Hose's Civet
Borneo's mysterious carnivore

A research team from the Wildlife Conservation Society (WCS) Malaysia Program, led by **John Mathai**, is fighting against time and a severe shortage of funding in an effort to study the habitat and ecology of the elusive Hose's Civet.

Text by **John Mathai**
Photos by **Wildlife Conservation Society (WCS) Malaysia**

Twenty years from now, the introductory sentence to the Hose's Civet Diplogale hosei in journals, magazines and textbooks may very well read: 'This rare, mysterious civet once roamed the mountainous forests of Borneo'. Like so many animals already, the Hose's Civet may, in the future, be extolled in extinction, yet at present, when alive and perhaps under severe threat, it is completely ignored.

However, the Hose's Civet still has a chance. It has been detected at high encounter rates in a logging concession deep in the interior of Sarawak, Borneo, and is now the focal species of a research team from the Wildlife Conservation Society (WCS) Malaysia Program. The team, led by myself, aims to understand the major threats to the species and hopes to recommend improved timber harvesting techniques and management strategies to ensure that not just the Hose's Civet, but the whole guild of small carnivores, vital to the health and integrity of forest ecosystems, can persist in the vast areas of forest designated for logging in the state.

The state of Sarawak in Borneo currently suffers high levels of deforestation, with forests outside protected areas rapidly being degraded by timber extraction, conversion to oil palm plantations and other land developments. With just 4% of the land area gazetted as protected areas compared to 35.2% earmarked for logging activities (Sarawak Forest Department, 1997), it is critical to document the status of mammals in forest remnants within logging concessions and in the modified habitats themselves so as to determine conservation priorities and management strategies.


Hose's Civet.

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Small carnivores can be good indicators of forest health, provided sufficient data are available. Carnivores sit high in the food chain and regulate populations of prey and other carnivores through predation and competition. Apart from diverse vertebrate and invertebrate prey, carnivores in Sarawak eat many fruits and regularly pass intact seeds in their faeces, indicating their importance as seed dispersers.

They thus have cascading effects on the entire forest trophic system and play a vital role in forest regeneration.


Photo: John Mathai
Mossy forest n the Forest Management Unit.

Borneo was identified as one of the seven global priority areas for small carnivore conservation by the IUCN/SSC small carnivore action plan in 1989 (Schreiber *et al.*, 1989). It has more endemic carnivores than any other island except Madagascar (Meiri, 2005). In spite of the undoubted importance of Borneo to small carnivores, credible, accurate and up-to-date information about their distribution and ecology in Sarawak is scarce, with few systematic studies having being undertaken till date.

To understand status and ecology of wildlife in logging concessions in Sarawak, and to evaluate conservation priorities and management recommendations, a long-term monitoring programme was launched by WCS Malaysia in 2004 in the Sela'an-Linau Forest Management Unit (FMU), the first of only two logging concessions in the state which were once certified under the Malaysian Timber

Three methods recorded small carnivores: line transects (diurnal direct observation), sign surveys, and camera-trapping.


Photo: John Mathai
Waterfalls in the FMU.

Certification Scheme. The main objective was to document the diversity and distribution of mammals and birds within the FMU. Small carnivores were simply part of the general remit, and reported here are records of them from the first 54 months.

Study Area

The Sela'an-Linau FMU covers 55,949 ha (or 559 km^2, roughly 80% the size of Singapore), and lies in the hinterland of northern Sarawak, north of the upper Baram River. Samling Strategic Corporation (Samling) is the licensed concessionaire. In the FMU live many indigenous human communities such as the Kayan, Kelabit, Kenyah and Penan, many of whom depend on forest for their livelihood and on wildlife for their protein.

The Sela'an-Linau FMU is undulating in nature, with altitudes from 300 m above sea level (a.s.l.) in its southwest to about 2,000 m a.s.l. in the Tama Abu Range on its eastern edge. Much (60%) supports mixed dipterocarp forest, with some montane forest on higher ground (4%) and tropical heath forest (*kerangas*) on infertile soils (21%). Old and current swidden (*temuda*) covers 15%. Enrichment planting with native timber species is being done in some 3,000 ha that burnt during the 1997–1998 El Niño event. About half the forest was logged conventionally in the past, but since 2003 a reduced impact logging (RIL) is applied. The area receives high rainfall (3,400–5,900 mm annually) with no distinct wet or dry season. Temperatures in low-lying areas average around 26˚C, falling to 14 ˚C on summits.

