threats to habitats and fauna.

Keywords: Chu Yang Sin National Park, Da Lat plateau, Tay Nguyen highlands, threats

Vùng phân bố của loài Cầy vằn *Chrotogale owstoni* ở Việt Nam mở rộng về phía nam

ĐẶNG Ngọc Càn và LÊ Trọng Trãi

Tóm tắt

Hai lần ghi nhận gần đây cho loài Cầy vằn *Chrotogale owstoni* ở Vườn Quốc gia Chu Yang Sin, tỉnh Đắk Lắk, Việt Nam: năm 2002 (một mẫu Cầy vằn chết đã tìm thấy trong bẫy của thợ săn) và năm 2009 (quan sát thấy loài này trong khi điều tra thực địa). Đây là điểm ghi nhận có khoảng cách 200 km về phía nam so với điểm ghi nhận trước đó ở Việt Nam, và loài này chưa từng được ghi nhận ở Cấm Pu Chia, chỉ có thể ở quốc gia khác xa về phía nam. Vườn Quốc gia Chu Yang Sin đang bảo vệ một diện tích rừng liên tục lớn nhất ở Tây Nguyên, Việt Nam, và nhiều loài động vật hoang dã có tầm quan trọng bảo tồn toàn cầu, thế nhưng khu hệ động vật và nơi ở của chúng vẫn còn đối mặt với nhiều đe dọa.

Từ khóa: Cao Nguyên Đà Lạt, những đe dọa, Tây Nguyên, Vườn quốc gia Chu Yang Sin

Owston's Civet *Chrotogale owstoni* is a little-known species restricted to Vietnam, adjacent eastern Lao PDR, and a small part of adjacent China (Schreiber *et al.* 1989). It is categorised on *The IUCN Red List of Threatened Species* as globally threatened: Vulnerable, reflecting the heavy use of non-selective traps across its range, particularly snares, coupled with the great conversion, degradation and fragmentation of forest in Vietnam in recent decades (IUCN 2009). It is the only species of its genus (Veron & Heard 2000), arguably elevating its conservation significance over that of similarly threatened species but which have close relatives that remain common.

Named by Thomas (1912), few Owston's Civet specimens were collected in the early part of the twentieth century and Thomas's (1927) excitement on describing the first adult with skull (and only the third specimen then known) to arrive in Europe, collected on 8 January 1926 (Pocock 1933), is still obvious when reading his account seven decades later. Delacour (1940), one of the most active collectors in Indochina during the 1920s–1930s, considered Owston's Civet to be very rare, although Bourret (1944: 11), the only competent mammalogist to live in Vietnam in the first half of the twentieth century, described the species as (in translation) “apparently the most common civet in the region between Fan Si Pan and the Black River”. Unfortunately, Bourret (1944) did not detail the basis for his statement, which has been largely overlooked by modern authors; it is corroborated by a camera-trapping survey in the montane area around Fan Si Pan (Van Ban and Mu Cang Chai), which photographed Owston's Civet more commonly than any other carnivore (Swan & O'Reilly 2004a, 2004b). Overall,

however, Schreiber *et al.* (1989) traced only about 40 records of Owston's Civet and considered it one of the highest global conservation priorities among small carnivores.

The southernmost Vietnamese record in Schreiber *et al.* (1989) was from Cuc Phong National Park (about 20°19'N), with the southernmost world record from Xiangkhouang in Lao PDR (Thomas 1927; 19°20'N). This was extended south to Gia Lai province at 14°20'N by Rozhnov *et al.* (1992), which was the southernmost locality given for the species in Kuznetsov (2006). Robertson's (2007) exhaustive review of Vietnamese small carnivore records found no proof of Owston's Civet south of Gia Lai, but there was an unconfirmed indication from Bu Gia Map Nature Reserve (Nguyen *et al.* 1997; 12°09'N) and on the basis of habitat he predicted it might occur into the far south of Vietnam.

Owston's Civet has never been recorded in Cambodia (E. Pollard *in litt.* 2010), although two stuffed mounts were seen at the small specimen collection of the Phnom Tamao Zoo (Phnom Penh) in the late 1990s, which were felt unlikely to have originated from outside Cambodia (C. M. Poole verbally 2000). It might be expected in the country's easternmost forests. Long & Minh (2006) pointed out that records from south and central Vietnam remain few. The species is held in the Da Lat Museum, which lies south of the documented Vietnamese range (Pham *et al.* 1996). No labels were attached, and some specimens of other species in this museum were confiscated from wildlife trade (Pham Trong Anh verbally 2010), and thus the Owston's Civets cannot be assumed to have come from nearby areas.

The most recent checklist of Vietnamese mammals, Dang *et*

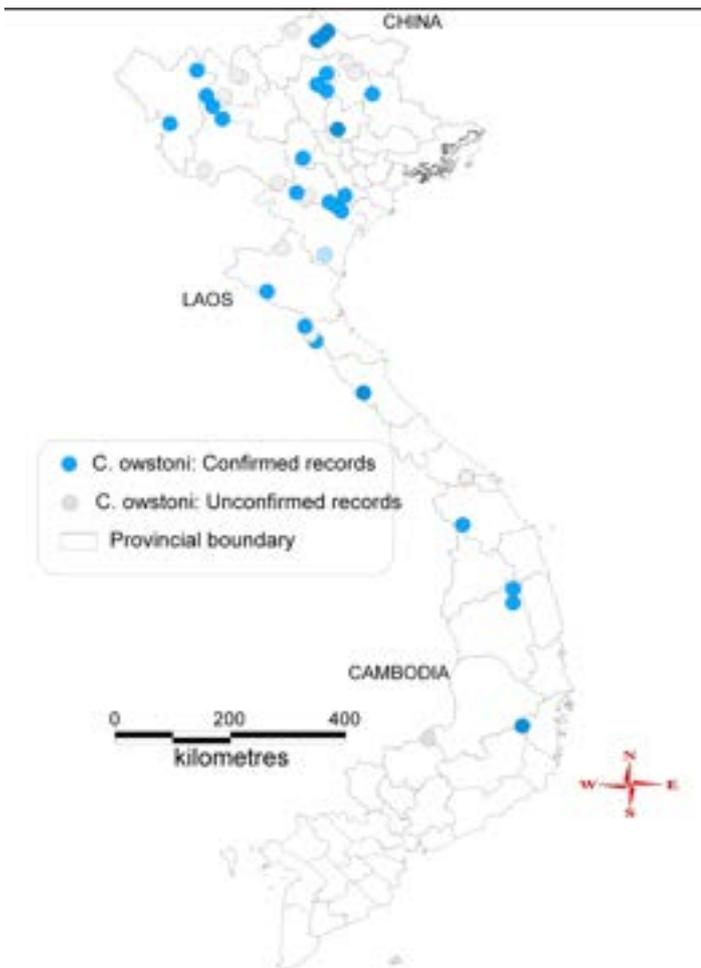


Fig. 1. Recorded localities of Owston's Civet *Chrotogale owstoni* in Vietnam. After Robertson (2007) and Dang et al. (2008). The southernmost confirmed record point is for Chu Yang Sin National Park.

al. (2008), listed Owston's Civet for Chu Yang Sin National Park (NP), about 200 km further south of the previous southernmost Owston's Civet record (Fig. 1), and this note provides the basis for this listing. During 2006–2009, several wildlife surveys were undertaken at Chu Yang Sin NP (Dang et al. 2007, 2009, BirdLife International 2010). The surveys generated two records of Owston's Civet, consistent with Robertson's (2007) habitat-based prediction of its occurrence this far south. A mounted specimen in the NP museum collection (Fig. 2) was reported to be made from a dead civet in snare collected during a forest patrol at 12°25'12"N, 108°20'58"E (about 900 m altitude) in 2002 (Tong Ngoc Chung verbally 2002). A single Owston's Civet was observed at 12°21'16"N, 108°23'31"E (1,380 m) at 04h48 on 16 March 2009 by spotlight (Maglite, 3 D-cell) by DNC and Nguyen Van Quyet on their way to a gibbon listening point. The animal was 8–10 m from the observers and was watched, unobscured, for about 30 seconds up a tree 3 m above ground; it then ran off across the ground.

The surveys of Chu Yang Sin NP covered vegetation, large and small mammals, birds, herpetofauna, fish and butterflies, and revealed the outstanding global significance of park's wildlife, as well as the battery of threats facing it (BirdLife International 2010). For such an ecologically complex area, these surveys could only scratch the surface, and it is not possible to determine how common the civet is in the national park.



Fig. 2. Owston's Civet *Chrotogale owstoni* recovered from a snare in Chu Yang Sin National Park. Photo: Dang Ngoc Can.

Chu Yang Sin, rising to 2,442 m, is one of the highest mountains in southern Vietnam. The park covers 589 km² and includes land from below 600 m to the summit. It is the largest protected area on the Da Lat Plateau, and together with adjacent forests such as those of Bi Doup Nui Ba National Park, includes an unbroken transition of forest from lowland evergreen to montane forest and offers protection to the largest remaining block of contiguous forest in Vietnam's Tay Nguyen highlands. The rich animal communities retain numerous hunting-sensitive species (BirdLife International 2010). BirdLife International (2010: 28) concluded that "high levels of hunting and relatively low encounter rates within the forests indicate that populations of most larger species of mammals are likely to be depressed and spread thinly across the forests of the Park". The park also faces severe threats of forest conversion and fragmentation (BirdLife International 2010), which, if they continue, will reduce the resilience of quarry species to any given level of hunting. Currently, the population of Owston's Civet in the park, along with other hunting-sensitive globally significant mammals such as Black-shanked Douc *Pygathrix nigripes*, Yellow-cheeked Crested Gibbon *Nomascus gabriellae*, Sun Bear *Helarctos malayanus* and Large-antlered Muntjac *Muntiacus vuquangensis*, cannot be regarded as secure.

Acknowledgements

We would like to thank the Integrating Watershed and Biodiversity Management Project funded by World Bank/GEF and BirdLife International in Vietnam for their funding for several wildlife surveys in Chu Yang Sin National Park. We particularly thank Mr Luong Vinh Linh, the park's director, and his staff for their support during the surveys. Will Duckworth assisted the write-up, and useful information was received from Nguyen Van Quyet, Pham Thong Anh, Edward Pollard and Colin Poole.