Surveys were concentrated in 14 sites in the western, northern and central Sela'an-Linau FMU. The survey areas were divided into sectors based on differences in logging regime, time elapsed after logging, elevation, hunting pressure, proximity to settlements and slash and burn fields, proximity to logging roads, and forest contiguity (Mathai *et al.*, 2010). This was done to allow investigation of occurrence patterns for regularly encountered species; however, no small carnivore was found frequently enough to allow an analysis of such spatial precision. Most of the survey efforts were conducted in the Protected

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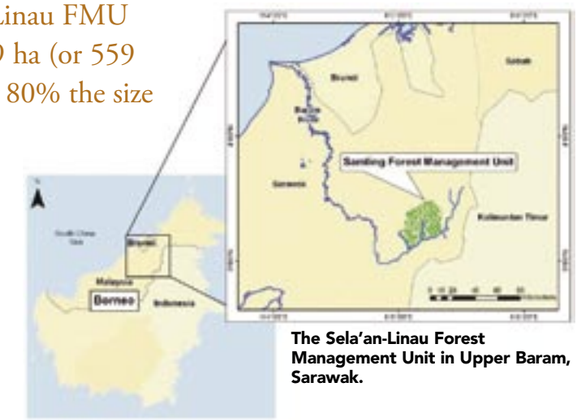


The Sela'an-Linau Forest Management Unit in Upper Baram, Sarawak.

Zone (PZ), an area which is set aside for conservation, with no timber harvesting planned in the FMU's current Forest Management Plan. The PZ, however, is not gazetted under the state government and hence has no legal protection. It is mainly montane and submontane forest, ranging from 900 m to almost 2,000 m a.s.l.

Methods

Field work spanned March 2004 to September 2008, using multiple methods. Three methods recorded small carnivores: line transects (diurnal direct observation), sign surveys, and camera-trapping. The survey team walked 789 km of line transects, 277 km during sign surveys, and camera-trapped for 5,252 trap-nights.

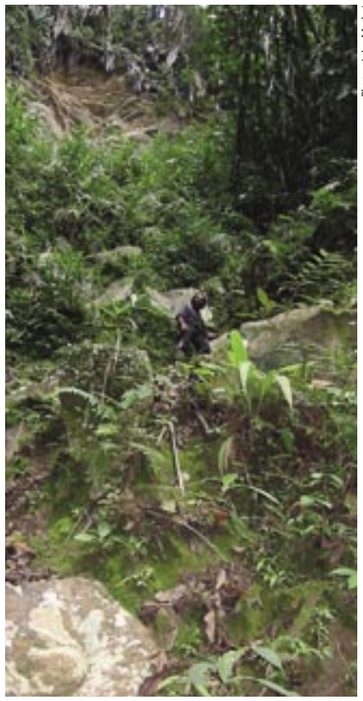


Photo: John Mathai

Transect lines are not necessarily straight and flat; in fact, they are very often steep and treacherous.

Line transects undertaken separately for direct sighting and for sign surveys were the major general survey methods. 25 transect lines of approximately 2 km each were established and marked every 25 m. Transects were surveyed daily starting from 07:00 am until about 11:00 am. At each 25 m interval, surveyors stopped for 1 minute and all mammals and large birds either observed or heard were recorded.

Sign surveys were conducted along the same transect lines as direct diurnal observations. Tracks, diggings in the earth and on fallen trees, body markings, antler markings and claw marks were recorded, as were the probable size of the individual (adult or young) and time since the signs were made.

These surveys are still on-going during 2010. However, both methods yield too few small carnivore records for species-level analysis.

Camera-trapping occurred from January 2005 to September 2008, using 40 Camtrakker^{TM} units. In 2008, two LeafRiver digital units were acquired. By the end of the survey, all 42 cameras were out of commission, mainly due to high humidity. Cameras were set at salt licks, at Great Argus *Argusianus argus* dancing grounds, and along ridges near the transect lines. Some were placed far from transect lines. Cameras were placed typically at heights of 20-30 cm above ground level, at a distance between 1 and 1.5 m from the animal trail. All cameras were set to run 24 hours a day. Images of conspecifics at the same camera location separated by at least half an hour were recorded as independent observations (O'Brien *et al.*, 2003).