References

- BirdLife International 2010. *The biodiversity of Chu Yang Sin National Park, Dak Lak Province, Vietnam*. BirdLife International in Indochina, Hanoi, Vietnam.
- Bourret, R. 1944. Mammifères récemment entrés dans les collections du Laboratoire de Zoologie de l'École Supérieure des Sciences. *Notes et Travaux de l'École Supérieure des Sciences* 3: 1–17.
- Dang N. C., Ha V. T., Le M. H., Nguyen T. S., Nguyen H. D., Monastyrskii, A., Do A. T. & Nguyen D. T. 2007. *First biodiversity report for Chu Yang Sin National Park, Dak Lak province, Vietnam*. BirdLife International in Indochina, Hanoi, Vietnam.
- Dang N. C., Endo, H., Nguyen T. S., Oshida, T., Le X. C., Dang H. P., Lunde, D. P., Kawada, S.-I., Sasaki, M. & Hayashida, A. 2008. [Checklist of wild mammal species of Vietnam]. Shoukadoh, Kami-

- gyo, Kyoto, Japan. (In Vietnamese.)
- Dang N. C., Tran Q. T. & Tong N. C. 2009. *Mammal survey of selected sites in Chu Yang Sin National Park*. BirdLife International–Vietnam Programme, Hanoi, Vietnam.
- Delacour, J. 1940. Liste provisoire des mammifères de l’Indochine française. *Mammalia* 4: 20–29, 46–58.
- IUCN 2009. *2009 IUCN Red List of Threatened Species*. <www.iucn-redlist.org>. Downloaded on 30 November 2009.
- Kuznetsov G. V. 2006. [*Mammals of Vietnam*]. KMK Scientific Press, Moscow, Russia. (In Russian.)
- Long, B. & Minh H. 2006. Recent records of and notes on the conservation of small carnivores in Quang Nam province, central Vietnam. *Small Carnivore Conservation* 34 & 35: 39–46.
- Nguyen V. S., Pham T. A., Truong V. L. & Le X. H. 1997. *The fauna (mammals, birds, reptiles, amphibians and insects) of Bu Gia Map Nature Reserve*. Institute of Ecological and Biological Resources, Hanoi, Vietnam.
- Pham T. A., Nguyen D. K. & Nguyen T. T. L. 1996. Checklist of mammal collection of Da Lat Biological Subinstitute. *Tap Chi Sinh Hoc [Journal of Biology, Hanoi]* 18 (1): 16–22. [In Vietnamese with English title and summary.]
- Pocock, R. I. 1933. The rarer genera of oriental Viverridae. *Proceedings of the Zoological Society of London* '1933': 969–1035.
- Robertson, S. I. 2007. *The status and conservation of small carnivores in Vietnam*. PhD thesis, University of East Anglia, Norwich, U.K.
- Rozhnov, V. V., Kuznetsov, G. V. & Pham T. A. 1992. New distributional information on Owston’s Palm Civet. *Small Carnivore Conservation* 6: 7.
- Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives: an action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.
- Swan, S. R. & O’Reilly, S. M. G. (eds) 2004a. *Van Ban: a priority site for conservation in the Hoang Lien mountains. Community-based conservation in the Hoang Lien mountains: Technical Report N° 1*. Fauna & Flora International Vietnam Programme, Hanoi, Vietnam.
- Swan, S. R. & O’Reilly, S. M. G. (eds) 2004b. *Mu Cang Chai Species/Habitat Conservation Area. Community-based conservation in the Hoang Lien Mountains: Technical Report N° 2*. Fauna & Flora International Vietnam Programme, Hanoi, Vietnam.
- Thomas, O. 1912. Two new genera and a new species of viverrine Carnivora. *Proceedings of the Zoological Society of London* '1912': 498–503.
- Thomas, O. 1927. The Delacour exploration of French Indochina – mammals. *Proceedings of the Zoological Society of London* '1927': 41–58.
- Veron, G. & Heard, S. 2000. Molecular systematics of the Asiatic Viverridae (Carnivora) inferred from mitochondrial cytochrome b sequence analysis. *Journal of Zoological Systematics and Evolutionary Research* 38: 209–217.

**¹Institute of Ecology and Biological Resource, 18 Hoang Quoc Viet Street, Hanoi, Vietnam.
Email: dncaniebr@yahoo.com.vn**

**²BirdLife International in Indochina, P.O. Box 89, No. 6, Dinh Le Street, Hanoi, Vietnam.
Email: trai@birdlife.org.vn**

Mystery or myth: a review of history and conservation status of the Malabar Civet *Viverra civettina* Blyth, 1862

R. NANDINI¹ and Divya MUDAPPA²

ABSTRACT

Malabar Civet *Viverra civettina*, one of only two small carnivores in the world listed as Critically Endangered, is considered endemic to the Western Ghats, India. However, it has never been sighted with certainty in the wild and its 'known' ecology is based on speculation, not fact. We reviewed the history of its collection and published and unpublished literature on the species, and collated and interpreted results of recent surveys in order to review critically some persistent uncertainties about the species. All known skins have changed hands before reaching their current destinations, and the primary origin of each remains unknown. Malabar Civet is so close morphologically to the disjunct Large-spotted Civet *V. megaspila* of South-east Asia that the two are often considered conspecific. Four early skins have been identified as both *V. megaspila* and *V. civettina* at different times. Discrepancies in the early field descriptions attributed to Malabar Civet suggest that they refer to other, non-congeneric, species (no other *Viverra* is suspected to occur in southern India), yet most of these descriptions have been repeated as applying to Malabar Civet almost verbatim until the present, with no additional information from the wild. We present a novel possibility that the genus *Viverra* does not occur in the wild in southern India and Malabar Civet is not a taxon. If the latter is a valid taxon, the results of recent surveys suggest that it may be either extinct or near extinction across its small world range.

KEYWORDS: Critically Endangered, extinct, India, Viverridae, Western Ghats

Introduction

Among mammalian carnivores, the Viverridae is an ancient family, widely distributed in Asia and Africa across a variety of habitats. Of the 33 viverrid species (civets, genets and oians) recognised by *The IUCN Red List of Threatened Species*, 14 are currently classified as globally threatened (Schipper *et al.* 2008). This includes Malabar Civet *Viverra civettina* Blyth, 1862—a species described as endemic to the Western Ghats (Pocock 1939, Schreiber *et al.* 1989, Corbet & Hill 1992, Jennings & Veron 2009). The Western Ghats biogeographic zone includes the biotic provinces of the Western Ghats mountains and Malabar Plains as per Rodgers & Panwar (1988) and Rodgers *et al.* (2002). This species has been shrouded in mystery since its original description, and no reliable information exists about its distribution, ecology or population status. Currently listed as the only Critically Endangered (CR) viverrid by *The IUCN Red List of Threatened Species* (Schipper *et al.* 2008), it was feared extinct until its rediscovery by G. U. Kurup in 1987 (Kurup 1987, 1989).

Within its reported geographic range of southern India, Malabar Civet remains the least common of the four sympatric civets; the two scansorial palm civets—Common Palm Civet *Paradoxurus hermaphroditus* and Brown Palm Civet *P. jerdoni* (subfamily Paradoxurinae)—and the ground-dwelling Small Indian Civet *Viverricula indica* (subfamily Viverrinae) being relatively common and widely distributed (e.g. Mudappa 1999).

Within its genus, Malabar Civet is by far the most range-restricted species. It is one of the four species of the genus *Viverra*, which is restricted to Asia (Corbet & Hill 1992), with the closest relative of this genus being African Civet *Civettictis civetta* of sub-Saharan Africa (Ray 1995). Besides Malabar Civet, *Viverra* includes Large Indian Civet *V. zibetha*, Large-spotted Civet *V. megaspila* and Malay Civet *V. tangalunga*. Malabar Civet is often considered a subspecies of Large-spotted Civet (see below) and closely resembles it in appearance, although there is a large gap in their geographic ranges.

Table 1 gives geographic ranges of *Viverra* and *Viverricula*. Large Indian Civet is the most widely distributed species of *Viverra*, and Small Indian Civet is also very widespread. Malabar Civet is reported only from the Western Ghats in south India (Kurup 1989, Corbet & Hill 1992, Ashraf *et al.* 2009): there are no records of Malabar Civet from the Eastern Ghats or central India (Blanford 1888, Schreiber *et al.* 1989). Some of these civet species are found outside their native ranges, having been transported by humans for various purposes. Large Indian and Large-spotted Civets overlap widely in range with each other, and may also show a small overlap with the mostly allopatric Malay Civet; Small Indian Civet overlaps in range with all species of the genus *Viverra*. The reported distribution of Malabar Civet overlaps no other species of *Viverra* (Table 1).

Malabar Civet has not been sighted with certainty in the wild and is a species known exclusively from specimens. Therefore, there is an urgent need to consolidate the available information on the species and review its status in order to frame conservation plans. Here, we review information on the species's occurrence, assess critically the state of knowledge of this species and provide a comprehensive account of reports throughout its world range—based on the locations (albeit imprecise) of extant skins in museums and sighting reports in the Western Ghats biogeographic zone that includes the Malabar Plains and the Western Ghats mountains.

Methods

We collated information on all known skins of Malabar Civet from the literature, and checked the actual presence of the skins at six museums through visits. To examine specimens of Malabar Civet and the history of each, we obtained information directly from the Natural History Museum, London, UK (NHM) and from five museums in India—Bombay Natural History Museum, Mumbai (= Bombay) (BNHS); Zoological Survey of India Museums in Kolkata (= Calcutta) and Kozhikode (= Calicut) (ZSI); Calicut Uni-

Table 1: Distribution and range overlap of civets of the genera *Viverra* (Malabar Civet, Large Indian Civet, Large-spotted Civet and Malay Civet) and *Viverricula* (Small Indian Civet) across South and South-east Asia. Light grey = native distribution, dark grey = introduced regions. Source: Corbet & Hill (1992).

Civet Species	South India	East India	NE India	Burma	China	Laos, Cambodia, Vietnam, Thailand	Singapore	Malay peninsula	Sumatra	Borneo	East Asia Islands	Philippines
Malabar <i>V. civettina</i>												
Large Indian <i>V. zibetha</i>												
Large-spotted <i>V. megaspila</i>												
Malay <i>V. tangalunga</i>												
Small Indian <i>Viverricula indica</i>												

versity Museum, Kozhikode; and Chennai Government Museum, Chennai (= Madras). Tag details were noted (accession number, date of collection, location of collection, details of collection and collector, sex of the specimen; Table 2). We spoke with curators regarding the skins and obtained as much detail as possible, but in most cases we had no access to accession registers or collectors' field books. Where it was permitted, we photographed the skins. Also, we searched for skins and skulls of *Viverra* and *Civettictis* in museum collections using the online search engines MaNIS (Mammal Networked Information System), BioCASE (Biological Collections Access Service for Europe), Arctos, GBIF (Global Biodiversity Information Facility) portal, and Systax. We searched online collection databases of certain museums—the Natural History Museum, South Kensington, London, U.K., and Muséum National d'Histoire Naturelle, Paris, France. We obtained information of the collections at the World Museum, Liverpool, U.K., Raffles Museum of Biodiversity Research, Singapore, and at the Netherlands Centre for Biodiversity, NCB Naturalis (formerly Rijksmuseum van Natuurlijke Historie; RMNH), Leiden, the Netherlands, via direct correspondence with the curators.

We also collated data on the taxonomy and distribution from available literature on Malabar Civet. Three search engines (Web of Science, Current Contents and Google Scholar) were used to find literature on Malabar Civet using the keywords "*Viverra civettina*", "Malabar civet" and "*Viverra megaspila civettina*" (searches ending 5 May 2009). We also compiled a list of references from the reference lists of other publications and unpublished reports, notably Van Rompaey & Colyn (1996).

We held discussions with field biologists who have carried out civet surveys in southern India, as well as others who have had possible sightings of Malabar Civet, and collated recent unpublished information on the species.

In the following sections, we collate the details of the specimens of Malabar Civet in museum collections and then discuss the descriptions and historical accounts of Malabar Civet in the literature. Finally, we synthesise the field accounts and reported sightings of the species since its description up to the present, including current research.

Results

Database searches and direct communication with museum curators revealed specimens of other *Viverra* species but not of Mala-

bar Civet. Searching the NHM catalogue revealed two skins of Malabar Civet in their collections and these were viewed and tag details noted. Six surviving skins were viewed in museums within India. These were located through direct contact and published accounts. We got details of the holotype from Khajuria *et al.* (1977), but we were not able to access it during the visit to ZSI – Kolkata. Comparison of Malabar Civet skins with two other species of *Viverra* and the sympatric *Viverricula* is presented as Fig. 1.

The search engines—Current Contents and Web of Science—did not yield any result for the keywords "*Viverra civettina*", "Malabar Civet" or "*Viverra megaspila civettina*" while Google Scholar yielded 53, 412 and 12 search results, respectively. Most



Fig. 1. Skins (top to bottom) of Small Indian Civet *Viverricula indica*, Malabar Civet *Viverra civettina* and Large Indian Civet *V. zibetha* at BNHS; and Large-spotted Civet *V. megaspila* at NHM

Table 2. Specimens of Malabar Civet: locations and collection details from tags. All specimens below had tags labelled *V. civettina* or *V. megaspila civettina*. However, we think specimens 1 and 2 (*in table below) were reclassified by Lindsay (1928) as *V. megaspila* (sensu stricto) and are not *V. civettina*. We did not see skins 9–13, and we obtained details for 11 from Khajuria et al. (1977), and from curators or publications for 9, 10, 12, and 13.

	Museum	Collection number	Skin	Skull	Sex	Collection location	Source of skin	Date of collection	Collector	Complete Tag details
1*	Zoological Survey of India, Kolkata	10394	Y	N	-	-	Unknown	Unknown (nineteenth century)	Unknown	Tag 1: Indian Museum Calcutta, <i>Viverra civettina</i> , Purchased Tag 2: ZSI, <i>Viverra megaspila</i> subsp. <i>civettina</i> Blyth, Purchased, det. Robinson and Kloss 7.1.20
2*	Zoological Survey of India, Kolkata	20834	Y	N	-	-	Purchased	Unknown (nineteenth century)	Unknown	Tag 1: Indian Museum Calcutta, <i>Viverra civettina</i> , South Indian variety, <i>V. civettina</i> Blyth, Purchased Tag 2: ZSI, <i>Viverra megaspila civettina</i> Blyth Tag 3: Indian Museum, <i>Viverra civettina</i> , Purchased
3	Natural History Museum, London	ZD 1884.6.3.11	Y	Y	M	Sumatra on earliest tag - later changed to South India	Unknown, deposited at Zoological Society, London, then sold to Dr. Crisp, then sold to NHM, purchased	Donated to Zool. Soc. before 1838, bought from Dr Crisp 1860	Sir T. S. Raffles	Tag 1: <i>V. megaspila</i> , Sumatra, Collector: Sir T. S. Raffles, Crisp Sale Tag 2: <i>V. civettina</i> , Probably S India, Collector: Sir T. S. Raffles, Crisp Sale Tag 3: <i>Moschothera civettina</i> , India (no doubt), Collector: Sir T.S. Raffles, Crisp Sale
4	Natural History Museum, London	ZD 1920.1.17.3	Y	Y	M	Trivandrum Zoo	Obtained from Trivandrum Zoo	1907 - Govt. Zoo/ Museum - Tvdm, 1918 - BNHS, 1920 - NHM	W. S. Millard	Tag 1: <i>Viverra civettina</i> , Trivandrum Zoo, Bombay Natural History Society Tag 2: <i>Moschothera civettina</i> , Travancore, Trivandrum Zoo.
5	Bombay Natural History Society, Mumbai	5599	Y	Y	M	Trivandrum Zoo	Obtained from Trivandrum Zoo	1907 - Govt. Museum - Tvdm, 1918 - BNHS	W. S. Millard	<i>Viverra civettina</i> , Trivandrum Zoo, patch of skin missing from neck, possibly due to a skin infection.
6	Zoological Survey of India, Kozhikode	3847	Y	N	-	Elayur, Kerala	Recovered from a hunter	1987	G. U. Kurup	Viverridae, Malappuram district, Ernad Taluk, Karyzannur, Elayur, Collection date: 9.3.1987 (<i>sic</i>), date of entry: 17.3.1987 (<i>sic</i>).
7	Calicut University Museum, Kozhikode	no details	Y	N	-	Elayur, Kerala	Recovered from a hunter	1987	N. G. George and ZSI team	Malabar Civet cat
8	Chennai Government Museum	no details	Y	N	-	Unknown	Unknown	Presumably before 1923	Unknown	Unknown
9-10	Wildlife Institute of India, Dehra Dun	2 skins, destroyed	N	N	-	Elayur, Kerala	Recovered from a hunter	1990	N. V. K. Ashraf	Unknown
11	Zoological Survey of India, Kolkata	10393 (=A.S.B No. 140A, =I.M, No.b)	Y	Y	-	South Malabar, Kerala, India		1845	Lord Arthur Hay	[not seen]
12	NCB Naturalis, Netherlands (RMNH)	3748	Y	Y	F	India	Unknown	14 June 1938	Gebr. Blazer	<i>Civettictis civetta</i> , India
13	Zoological Survey of India, Kolkata	?	Y	Y	-	?	Unknown	Unknown (nineteenth century)	Lord W. Rutledge	[not seen]. According to Sclater (1891) the skeleton corresponding to this skin is at the museum.

of these results pertained to the biodiversity of the Western Ghats where Malabar Civet was mentioned and were not studies or reviews of the species itself. Further, only nine of these results were peer-reviewed publications. Obtaining references from published papers and unpublished reports (of projects carried out) proved the best method of obtaining literature on the species. Many publications on Malabar Civet pertain to taxonomic discussions or descriptions, and most were written before 1940. Since 1990, four surveys (Ashraf *et al.* 1993, 2009, Rai & Kumar 1993, Jayson 2007, Rao *et al.* 2007, N. G. George unpublished) have been conducted for Malabar Civet and the recent papers and unpublished reports pertain only to these surveys.

Museum specimens of Malabar Civet

Schreiber *et al.* (1989) quoted W. C. Wozencraft (*in litt.* 1988) that there are 10 skins of Malabar Civet in museums; however, we found only six skins and four skulls (belonging to four of the six skins), deposited in museums in India and the United Kingdom, labelled *Viverra civettina*, and took details from the literature for one more. Within India, the specimens are: the holotype skin and skull in the ZSI – Kolkata (not seen), one skin in the ZSI – Kozhikode, one skin and skull in BNHS, one skin in Calicut University, and one stuffed specimen in the Chennai Government Museum. Two skins and their corresponding skulls are deposited at the NHM (Table 2). In addition, we examined two non-type skins at ZSI – Kolkata that are labelled as *V. civettina* but seem to be *V. megaspila* (*sensu stricto*). Papeş & Gaubert (2007) mentioned a specimen (number 3478) at RMNH, and we examined photographs of the skin and skull sent to us by the museum and the tag on the specimen, which records the animal as *Civettictis civetta* from India (entered in 1938). Based on its appearance, and despite the labelled origin of ‘India’, we believe that it is not a *Viverra* of any species. Pending a proper investigation of this specimen, it is not discussed any further in this paper.

The holotype of Malabar Civet was obtained by Lord Arthur Hay; it was given by him in 1845 to the Asiatic Society of Bengal and was later transferred to the Indian Museum in Calcutta (now called Kolkata), then to the Zoological Survey of India, Kolkata (Sclater 1891, Lindsay 1928, Khajuria *et al.* 1977). There is neither recorded account of the origin (specific geographic location, captive/wild animal, traded/hunted animal) of this specimen nor any other first-hand detail of its collection. Lindsay (1928) recounted Blyth’s description of the holotype in his catalogue of 1862 where the latter described the specimen to be in poor condition. Lindsay (1928) also noted that the skin was torn down the back but that there are enough of the flanks, feet, and tail to discern the patterns. She stated that the skin was dull yellowish with brown markings, speculating that this was possibly due to the curing methods employed. At the time, she noted that while the upper jaw of the skull was in good condition, the lower jaw was broken.

We were able to examine only two skins at ZSI – Kolkata, both labelled as *V. civettina*, neither of which was the holotype. One specimen (catalogue number 10394) had two tags, and the second skin (catalogue number 20834) had three tags attached to it (Table 2). We believe that these are two of the purchased skins (c and d) listed in Sclater (1891) that Lindsay (1928) reclassified as *V. megaspila* (see later). We were not able to examine the specimen listed as the holotype (catalogue number 10393, *vide* Khajuria *et al.* 1977) that was discussed by Lindsay (1928). Khajuria *et al.* (1977) gave the following details for the holotype: “**Viverra**

civettina Blyth, 1862. *J. Asiat. Soc. Beng.*, Calcutta, **31**: 332. *Holotype*: Reg. No. 10393 (= A. S. B. No. 140A, = I. M. No. b), unsexed; study skin and skull (one ramus of the lower jaw damaged); South Malabar, Kerala, India; 1845; Lord A. Hay collector. Current name: *Viverra megaspila civettina* Blyth” (*sic*).

The two specimens of Malabar Civet at NHM (Fig. 2a) were deposited there at different times. The older specimen (ZD 1884.6.3.11; with skin and damaged skull) was traded twice before it reached the Museum. It was first presented by Sir Thomas Stamford Raffles to the Zoological Society before 1838, and later bought from the sale of the society’s museum collections by a Dr Crisp around 1860. The British Museum in turn “purchased (it) from the effects of Dr Crisp” (D. M. Hills, NHM, *in litt.* 2007; Fig. 2a, bottom skin). The specimen carries three tags. The original details for this specimen, in the Zoological Society catalogue (and oldest tag) record it as *V. megaspila* from Sumatra collected by T. S. Raffles. Lindsay (1928) and Pocock (1933) examined the specimen and identified it as a Malabar Civet, noting that *V. megaspila* does not occur in Sumatra. Thus, whatever the identity of the skin, this reported locality cannot be of a wild origin. Further, Pocock (1933) found that the skull characteristics of the specimen matched those of Malabar Civet skull in ZSI – Kolkata. It is therefore possible that the second tag (*V. civettina*, location “probably S India”) was attached after Lindsay’s examination of the skin, and the third tag (*Moschothera civettina* Blyth, location “India (no doubt)”) must have been written after Pocock’s examination because the genus *Moschothera* was first proposed only at this time (Pocock 1933). The later two tags’ location of India is presumably inferred from the reidentification of the specimen, rather than being based on any objective evidence. Pocock (1933) speculated that it was probably raised in captivity, and ascribed to this the differences in skull morphology of this specimen from the holotype.

The second specimen (ZD 1920.1.17.3; skin and skull) at NHM is one of two male civets that lived and died in captivity at the Trivandrum Zoological Park, Kerala, India. They were both deposited in the Government Museum, Trivandrum, in 1907, and subsequently were obtained by the Bombay Natural History Society in 1918. One was deposited at NHM in 1920 (D. M. Hills *in litt.* 2007; Fig. 2a, top), while the other (also skin and skull) was retained in BNHS (Fig. 2b). The Trivandrum Zoo holds no records regarding origin of specimens from prior to the 1950s. Furthermore, the zoo belonged to the regional monarch in the first half of the twentieth century and as animals were probably procured from various places during the king’s travels, it is not prudent to assume that the animals were captured locally within the Travancore region (Director, Trivandrum Zoo verbally 2010). Again, therefore, these specimens’ locality of origin remains unknown.

The skins in ZSI – Kozhikode and in Calicut University Museum are the most recently collected (Figs 2c, 2d). That at ZSI – Kozhikode was procured from Elayur (also called Elayavur), Kerala, by a team led by G. U. Kurup (1989) and the other skin obtained during the same expedition was deposited at Calicut University Museum (N. V. K. Ashraf and A. Kumar verbally 2010). Most recently, another skin and a stuffed specimen were collected by N. V. K. Ashraf from a tribal settlement near Poongode (< 15 km from Elayur), Kerala, during a survey in 1990 (Ashraf *et al.* 1993) (Fig. 3) and were deposited at the Wildlife Institute of India (WII), Dehradun. DM searched for them at the WII museum and confirmed with the laboratory in-charge that a skin and a stuffed specimen of Malabar Civet had been discarded on disintegration.