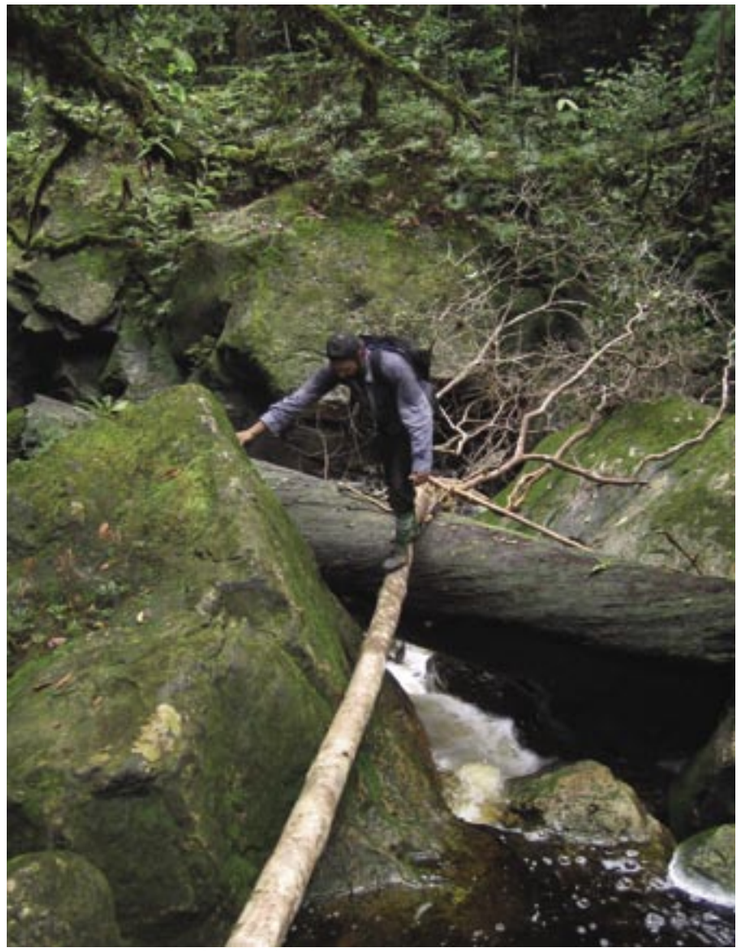
Results

In total, 16 carnivore species were recorded: 14 small carnivores, Sun Bear and Sunda Clouded Leopard. Of the small carnivores, there were at least 3 species of mustelids (otters, martens and weasels) (otters could not be identified to species, so there could potentially be more), 7 species of viverrids (civets), 2 species of herpestids (mongooses) and 2 species of felids (cats). Four of these small carnivore species are listed as Vulnerable under the *IUCN Red List of Threatened Species* (IUCN, 2010): Hose's Civet (endemic to Borneo), Binturong, Banded Civet and Marbled Cat. Otters were not identified to species, but are also red-listed. One species, Collared Mongoose, is Data Deficient on the Red List. Both large carnivores are listed as Vulnerable.

The Protected Zone recorded the highest small carnivore diversity; nine of the 14 small carnivore species recorded were found there (64.3%). However, survey effort and type varied too much from site to site for comparisons between them of their small carnivore records to be meaningful.

Camera-trapping was the best survey method for small carnivores (Table 1): of 14 species recorded, 12 were detected by camera-traps, only six by line transects, and, given ambiguous species identification, sign surveys were useful only for Malay Civet *Viverra tangalunga*, Sun Bear and otters. Sun Bear was the most widely found carnivore, in 12 of the 14 sites (Table 1).

This is, however, to be expected: it and Malay Civet are the only species identifiable by signs, thereby increasing recording efficiency. Small carnivores were mostly sparsely recorded. Yellow-throated Marten *Martes flavigula* was the most widely encountered, at five sites (35.7%), perhaps reflecting its position as one of the few carnivores recorded during line transects, rather than it genuinely being more widespread than all other species.



Many transects need to be negotiated over streams and rivers.

Preparing a camera trap.

Binturong, Masked Palm Civet *Paguma larvata*, Common Palm Civet *Paradoxurus hermaphroditus*, Banded Civet and Short-tailed Mongoose *Herpestes brachyurus* are also probably widespread within the FMU.

Hose's Civet and Malay Civet, though two of the most commonly found small carnivores, were found at few sites. Malay Civet may occur mainly below 900 m a.s.l. and Hose's Civet may be more common between 600 to 1,500 m a.s.l. Banded Linsang *Prionodon linsang*, Marbled Cat, Leopard Cat *Prionailurus bengalensis* and Collared Mongoose were detected in just one site each (7.1%). All these patterns, however, require verification through more records.