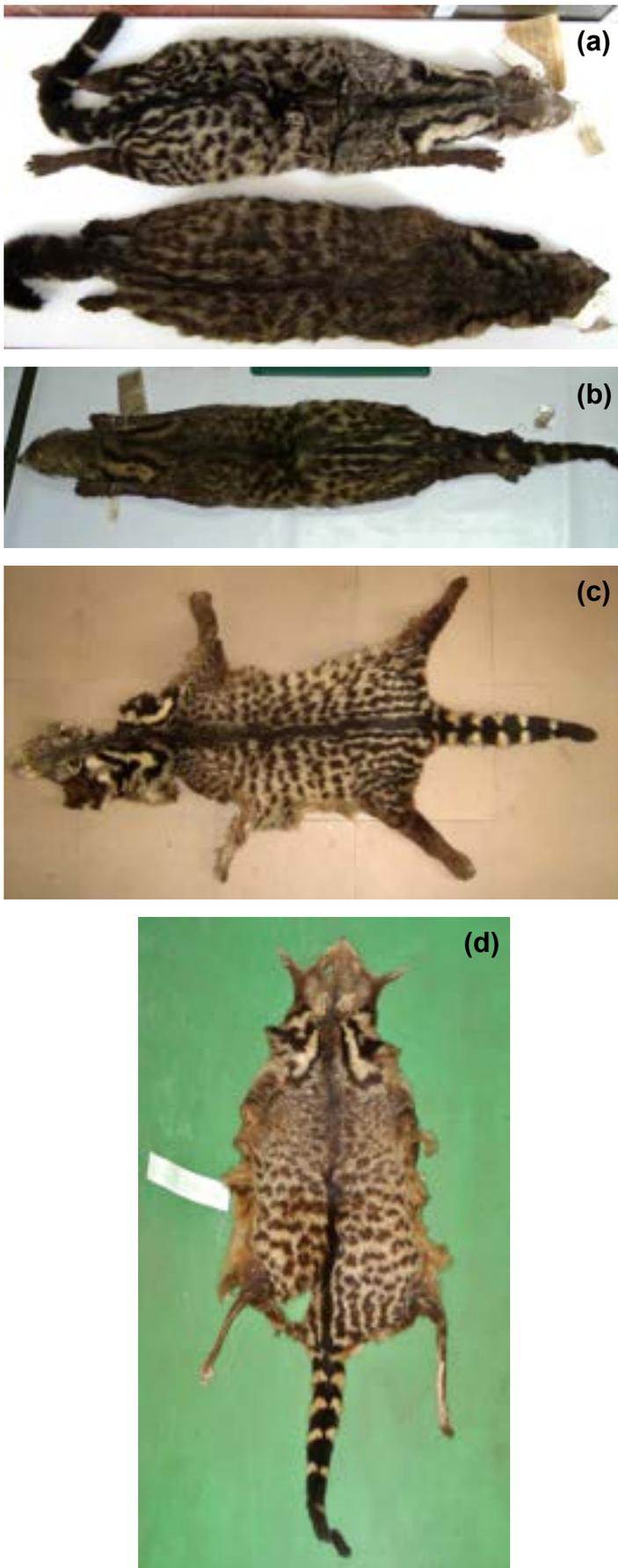


Fig. 2. Malabar Civet *Viverra civettina* specimens at: (a) NHM (top: ZD 1920.1.17.3, bottom: ZD 1884.6.3.11); (b) BNHS (5599); (c) ZSI – Kozhikode; and (d) Calicut University, Kozhikode.



Fig. 3. Skin and a stuffed specimen of Malabar Civet *Viverra civettina* collected by Ashraf et al. (1993). Photo: N. V. K. Ashraf.

Taxonomic descriptions and historical accounts

Blyth (1862) is the original description of *Viverra civettina*. As curator of the Zoological Department of the Asiatic Society of Bengal, Blyth documented various donations to the collections. In documenting several such skins, to which he gave the name *Viverra megaspila*, he discussed the other species of *Viverra* in Asia as well as the African Civet (which he called *V. civetta*). In this publication, he proposed both the names *V. megaspila* and *V. civettina*, giving very brief notes of their occurrence and morphology. He stated that there were four ‘races’ (*sic*) of Asiatic civets that were different from *V. civetta*. He described *V. civettina* as inhabiting Southern Malabar and being similar to *V. civetta* except for the mane, and noted that *V. megaspila* differed from *V. civettina* in the pattern of stripes on the sides. In a later note on Asiatic civets, Blyth (1864) suggested that *V. civettina* inhabited “Southern Malabar and probably Ceylon”, and again contrasted its stripe patterns and mane with those of *V. civetta*.

The next published information about Malabar Civet is by Jerdon (1874), who reported it to be very common, having seen many individuals. He stated that it occurred throughout the Malabar coast from Travancore region (present-day southern Kerala) up to Honore (= Honavar, Karnataka), and probably to the north of this as well. He had not seen it in the Eastern Ghats or central India, but suspected it would be found in Sri Lanka. He distinguished the species from the (allopatric) Large Indian Civet by colour patterns and described the pelage of Malabar Civet as follows: “dusky grey, with large transverse dark marks on back and sides; two obliquely transverse dark lines on the neck, which, with

the throat, is white; a dark mark on the cheek; tail ringed with dark bands; feet dark. Size of the last [*V. zibetha*] or nearly so". This description had omissions and factual errors. It did not clearly mention the distinct crest/mane along the back running to the tip of the tail, the banded/collared pattern of the throat, or the distinct (spotted) markings on the flanks, though he did note such details about *V. zibetha*.

Lindsay (1928), after examining four Malabar Civet skins, noted that it had "three obliquely transverse black lines on the throat", which we have found true in our examination of skins. In contrast, Small Indian Civet has two transverse marks on the neck and throat that vary in colour and size between individuals (our examination of 15 skins and 20 photographs). Lindsay (1928) also noted that Malabar Civet did not have a dark patch under the eye (on the cheek). Small Indian Civet has a dark patch under and sometimes around the eyes, and these patches vary in colour and size (examination of same skins and photographs). Given the similarity of Jerdon's description to characteristics of Small Indian Civet, and given that his projected range for Malabar Civet overlaps with the relevant part of the present-day range of Small Indian Civet, we echo Pocock's (1933) thoughts and suggest that Jerdon had mistaken Small Indian Civet for Malabar Civet. This is particularly unfortunate, because Jerdon (1874) contained the first reported sightings of Malabar Civet and the first account of its projected geographic range, and has thus formed the basis of most accounts of its distribution and ecology ever since (Sterndale 1884 to Menon 2003, Jayson 2007, Ashraf *et al.* 2009). However, Jerdon (1874) also gave a species entry for Small Indian Civet, and regarded it to be common.

Sterndale (1884) repeated Jerdon's description and distribution of *V. civettina*. He noted that Large Indian Civet is found south to Orissa and central India but is then replaced by Malabar Civet further south, but noted that Kellaart (*sic*) did not record the latter from Sri Lanka. Blanford (1888) noted that the reported range of Malabar Civet is geographically separate from that of Large Indian Civet, indicating that the two are probably separate species. Blanford, based on his correspondence with W. L. Sclater and on Jerdon's (1874) account, described the pelage and dentition of *V. civettina* while stating that he himself had never seen the animal. Pocock (1933) pointed out that Blanford mistakenly described the tail of Malabar Civet to have complete bands (as does Small Indian Civet's). However, Blanford (1888) had also mentioned that in his correspondence with W. L. Sclater, the latter had described the tail bands being united by a black line above.

Sclater (1891) studied four specimens then held at the Indian Museum, Kolkata. He repeated Jerdon's distribution, but described the features of the skin and skull after his own examination. Pointing out features of the skin and skull that distinguish Malabar Civet from Large Indian Civet, he directed attention to the distinct marking on the hindquarters, the black line down the tail, and the quadrangular shape of the first upper molar of Malabar Civet. He listed four specimens of *V. civettina* as in the holdings of the Indian Museum – one (skin, skeleton) donated by Lord W. Rutledge; one, the type (skin, skull), contributed by Lord A. Hay, via the Asiatic Society of Bengal in 1845; and two skins purchased, for which no further details of origin are available. Subsequently, these specimens were examined closely by Lindsay (1928), who declared that only Hay's was a Malabar Civet, the rest being Large-spotted Civets.

Robinson & Kloss (1920) considered Malabar Civet a sub-

species of Large-spotted Civet. They examined the skull of the holotype and a skin at the Indian Museum, which had "no provenance". While they pointed out differences in pelage and skull morphology between Malabar Civet and Large-spotted Civet, they also stated that these characteristics are highly variable, and that these differences might be individual variations. However, Lindsay (1928) opined that they probably examined the skull of the holotype while mistakenly examining a skin that was actually *V. megaspila*, although called *V. civettina* by Sclater (1891); and that this was probably why they considered Malabar and Large-spotted Civets conspecific. Our examination in ZSI – Kolkata, which received some years ago most, perhaps all, of the mammal specimens of the Indian Museum, Kolkata, revealed two skins labelled as both *Viverra megaspila civettina* and *Viverra civettina* (see above for details and Table 2) that are probably two of the three specimens reclassified by Lindsay (1928) as *V. megaspila*, although no additional tag or information seems to have been added to reflect this. The tag identifications still classify them as *Viverra civettina* and *Viverra megaspila civettina* (tag details in Table 2). Examination of archival notes and accession registers might provide the necessary information for these skins. The present location and identification of the Lord W. Rutledge specimen (skin and skeleton) reported by Sclater (1891) is unclear to us.

Lindsay (1928) investigated comprehensively the skins and skulls of Malabar Civet available in various museums ('Calcutta Museum' [now called the 'Indian Museum, Kolkata']; BNHS; and NHM) and compared them with the other *Viverra* species. She concluded that *V. civettina* is a distinct species, and clarified details of a number of museum specimens then extant. In Kolkata, she re-identified as *V. megaspila* three skins listed by Sclater (1891) as *V. civettina*. She also considered two skins and skulls at NHM as undoubted Malabar Civets. She examined various morphological characteristics (skin and skull) of all four species of *Viverra* and noted the differences in the upper premolars, bullae, and shape of the coronoid processes. She cited A. P. Kinloch's (1923) record in the Nelliampathy Hills of a civet probably larger than the Toddy-cat (= Common Palm Civet) judging from the faeces. Kinloch (1923) had never seen the animal leaving these faeces, and made no mention of Small Indian Civet, an obvious possibility; but the editors of the journal (*JBNHS* 1923; R. A. Spence and S. H. Prater) suggested in the editorial that it might be a Malabar Civet. They also stated that there might be a stuffed Malabar Civet in the Madras Museum, Tamil Nadu, India. We located this specimen, which is kept in a glass case. It is clearly a specimen of *Viverra*, but the details to allow identification to species are obscured by its poor condition. The records of the museum (Satyamurthi 1971), however, noted this as *Moschothera civettina* (*sic*).