For comparison, there were 170 camera trap images for muntjac deer *Muntiacus* spp. over the same period, sign surveys gave 163 independent deer observations and line transects gave 140 independent deer observations.

Other small carnivores

The otter species present in the FMU remain unclear - Davis (1958) recorded two in the nearby Kelabit Highlands, the Oriental Small-clawed Otter *Aonyx cinereus* (IUCN Vulnerable) and the Hairy-nosed Otter *Lutra sumatrana* (IUCN Endangered). At least four more species of small carnivore plausibly in the Upper Baram were not found by this survey. Small-toothed Palm Civet *Arctogalidia trivirgata* (IUCN Least Concern) was recorded in the Kelabit Highlands by Davis (1958) and reported by local people in the FMU. It is strongly nocturnal and arboreal, and no survey methods suitable to find it were used. Local hunters' reports suggest that two IUCN Endangered species, Bay Cat *Catopuma badia*, endemic to Borneo and one of the rarest cats in the world, and Otter Civet *Cynogale bennettii*, previously seen in the Kelabit Highlands by Tom Harrisson (Medway, 1977), occurred in the FMU. These reports date from before logging operations were wide scale. Another species, the Sunda Stink-badger (Malay Badger) *Mydaus javanensis* (IUCN Least Concern), has been collected several times in the Kelabit Highlands (Davis, 1958). This highly distinctive species seems unknown to local people, so it may have never inhabited the FMU.

In the Selaan-Linau FMU

Carnivores threatened under the IUCN Red List detected by camera trap in the Selaan-Linau FMU.

Hose's Civet *Diplogale hosei*

Binturong *Arctictis binturong*

Banded Civet *Hemigalus derbyanus*

Marbled Cat *Pardofelis marmorata*

Sunda Clouded Leopard *Neofelis diardi*

Collared Mongoose *Herpestes semitorquatus*

Sun Bear *Helarctos malayanus*

Table 1

Number of independent observations of each carnivore species using each method and number of sites where each species was detected.

Species	IUCN Red Listing (LC = Least concern, DD = Data deficient, NT = Near Threatened, VU = Vulnerable, EN = Endangered)	Number of independent observations				Number of sites detected
		Line transect	Sign survey	Camera trap	Total	
Malay Weasel	LC	2	0	0	2	2
Yellow-throated Marten	LC	4	0	1	5	5
Otter	Either EN, VU or NT	0	3	0	3	3
Banded Linsang	LC	0	0	1	1	1
Malay Civet	LC	0	9	12	21	3
Common Palm Civet	LC	1	0	2	3	2
Masked Palm Civet	LC	1	0	6	7	3
Binturong	VU	3	0	4	7	4
Hose's Civet	VU	0	0	12	12	3
Banded Civet	VU	0	0	6	6	3
Collared Mongoose	DD	0	0	2	2	1
Short-tailed Mongoose	LC	2	0	2	4	3
Marbled Cat	VU	0	0	1	1	1
Leopard Cat	LC	0	0	1	1	1
LARGE CARNIVORES						
Sun Bear	VU	4	45	7	56	12
Sunda Clouded Leopard	VU	0	0	3	3	1

Threats

The main threats to small carnivores in the FMU remain unclear. They are not actively sought by local hunters, and some species were found in areas of high hunting pressure. Hunting in the FMU usually (but not always) involves dogs, which accompany local hunters in their search for ungulates, especially Bearded Pig *Sus barbatus*, muntjacs and Sambar *Cervus unicolor*. Primates, especially macaques *Macaca* and langurs *Presbytis*, and rodents are hunted to a lesser extent. Sun Bear, Binturong and other palm civets are taken as encountered, but hunters do not set out to hunt them. Local hunters usually use home-made guns, spears and blowpipes, and hunt both by day and night. Snares are often used, intended for pheasants, rodents and mouse deer *Tragulus*. However, these snares can pose a serious threat to the more ground-dwelling civets such as Hose's Civet, Banded Civet and Malay Civet.