Pocock (1933) reviewed the taxonomic status of the genus *Viverra* and placed two of the four civets theretofore of that genus into a new genus, *Moschothera*: Large-spotted and Malabar Civets. He distinguished the two genera through differences in foot and skull morphology. Concordant with Blyth (1862), he perceived a closer similarity between *Moschothera* and the African Civet—previously grouped with *Viverra* until moved to a new genus *Civettictis* by Pocock (1915)—than with *Viverra* (*sensu stricto*). Both *Viverra* and *Moschothera* have been used for these two species for the next seven decades, depending on author. Following an examination of multiple specimens of the four species, he emphasised that intraspecific variation in skull morphology and pelage is often greater than interspecific differences. He suggested

that some characteristics of Malabar Civet used to differentiate it from other *Viverra* (s.l.) could be a result of captive rearing (four specimens—two NHM, one BNHS, and one ZSI – Kolkata—known at the time were speculated to have been captive for at least part of their lives). Regarding Jerdon's (1874) report of the common occurrence of Malabar Civet, he wondered if Jerdon had mistaken the more widely distributed Small Indian Civet for this species. In his own attempts to obtain fresh specimens of Malabar Civet, he was sent a pair of civets from Trivandrum by his contemporaries, who had apparently “had no difficulty in getting a pair [of Malabar Civets]”, but these turned out to be Small Indian Civets (Pocock 1933). Pocock (1939) compared one skin from Trivandrum Zoo with *V. megaspila*, commenting on the foot and pelage morphology, again pointing to the need to examine inter-specific variation within each of these species.

Prater (1935) mentioned in passing two other large civet species in British India in addition to *V. zibetha*—Large Malabar Civet (*sic*) *Moschothera civettina* from Travancore and Cochin, and Burmese Civet (*sic*) *M. megaspila* found in Southern Burma, Siam, Annam, Cochin China and the Malay Peninsula. He noted that the differences between *Moschothera* and *Viverra* were in the absence of sheaths to the claws of the fore feet and relative hairless skin between the pads of the feet. He considered both the species to be rare.

Webb-Peploe (1947) in his notes on the mammals of south Tinnevely [= Tirunelveli] was doubtful of the presence of Large Malabar Civet in this region but suspected it to occur in the mountains since the species recorded there were similar to those in neighbouring Travancore (present day region around Trivandrum) where Malabar Civet had been reported.

Ellerman & Morrison-Scott (1951) disagreed with Pocock's (1933) reclassification and considered *Moschothera* as merely a subgenus, and Malabar Civet as a geographic race of Large-spotted Civet.

Prater (1965) mentioned Malabar Civet only briefly, which he considered a race of Large-spotted Civet. He stated that this civet “was once very common in the coastal districts of Malabar and Travancore”, occurring in wooded plains as well as the adjoining hill slopes (presumably repeating Jerdon 1874), but noted that at the time of his publication that it was rare and possibly nearing extinction; Pocock (1939) had already made this case quite strongly.

Subsequent to this, Wozencraft (1984, 1989) examined the NHM specimens of Malabar Civet and considered it a separate species. All taxonomic accounts henceforth maintain the status of this species (Jennings *et al.* 2008). However, Corbet & Hill (1992) kept *V. civettina* specifically distinct only provisionally, because only one of the morphological characteristics suggested by Lindsay (1928), the curved coronoid process of the mandible, seemed to be valid based on their examinations.

Field surveys and ecological accounts

There are very few accounts of Malabar Civet from the wild. The first account was provided by Jerdon (1874), who reported the species as common along the Malabar Coast and occasionally in the hills of Wynaad and Coorg [= Kodagu]. Following him, no biologist or surveyor appears to have believed that s/he had sighted the species until Hutton (1949). The extensive Mammals of India surveys conducted by the Bombay Natural History Society between 1908 and 1915 yielded no information or skins of Malabar

Civet (e.g. Wroughton 1921, Pocock 1939), but few of the surveys were in the presumed range of Malabar Civet, and most of these failed to detect even other nocturnal small carnivores even though some species like Small Indian Civet are common around these sites today. Several of the other small carnivores endemic (or nearly so) to south India (Stripe-necked Mongoose *Herpestes vitticollis*, Brown Mongoose *H. fuscus* [which also occurs Sri Lanka], Brown Palm Civet and Nilgiri Marten *Martes gwatkinsii*) were found on only one survey in the series (Wroughton 1921) and this took place, the collector (G. C. Shortridge) suspected, at too high altitude for Malabar Civet (Ryley 1913). G. C. Shortridge was also of the opinion that since nobody seemed familiar with Malabar Civet in Coorg, Blanford's record (Blanford only quoted Jerdon's description of the distribution) from there may have been of a straggler from the coasts. In the Berars (commonly known as Melghat), the surveyor, C. A. Crump, was informed by His Highness the Rao that Small Indian Civet was known by the local name ‘jabadio’ (Wroughton 1912); a local name suggested, without clear foundation, to denote specifically Malabar Civet in Kerala in the latter half of the twentieth century (see below).

The next claim of Malabar Civet in the wild after Jerdon (1874) is by Hutton (1949), who reported sightings from the High Wavy Mountains (9°42'N, 77°26'E; altitude > 1,500 m a.s.l.; Fig. 4) and Varushanad Valley (9°32'N, 77°22'E; altitude > 1,500 m a.s.l.). He described two species of civets from the region – the “Large Malabar Civet (*Moschothera civettina*)” and the “Small Indian Civet (*Viverricula indica*)” and listed the Tamil name ‘punagu poonai’ for both species. He stated that Malabar Civet was fairly common in evergreen forest, though not often seen, and reported that it was kept in captivity for the collection of civetone. He stated that he himself had been unsuccessful in raising animals. In describing Small Indian Civet he had little to say, stating that he had only seen one in deciduous forest at about 900 m a.s.l., but guessing that it must be fairly common, judging from the droppings; however, he did not state what characteristics he used to distinguish these species (either as faeces or for the animal itself). We examined a photograph (with kind permission from Hutton himself) of a young animal reared by him in the High Wavys that he identified as a Malabar Civet, but, given the size of the animal and its age, compounded by the quality of the image, we cannot identify the species with certainty: however, it looks more like a young Small Indian Civet than a *Viverra*. Currently, Small Indian Civet is common in the High Wavy Mountains (pers. obs.), but there has been no other evidence of Malabar Civet from this region (see following section).

Recent years – ‘rediscovery’ and sightings

In more than half a century since 1949, there have been only two published accounts of field sightings of possible Malabar Civets. K. U. Karanth (1986) reported sighting an animal he considered probably a Malabar Civet in Bhagavathy Valley, Karnataka (13°12'N, 75°12'E), in 1975. He saw the animal in daylight (17h00) at a distance of 10 m while driving down a road and described it as larger than Small Indian Civet, greyish in colour with indistinct patterns and a banded tail; he did not note the presence of a crest. As noted by Schreiber *et al.* (1989), Karanth (1986) published his account of the sighting nearly a decade after the sighting, when he checked his observation against a skin specimen to cross-check his identification (K. U. Karanth *in litt.* 2009).

Kurup (1987, 1989), in his papers on the “rediscovery” of

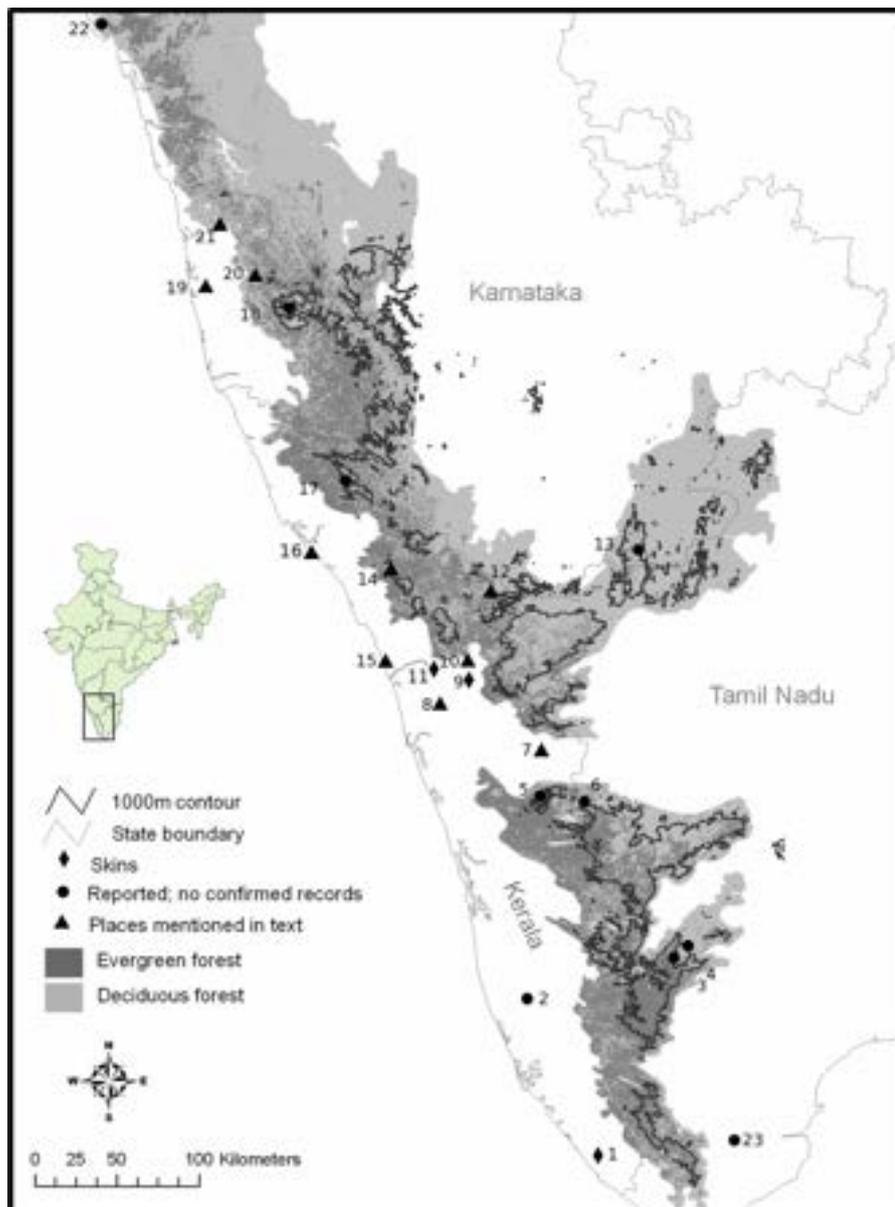


Fig. 4. Locations of collections and reported sightings of Malabar Civet *Viverra civettina*. Towns referred to in the text are also marked here. (1–Trivandrum, 2–Thiruvalla, 3–High Wavy Mountains, 4–Varushanad Hills, 5–Nelliampathy Hills, 6–Aliyar, 7–Palghat, 8–Malappuram, 9–Poongode, 10–Nilambur Reserved Forests, 11–Elayur, 12–Wynaad Wildlife Sanctuary, 13–Biligiri Rangaswamy Temple Wildlife Sanctuary, 14–Kannavam Reserved Forest, 15–Kozhikode, 16–Kannur, 17–Kodagu, 18–Kudremukh National Park, 19–Udupi, 20–Someshwara Wildlife Sanctuary, 21–Mookambika Wildlife Sanctuary, 22–Karwar, 23–Tirunelveli).

Malabar Civet, mentioned sighting an individual near Thiruvalla, Kerala (8°24'N, 76°58'E), a decade before publication, but provided no detailed description of the sighting or the animal. In March 1987, three live civets were reported to have been captured in Elayur (11°17'N, 76°06'E), Kerala, and a team from ZSI – Kozhikode, investigated the site (Kurup 1989). By the time they arrived there, the animals were dead. Apparently these were captured at a site that was being converted from a cashew *Anacardium occidentale* plantation to a rubber *Hevea brasiliensis* plantation (Ashraf *et al.* 2009). One of these skins is deposited in ZSI – Kozhikode (Kurup 1989) and another is at the Calicut University Museum (N. V. K. Ashraf, A. Kumar and N. G. George verbally 2010). Kurup (1987, 1989) did not furnish a detailed description of the skins or their capture (location of capture, purpose or method of capture, or ecology or behaviour of the animal). Although a passing mention is made of the report of three animals, Kurup (1989) only identified and described the skin now in the possession of ZSI – Kozhikode, and gave no details of the other two.

Following the reports from Elayur, several surveys have been conducted in the Western Ghats, particularly in the lowland forests and plantations (Ashraf 1992, Ashraf *et al.* 1993, 2009,

Rai & Kumar 1993, Jayson 2007, N. G. George verbally 2010). N. G. George, Curator at Calicut University, conducted a one-year survey in early 1990s around Elayur doing both fieldwork and conducting questionnaires using flyers with pictures of civets, but did not find any evidence of Malabar Civet (N. G. George verbally 2010). Ashraf *et al.* (1993) surveyed the regions of Elayur and adjoining areas of Calicut and Palghat (two districts in Kerala), and the Kudremukh Wildlife Sanctuary in 1990. Their survey did not result in direct sightings of the species but procured one skin (fairly fresh, from a tribal settlement, Poongode, 11°10'N, 76°16'E) and a stuffed specimen of an animal killed in 1987 from a hunter in Elayur. Both these specimens were deposited in the Wildlife Institute of India but have since been lost (see above). According to Ashraf *et al.* (1993), only 10% (mainly hunters, Ayurvedic physicians and civet-rearers) of people surveyed seemed to be familiar with Malabar Civet, reportedly referring to it by the local name 'jawad' (but see below). Of 22 areas surveyed, seven (in Kerala) reported having had captives assigned by the interviewers to Malabar Civets in the past 30 years to collect civetone. Hunters interviewed ($n=6$) in Kudremukh National Park did not recognise Malabar Civet through the discussion methods used. Ashraf

et al. (1993) consolidated information from discussions regarding captures and enumerated 22 captures of animals assigned by the interviewers to Malabar Civet in 18 occasions over 40 years (1953–1993); ten of these were caught by dogs. They listed potential sites with populations of Malabar Civets and provided a list of potential habitats (ecological distribution) for Malabar Civet based on interviews, although they did not come across any direct evidence for the occurrence of the species.

As a follow-up of the survey of Ashraf *et al.* (1993), Rai & Kumar (1993) conducted a short study in Nilambur and adjoining forests in Kerala, and a questionnaire survey north of the Palghat Gap from Nilambur, Kerala, north to Agnashini Valley in Karnataka (seven districts in total). This study resulted in no direct sightings or photographs of Malabar Civet, but reported hunters at various sites along the Western Ghats stating that they recognised the species based on verbal descriptions of the surveyors. Rai & Kumar (1993) reported Malabar Civet as occurring in cashew plantations and rice fields in Nilambur based on information from villagers, and they even located defecation sites, which they identified as from the species. Their survey suggested knowledge of Malabar Civet in the Kannavam Forest Range (Kerala) and Kudremukh NP, Someshwara NP, Mookambika WLS, and Karwar in Karnataka. Neither Ashraf *et al.* (1993) nor Rai & Kumar (1993) presented any comparative information regarding occurrence or abundance of Small Indian Civet at most of these sites. They obtained no skins but Rai & Kumar (1993) recovered a civet gland (species unconfirmed) from a hunter in Kannur district in Kerala who had killed an animal in February 1992. However, this gland was too foetid to be of use for histological or genetic analysis (A. Kumar verbally 2010). Rai & Kumar (1993) also walked transects at night, and reported Small Indian Civet among other nocturnal mammals at certain sites, but did not record Malabar Civet.

The most recent survey for Malabar Civet was a reconnaissance in eleven districts in Kerala and six in Karnataka in 2006 and 2008 (Rao *et al.* 2007, Ashraf *et al.* 2009). Again, this study resulted in no sightings or photographs of Malabar Civet but questionnaire surveys suggested knowledge of the animal in Malappuram and Kannur districts in Kerala. However, in contrast to Rai & Kumar (1993), they concluded that only few people in Karnataka had local knowledge of the species, almost all of them from the Udupi district. Ashraf *et al.* (2009) also found community-specific local names used for large ground-dwelling civets within their survey sites. The name ‘jawad’ and its derivatives that Rai & Kumar (1993) reported to mean the Malabar Civet in Kerala, was used for the Small Indian Civet in Karnataka (Rao *et al.* 2007). Although it is quite plausible that the name would also be used for Malabar Civet, that it is clearly not tied only to it invalidates the conclusions of Rai & Kumar (1993) and Ashraf *et al.* (1993) regarding the extensive distribution of Malabar Civet in Karnataka.

Another two-year study in Kerala (Jayson 2007) used field surveys, questionnaires, brochures inviting public response, and live-trapping to seek Malabar Civet. The study also visited captive-breeding centres of Small Indian Civet. This study too could not find Malabar Civet, and concluded that many identifications of Malabar Civet by recent surveyors using local people’s answers were false: upon examination these invariably turned out to be Common Palm Civet (Jayson 2007).

Over the past few years a few sightings of ‘possible Malabar Civets’ have not entered mainstream literature, including (with

kind permission for their presentation here from the observers) sightings apparently of large civets stated to be different from Small Indian Civet from Karwar (T. Baskaran verbally 2010), the High Wavy Mountains (R. Whitaker & J. Lenin verbally 2009), the Biligiri Rangaswamy Temple Wildlife Sanctuary (A. Datta verbally 2009), the Aliyar Forest Range of the Indira Gandhi Wildlife Sanctuary (M. Singh verbally 2010) and Coorg (S. Molur in Ashraf *et al.* 2009); none of these could be confirmed as involving Malabar Civet by the observers themselves.

Discussion

A century and a half after it was described and several surveys and reports later, Malabar Civet remains elusive, and nothing solid is known about its distribution, ecology or status. A critical review of available information leads to two possible conclusions: one, now widely accepted, is that Malabar Civet is an extremely rare species that is extinct or nearly so. The second, more novel, possibility is that the species is an artefact and did not exist at all.

Is Malabar Civet extinct?

The Western Ghats has lost much of its forest cover in the past century (Menon & Bawa 1998), mostly through land use change, expansion of human population and development projects. Kerala, the state that Malabar Civet is primarily reported to inhabit, lost 25.6% of its forest area between 1973 and 1990, including 19.5% of its dense forest cover (Jha *et al.* 2000). Within Kerala, Jha *et al.* (2000) also estimated that forest loss was greatest in the Palghat district, Kerala, and increase in agriculture was most in the Kozhikode district, both lowland regions that presumably had evergreen forests. These districts encompass the sites identified as potential Malabar Civet habitat by Ashraf *et al.* (1993), and also the region where the species was ‘rediscovered’ (Kurup 1989). Coupled with this, Kerala had the highest state-level average human population density in India until the 1980s, with the population growing over five-fold in the past century (National Informatics Centre 2005). Human population density can be used as a surrogate of anthropogenic impact (Cardillo *et al.* 2004), and has been associated with a measure of mammal population declines in other studies (Brashares *et al.* 2001).

Another human activity driving animal extinctions, as well as, more commonly, population reductions, is hunting for trade and subsistence (Corlett 2007). Civets have played an historically important role in various civilisations, and in India from as far back as 1030 B.C. until the present day (Abebe 2003). They are a source of the aromatic product ‘civet’, which is obtained from glands near the anus, and the English name civet itself originates from the African word ‘zibeth’ or Arabian word ‘zabaad’ denoting the civet perfume; evidently, ‘jawad’, in use in southern India for civets (see above), is also homologous. While all civets of the subfamily Viverrinae produce civet, mainly African, Large Indian and Small Indian Civets have been kept in captivity and traded for extraction of civet in India, China, Ethiopia, Egypt, Arabia and Europe (Dannenfeldt 1985).

Within India, civet was among two animal products mentioned in trade lists (the other being musk) in the Coromandel region (present day Tamil Nadu) in the mediaeval (900–1300 CE) and the Vijayanagara (1400–1600 CE; present day northern Karnataka) periods, and used locally for temple services (Mukund 1999). Civet was also used for medicinal purposes in South

India (Hymavathi 1993), and today remains a key ingredient in Ayurvedic medicine, a form of traditional medicine (Balakrishnan & Sreedevi 2007a). Small Indian Civets are kept in captivity in Kerala to extract the civet for Ayurvedic medicine (Xavier 1994), and it is thought that most civet farms replenish their stock of animals by capture from the wild and not through captive-rearing (Balakrishnan & Sreedevi 2007a). While there are only records of Small Indian Civet in captivity today, there are reports of animals said to be Malabar Civet having been used for the extraction of civet in the past (Hutton 1949, Ashraf *et al.* 2009; but see above for the uncertainty over identifications of this species). Hunting of *Viverra* species has eliminated them from most of their range in China (Corlett 2007, Lau *et al.* 2010). Had there been targeted such exploitation of Malabar Civet in south India, this might have further spiralled its decline, resulting in its current great rarity.

The combination of the limited geographical and postulated ecological distribution, disappearing habitat within this range, and possible hunting of the species for its civet or meat, provides plausible reasons to explain the rarity of this species. However, even in regions where hunting and encroachment of natural habitats are chronic conservation issues, as in parts of South-east Asia, behaviourally similar species like Large-spotted Civet persist. This latter is relatively readily found by surveys using appropriate methodology in the occupied altitude range in large contiguous tracts of forest (Austin 1999, Lynam *et al.* 2005, Jenks *et al.* 2010, Gray *et al.* 2010) and even in some smaller habitat blocks (Nguyen *et al.* 2004). Surveys that use appropriate techniques but outside the altitude and habitat type typically occupied by the species do not record it at all (J. W. Duckworth *in litt.* 2010).

It remains possible that Malabar Civet has been overlooked by recent surveys through a failure to focus on exactly suitable habitats (whatever these might be), and if these habitats are fragmented or mostly converted, hunting would be highly damaging to any remaining (small) populations. By contrast, if suitable habitat remains at all widespread, large-scale hunting as a cause for extinction of Malabar Civet seems unlikely as (a) even hunters do not seem to be familiar with the species, and (b) no other mammal species, including many of the rare primates that are more commonly hunted/preferred, have become extinct in the last century in this region.

Is Malabar Civet a myth?

It is possible that Malabar Civet may not be a valid taxon, and that no *Viverra* species has occurred (in historical times) naturally in the Western Ghats. The first reason to doubt that any *Viverra* occurs naturally in south India is the poorly-documented history of Malabar Civet specimens. None has reliable location data, and collections were not of animals that had been directly obtained alive from the wild by the collectors themselves and therefore their actual origins also are unknown.

The pre-1980 specimens could be explained as Large-spotted Civets mislabelled as to location. Edward Blyth, who described Malabar Civet, traded exotic species across continents for mercantile as well as academic purposes, and Kolkata was at the time a hub for such animal trade (Brandon-Jones 1997); and mistakes in cataloguing could have been a distinct possibility for specimens in addition to the obvious such case for the NHM specimen originally labelled Sumatra. This skin was contributed by Sir T. S. Raffles, who worked extensively in South-east Asia and very little in India (Raffles 1830), so it is possible this skin was mislabelled at a

later date as being from India having in fact come from the South-east Asian range of *V. megaspila*.

It has also been speculated before that all the earlier specimens collected were possibly of individuals kept in captivity. Out of all the distinguishing features of Malabar Civet discussed, only one—the angle of the coronoid process—is consistently distinctive for *V. civettina* compared with *V. megaspila* (Pocock 1933). Pocock (1933) and Corbet & Hill (1992), while accepting, tentatively, the validity of *V. civettina*, cautioned that interspecific variation between *Viverra* is eclipsed by intraspecific variation within these species and suggested that the distinguishing features of Malabar Civet could be cases of individual variation within Large-spotted Civet.

It is also curious there have been no confirmed sightings of Malabar Civet in the wild, despite directed surveys (see above). The only historical primary reports of sightings in the wild, Jerdon (1874) and Hutton (1949), both seem to have been misidentifications of Small Indian Civet. Other efforts specifically for the species led to the procurement only of Small Indian Civets, albeit misidentified as Malabar Civet (Pocock 1933). The only two published accounts of possible sightings in the recent years (Karanth 1986, Kurup 1989) do not carry adequate information regarding the description of the individuals sighted to enable firm identification to species by others.

While all the earlier skins might be explained as mistakes over provenance, the appearance of four skins in the late 1980s (Kurup 1989, Ashraf *et al.* 1993) within a 15 km radius warrants a fresh line of reasoning. The paucity of sightings after numerous localised surveys around the sites of the rediscoveries might suggest that these individuals were derived from trade or farming.

Civets have been transported to various countries and islands to be farmed for the production of civet, and in some areas free-ranging self-sustaining populations have resulted. The Large Indian Civet has been introduced to the Andaman Islands (Corbet & Hill 1992); Small Indian Civet has been introduced to the islands of Lombok, Sumbawa, the Philippines (Heinsohn 2001) and Madagascar, the Comoros and Socotra (Corbet & Hill 1992); and the Malay Civet has been introduced to Sulawesi and the Moluccas, all plausibly for the extraction of civet (Boitani 2001). Many carnivore introductions have been successful, and an example of an alien invasive is the American Mink *Neovison vison*, that succeeded in environments where it was not ecologically distinct from its conspecifics (Macdonald & Thom 2001). Small Indian Civet, introduced to Madagascar from tropical Asia nearly 2000 years ago, is said to be now common in degraded and agricultural lands (Primack & Corlett 2005).

It is plausible that Large-spotted Civet was traded or introduced into India for use in the perfume industry, and few individuals might have run wild, resulting in the low number of reports and skins. The recent records are from near Kozhikode, a well-known and important international trading port since ancient times (Malekandathil 2007). Import of animals might explain the lack of confirmed sightings in the wild, and accounts of the animals only from hunters and traditional medicine practitioners. Although Ashraf *et al.* (1993) concluded that Ayurvedic physicians were aware of the use of the civet from Malabar Civets in captivity, later studies do not report the same (Balakrishnan & Sreedevi 2007b). At present the only civets in captivity in South India are Small Indian Civets, and these are farmed extensively across Kerala state (Balakrishnan & Sreedevi 2007a).

Conclusion

This examination of historical information highlights more than ever the importance of determining the taxonomic status, and indeed existence, of Malabar Civet. Given the current limited state of knowledge of the species, we do not advocate one possibility over the other, but that both these so different possibilities exist emphasises how remarkably poorly known is Malabar Civet.

An obvious approach would be a study of the morphometrics and molecular phylogenetics of the genus, particularly of all *Viverra civettina*, *Viverra megaspila* and *Civettictis civetta* skins labelled as being from India before further field surveys are commissioned. This might provide information regarding the taxonomic validity of Malabar Civet, its origin and the relationship between Malabar Civet and its congeners. However, the results of such investigations might be inconclusive if enough samples of the *V. megaspila* are not available from all across their range. Recent molecular studies on another mammal, Layard's Striped Squirrel *Funambulus layardi*, reported from the Western Ghats and Sri Lanka but never sighted in the wild in the Western Ghats, have revealed that the locality within India was possibly a mistake (R. Dissanayake verbally 2010). Once genetic information on the skins is generated, non-invasive genetic techniques can be standardised for distinction of this species from other small carnivores (data for many other carnivores already available; see Mukherjee *et al.* 2010), and these techniques can be applied to faeces collected from the field.

It is also important simultaneously to examine the prevalence of historical trade of animals in the subcontinent and the extent of current and past use of civets in the Ayurveda industry. Government archives with records of animals brought into the country at specific locations might provide some leads. Details of locations from validated museum records could help with designing intensive surveys in specific sites. Intensive field studies should be undertaken after a careful assessment of the habitat (forest cover, altitude and other ecological variables) at the presumed locations of validated skins and identification of similar habitat patches across the Western Ghats.

It is imperative to have accurate information regarding the validity of species so that efforts are not wasted in conservation assessments or plans. However, if Malabar Civet is indeed a distinct species, it would be the first mammal to reach near-extinction in the Western Ghats within historical times, and urgent and large-scale surveys to locate and assess the species in the wild must be conducted as a priority.

Acknowledgements

We dedicate this paper to the late Naresh Chaturvedi, ex-Curator of BNHS, for his encouragement and support. We thank the staff of various museums for their co-operation, especially C. Radhakrishnan and Ramakrishna at ZSI, and staff at Calicut University Museum, Paula Jenkins and Daphne Hills at NHM, Varad Giri at BNHS, and Steven van der Mije, NCB Naturalis (RMNH). The authorities at the Trivandrum Zoo and Kerala State Archives, Thiruvananthapuram, were helpful with our queries. We are also grateful to many people for discussions and information: N. V. K. Ashraf, M. Balakrishnan, Theodore Bhaskaran, Aparajita Datta, Rajith Dissanayake, N. G. George, Thomas Groen, Angus Hutton, E. A. Jayson, P. Jeganathan, K. Ullas Karanth, V. Karthikeyan, Ajith Kumar, Janaki Lenin, Charudutt Mishra, Kakoli Mukhopadhyay, Malvika Onial, Suhel Quader, Siddharth Rao, A. R. Rahmani, Uma Ramakrishnan, Mahesh Rangarajan, Mewa Singh, Anindya Sinha, K. A. Subramanian,

Kalyan Varma, V. S. Vijayan and Francis Xavier. J. W. Duckworth, Jerry Belant, T. R. Shankar Raman, Robin Vijayan, and M. D. Madhusudhan and two anonymous reviewers provided insightful comments on the manuscript. The first author was supported by a grant from the CEPF-ATREE (Critical Ecosystems Partnership Fund – Ashoka Trust for Ecology and Environment) Western Ghats Program and Nature Conservation Foundation, Mysore.

References

- Abebe, Y. D. 2003. Sustainable utilization of the African Civet (*Civettictis civetta*) in Ethiopia. Pp. 197–208 in Bihini Won wa Musiti (ed) *Second Pan-African symposium on the sustainable use of natural resources in Africa*. IUCN, Gland, Switzerland and Cambridge, U.K.
- Ashraf, N. V. K. 1992. From N. V. Ashraf Kunhunu... *Small Carnivore Conservation* 7: 18.
- Ashraf, N. V. K., Kumar, A. & Johnsingh, A. J. T. 1993. Two endemic viverrids of the Western Ghats, India. *Oryx* 27: 109–114.
- Ashraf, N. V. K., Menon, V., Amstrong, N., Rao, S. & Karthik, K. 2009. *Conservation of Malabar Civet (Viverra civettina) in Kerala and Karnataka: final report*. Wildlife Trust of India, New Delhi, India.
- Austin, S. C. 1999. Camera-trapping evidence of Large-spotted Civet *Viverra megaspila* in Xe Pian National Biodiversity Conservation Area (NBCA), southern Lao PDR. *Natural History Bulletin of the Siam Society* 47: 255–257.
- Balakrishnan, M. & Sreedevi, M. 2007a. Captive breeding of the Small Indian Civet *Viverricula indica* (Geoffroy Saint-Hilaire, 1803). *Small Carnivore Conservation* 36: 5–8.
- Balakrishnan, M. & Sreedevi, M. 2007b. Husbandry and management of the Small Indian Civet *Viverricula indica* (Geoffroy Saint-Hilaire, 1803) in Kerala, India. *Small Carnivore Conservation* 36: 9–13.
- Blanford, W. T. 1888. *The fauna of British India including Ceylon & Burma: Mammalia*. Taylor & Francis, London, U.K.
- Blyth, E. 1862. Report of Curator, Zoological Department, 1862. *Journal of the Asiatic Society of Bengal* 31: 331–345.
- Blyth, E. 1864. Notes on sundry Mammalia. *Proceedings of the Zoological Society of London* '1864': 482–486.
- Boitani, L. 2001. Carnivore introductions and invasions: their success and management options. Pp. 123–144 in Gittleman, J. L., Funk, S. M., MacDonald, D. W. & Wayne, R. K. (eds) *Carnivore conservation*. Cambridge University Press, Cambridge, U.K.
- Brandon-Jones, C. 1997. Edward Blyth, Charles Darwin, and the animal trade in nineteenth-century India and Britain. *Journal of the History of Biology* 30: 145–178.
- Brashares, J., Arcese, P. & Sam, M. 2001. Human demography and reserve size predict wildlife extinction in West Africa. *Proceedings of the Royal Society of London. Series B: Biological Sciences* 268: 2473–2478.
- Cardillo, M., Purvis, A., Sechrest, W., Gittleman, J., Bielby, J. & Mace, G. 2004. Human population density and extinction risk in the world's carnivores. *PLoS Biology* 2: E197.
- Corbet, G. B. & Hill, J. E. 1992. *The mammals of the Indomalayan region*. Oxford University Press, Oxford, U.K.
- Corlett, R. T. 2007. The impact of hunting on the mammalian fauna of tropical Asian forests. *Biotropica* 39: 292–303.
- Dannenfeldt, K. 1885. Europe discovers civet cats and civet. *Journal of the History of Biology* 18: 403–431.
- Ellerman, J. R. & Morrison-Scott, T. C. S. 1951. *Checklist of Palaearctic and Indian mammals*. British Museum (Natural History), London, U.K.
- Gray, T. N. E., Pin C. & Pin C. 2010. Status and ecology of Large-spot-

- ted Civet *Viverra megaspila* in eastern Cambodia. *Small Carnivore Conservation* 43: 12–15.
- Heinsohn, T. E. 2001. Human influences on vertebrate zoogeography: animal translocation and biological invasions across and to the east of Wallace's Line. Pp. 153–170 in Metcalfe, I., Smith, J. M. B., Morwood, M. & Davidson, I. (eds) *Faunal and floral migration and evolution in SE Asia-Australasia*. Swets & Zeitlinger, Lisse, the Netherlands.
- Hutton, A. F. 1949. Notes on the snakes and mammals of the High Wavy Mountains, Madura District, South India. Part II—Mammals. *Journal of the Bombay Natural History Society* 48: 681–694.
- Hymavathi, P. 1993. Religion and popular medicine in Medieval Andhra. *Social Scientist* 21: 34–47.
- Jayson, E. A. 2007. *Status of the critically endangered species, Malabar Civet Viverra megaspila civettina Blyth, 1862 in the southern Western Ghats*. Kerala Forest Research Institute (Research Report 305), Peechi, India.
- Jenks, K. E., Wanghonsa, S., Songsasen, N., Leimgruber, P. & Howard, J. 2010. Camera-trap evidence of Large-spotted Civet *Viverra megaspila* in Khao Ang Rue Nai Wildlife Sanctuary and Khao Yai National Park, Thailand. *Small Carnivore Conservation* 42: 19–21.
- Jennings, A. & Veron, G. 2009. Family Viverridae (civets, genets and oysans). Pp. 174–232 in Wilson, D. E. & Mittermeier, R. A. (eds) *Handbook of the mammals of the world. Vol. 1. Carnivores*. Lynx Edicions, Barcelona.
- Jennings, A., Veron, G. & Helgen, K. 2008. *Viverra civettina*. In *The IUCN 2008 Red List of Threatened Species, Version 2010.4*. <www.iucnredlist.org>. Downloaded on 24 April 2010.
- Jerdon, T. C. 1874. *The mammals of India; a natural history of all the animals known to inhabit continental India*. John Weldon, London, U.K.
- Jha, C., Dutt, C. & Bawa, K. 2000. Deforestation and land use changes in Western Ghats, India. *Current Science* 79: 231–238.
- Karanth, K. U. 1986. A possible sighting record of the Malabar Civet (*Viverra megaspila* Blyth) from Karnataka. *Journal of the Bombay Natural History Society* 83: 192–193.
- Khajuria, H., Chaturvedi, Y. & Ghoshal, D. K. 1977. Annotated catalogue of the type specimens of mammals in Zoological Survey of India. *Records of the Zoological Survey of India (miscellaneous publications, occasional papers)* 7.
- Kinloch, A. P. 1923. The larger mammals of the Nelliampathy Hills. *Journal of the Bombay Natural History Society* 29: 552–554.
- Kurup, G. U. 1987. The rediscovery of the Malabar Civet, *Viverra megaspila civettina* Blyth in India. *Cheetal* 28(2): 1–4.
- Kurup, G. U. 1989. The rediscovery of the Malabar Civet, *Viverra megaspila civettina* Blyth in India. *Tigerpaper* 16(1): 13–14.
- Lau, M. W.-N., Fellowes, J. R. & Chan, B. P. L. 2010. Carnivores (Mammalia: Carnivora) in south China: a status review with notes on the commercial trade. *Mammal Review* 40: 247–292.
- Lindsay, H. M. 1928. A note on *Viverra civettina*, Blyth. *Journal of the Bombay Natural History Society* 33: 146–148.
- Lynam A. J., Myint Maung, Saw Htoo Tha Po & Duckworth, J. W. 2005. Recent records of Large-spotted Civet *Viverra megaspila* from Thailand and Myanmar. *Small Carnivore Conservation* 32: 8–11.
- Macdonald, D. & Thom, M. 2001. Alien carnivores: unwelcome experiments in ecological theory. Pp. 93–122 in Gittleman, J. L., Funk, S. M., MacDonald, D. W. & Wayne, R. K. (eds) *Carnivore conservation*. Cambridge University, Cambridge, U.K.
- Malekandathil, P. 2007. Winds of change and links of continuity: a study on the merchant groups of Kerala and the channels of their trade, 1000–1800. *Journal of the Economic and Social History of the Orient* 50: 259–286.
- Menon, V. 2003. *A field guide to Indian mammals*. Dorling Kindersley & Penguin India, New Delhi, India
- Menon, S. & Bawa, K. 1998. Deforestation in the tropics: reconciling disparities in estimates for India. *Ambio* 27: 576–577.
- Mudappa, D. 1999. Lesser-known carnivores of the Western Ghats. *ENVIS Bulletin: wildlife and protected areas, mustelids, viverrids and herpestids of India* 2(2): 65–70.
- Mukherjee, S., Ashalakshmi, C. N., Home, C. & Ramakrishnan, U. 2010. An evaluation of the PCR-RFLP technique to aid molecular-based monitoring of felids and canids in India. *BMC Research Notes* 3: 1–8.
- Mukund, K. 1999. *The trading world of the Tamil merchant: evolution of merchant capitalism in the Coromandel*. Orient Blackswan, Hyderabad, India.
- Nguyen X. D., Pham T. A., Nguyen M. T. & Le H. T. 2004. Mammals. Pp. 85–103, 133–138 in Sage, N., Kutcher, S., Nguyen X. V., Wilson, P. & Dunlop, J. (eds) *Biodiversity Survey U Minh Thuong National Park*. Agriculture Publishing House, Ho Chi Minh City, Vietnam.
- Papeş, M. & Gaubert, P. 2007. Modeling ecological niches from low number of occurrences: assessment of conservation status of viverrids (Mammalia, Carnivora) across two continents. *Diversity and Distributions* 13: 890–902.
- Pocock, R. I. 1915. On the feet and glands and other external characteristics of the Viverrinae, with the description of a new genus. *Proceedings of the Zoological Society of London* 1915: 131–149.
- Pocock, R. I. 1933. The civet-cats of Asia. *Journal of the Bombay Natural History Society* 36: 423–449.
- Pocock, R. I. 1939. *The fauna of British India including Ceylon and Burma. Mammalia. Vol I. Primates and Carnivora (in part): families Felidae and Viverridae*. Taylor and Francis Ltd, London, U.K.
- Prater, S. H. 1935. The wild animals of the Indian Empire. Part IV. Carnivora or beasts of prey (continued). *Journal of the Bombay Natural History Society* 37: 189–215.
- Prater, S. H. 1965. *The book of Indian animals*, 2nd edn. Bombay Natural History Society, Bombay, India.
- Primack, R. B. & Corlett, R. T. 2005. *Tropical rain forests: an ecological and biogeographical comparison*. Blackwell Publishing, Oxford, U.K.
- Raffles, S. 1830. *Memoir of the life and public services of Sir Thomas Stamford Raffles F.R.S. &c., particularly in the government of Java, 1811–1816, and of Bencoolen and its dependencies, 1817–1824; with details of the commerce and resources of the Eastern Archipelago*. John Murray, London, U.K.
- Rai, N. & Kumar, A. 1993. A pilot study on the conservation of the Malabar Civet, *Viverra civettina* (Blyth, 1862). *Small Carnivore Conservation* 9: 3–7.
- Rao, S., Ashraf, N. V. K. & Nixon, A. M. A. 2007. Search for the Malabar Civet *Viverra civettina* in Karnataka and Kerala, India, 2006–2007. *Small Carnivore Conservation* 37: 6–10.
- Ray, J. 1995. *Civettictis civetta*. *Mammalian Species* 488: 1–7.
- Robinson, H. C. & Kloss, C. B. 1920. Notes on Viverridae. *Records of the Indian Museum* 19: 175–179.
- Rodgers, W. A. & Panwar, H. S. 1988. *Planning a wildlife protected area network in India*. Wildlife Institute of India, Dehradun, India.
- Rodgers, W. A., Panwar, H. S. & Mathur, V. B. 2002. *Wildlife protected area network in India: a review*. Wildlife Institute of India, Dehradun, India.
- Ryley, K. V. 1913. Bombay Natural History Society' Mammal Survey of

- India. Report No. 11. Coorg. *Journal of the Bombay Natural History Society* 22: 486–513.
- Satyamurthi, T. S. 1971. *The mammals (Tamil)*. Publication of the Government Museum, Chennai, India.
- Schipper, J., Hoffman, M., Duckworth, J. W. & Conroy, J. 2008. The 2008 IUCN Red Listings of the world's small carnivores. *Small Carnivore Conservation* 39: 29–34.
- Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives: an action plan for the conservation of mustelids and viverrids*. IUCN, Gland, Switzerland.
- Slater, W. L. 1891. *Catalogue of Mammalia in the Indian Museum, Calcutta*, part II. Indian Museum, Calcutta, India.
- Sterndale, R. 1884. *Natural history of the Mammalia of India and Ceylon*. Thacker, Spink & co., Calcutta, India.
- Van Rompaey, H. & Colyn, M. 1996. An annotated bibliography of the Herpestidae and Viverridae (Carnivora, Mammalia). *Musée Royal de l'Afrique Centrale Annales Sciences Zoologiques* 279: 1–411.
- Webb-Peploe, C. G. 1947. Field notes on the mammals of south Tinnelveli, south India. *Journal of the Bombay Natural History Society* 46: 629–644.
- Wozencraft, W. C. 1984. *A phylogenetic reappraisal of the Viverridae and its relationship to other Carnivora*. Unpublished PhD Thesis, University of Kansas, Lawrence, U. S. A.
- Wozencraft, W. C. 1989. Classification of the Recent Carnivora. Pp. 569–593 in Gittleman, J. L. (ed.) *Carnivore behavior, ecology and evolution*, vol. 1. Cornell University Press, Ithaca, U.S.A.
- Wroughton, R. C. 1912. Bombay Natural History Society's Mammal Survey of India: Report 2. *Journal of the Bombay Natural History Society* 21: 820–825.
- Wroughton, R. C. 1921. Summary of the results from the Indian mammal survey of the Bombay Natural History Society, Appendix. *Journal of the Bombay Natural History Society* 27: 520–534.
- Xavier, F. 1994. *A study on Small Indian Civet (Viverricula indica) as a sustainable wildlife resource*. University of Kerala (Ph. D. thesis), Thiruvananthapuram, India.

¹National Institute of Advanced Studies, Indian Institute of Science Campus, Bangalore 560 012, India, & Department of Biological Sciences, Auburn University, Auburn AL 36849, USA

Corresponding author email: nandinirajamani@gmail.com

²Nature Conservation Foundation, 3076/5, IV Cross, Gokulam Park, Mysore – 570002, India

Email: divya@ncf-india.org

SMALL CARNIVORE SYMPOSIUM

Small carnivore conservation in Colombia: SCSG and ProCAT Colombia cosponsor symposium at the III Colombian Zoological Congress

Little information is available on the ecology and life history of small carnivores in Colombia (families Mephitidae, Mustelidae and Procyonidae). As part of a new project about these species in Colombia, ProCAT Colombia and the Small Carnivore Specialist Group (SCSG) are gathering available information on these species and establishing research projects in several parts of the country. Also, this project is bringing together researchers from the entire country and is developing a web-based information system to update our knowledge of small carnivores.



Also, as part of this initiative and to help address information needs, ProCAT Colombia, the Universidad Distrital Francisco José de Caldas, and the Small Carnivore Specialist Group are co-sponsoring a symposium at the III Colombian Zoological Congress in Medellín, Colombia, 21–26 November 2010. The symposium is titled 'Small Carnivores of Colombia (Skunks, Raccoons, and Weasels)'. Objectives of this symposium are to summarise the state of knowledge and conservation of small carnivores in Colombia, prioritise information needs and possible conservation actions, and define a course of action to facilitate small carnivore conservation in Colombia. Presentations will include global priorities for small carnivore conservation, role of spatial scale in conserving small carnivores, current conservation measures being implemented, and the status of small carnivores in Colombia.

The project and symposium is being lead by SCSG members José F. González-Maya and Jerry Belant, with the support of Diego Zárrate, Sergio Balaguera, Amancay Cepeda and Abelardo Rodríguez among other national researchers, and the online platform is now under construction by Amancay Cepeda and Sandra Hernández.

For more information about the congress and this symposium, please visit <http://www.iiicongresocolombianozoologia.org/>, and for any other aspect related with the initiative and project please contact info@procat-conservation.org.



1



3a



2



3b



4a



4b



12

Figures for Eaton et al.,
pages 16–22