Many small carnivores were found in areas affected by logging, but logging may constrain Hose's Civet and Binturong range. Otters in mainland South-east Asia are in heavy decline through greatly increased trade-driven hunting, but this seems not to occur in Sarawak. Instead, here, shrinking habitat, pollution and siltation of rivers, as well as the use of chemicals and explosives/electricity during commercial fishing result in severe depletion of the prey base of otters (see Southeast Asian Mammal Databank, 2006). Shifting cultivation might be a threat to small carnivores mainly through the temporary loss of the areas under cultivation at any given time; most species were found near slash and burn fields. However, the ability for populations to persist in such landscapes may differ greatly.

Urgently required now are studies specifically of small carnivores to determine distribution and conservation status within the Sela'an-Linau FMU.

As encounter rates are very low and many species nocturnal and crepuscular, line transects yield very little data. Sign surveys are useful only for few species. Night-spotting may be an option, but there are no roads in unlogged areas and uneven terrain makes passage on foot noisy. Moreover, it is risky to the surveyors: hunters regularly use firearms at night in the FMU. Camera-traps seem best to study these animals, except those species that are mostly arboreal. Modifications to the selection of sites for camera-traps so far used here could include aiming cameras towards fallen trees, and, in particular, using odours/scents in canisters resistant to rain. Otters may require camera placement nearer rivers and streams, which would also allow consideration of Otter Civet status.

Hose's Civet

In conservation terms, Hose's Civet stands out from the other species recorded, because it has a much smaller known range. It is named after Charles Hose (1863-1929), a Sarawak-based, British zoologist who has a number of other mammals, birds and amphibians named after him as well. This civet is endemic to northern Borneo and recorded only from a few localities in Sarawak, Sabah and Brunei, no protected area is known to even hold any. Currently, the basic factors likely to determine its long-term future, such as population densities, dependency level on old-growth forest, ranging and dispersal patterns, and others, are entirely unknown, making specific conservation measures impossible. What little is known of the species comes primarily from 17 museum specimens worldwide (the first of which was collected in 1891 from Sarawak). There have been very few field sightings of the species and only one live capture;

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that was in Brunei, and this individual was subsequently released after two months. There remain no Hose's Civets in captivity anywhere in the world. Next to nothing is known about the habits and diet of Hose's Civet in the wild, though the single female captured in 1997 appeared to be entirely carnivorous, feeding on fish and meat as opposed to fruit, the preferred diet of all other civets in Borneo (Yasuma, 2004). Indeed, the Hose's Civet's partly webbed feet, extremely long facial whiskers, and surprisingly large snout, are all thought to suggest a specialist, foraging for small animals amongst mossy boulders and streams.

The first confirmed photographic image of a Hose's Civet in the wild may probably be that of a single individual photographed in early 2004 in Mount Kinabalu National Park, Sabah. Since then, only a handful of blurred, unconfirmed images have been captured from scattered localities within its range. WCS Malaysia captured 12 images of the Hose's Civet between January and December 2005, when all cameras were performing at their peak and researchers had sufficient experience in camera placement. However, there do exist 2 more images of the Hose's Civet taken in July 2004 (WCS unpublished data), when researchers were still experimenting with cameras, bringing the complete tally to 14 images from 4 separate locations in the FMU, by far the highest encounter rate ever. The previous largest series of encounters from one locality consisted of four specimens collected by Tom Harrison between 1945 and 1949 in the mossy forests of the nearby Kelabit Highlands, suggesting that this part of Sarawak may be the species' prime habitat.

It is thought that the preferred habitat of this little known species is the wet, mist-covered, mossy, montane forests of interior northern Borneo. However, it has reportedly been detected as low as 450 m a.s.l. in Brunei (Francis, 2002), begging the question whether this really is true. Of the 14 images obtained by WCS Malaysia, 13 were, in fact, from unlogged, contiguous, montane forests, with low hunting pressure and far from logging roads and slash and burn fields. One image, however, came from lower elevation forests (the camera itself was at

Photo: John Mathai.

Rugged terrain and mist covered mountains of the Selaan-Linau FMU.

730 m a.s.l) with high hunting pressure, near logging roads (but not with logging activities per se), and fragmented by slash and burn fields. Whether this is a dispersing animal or whether Hose's Civet can actually subsist in these more encroached areas, is unclear.

Urgent questions

Until recently, the semi-nomadic Penan people who inhabit the area did not have a name for the Hose's Civet in their native tongue, simply because they had never come across the species. This is now changing as more native hunters encounter it, due to a number of reasons. Local hunters may now have to venture further into the mountains in search of wild meat as populations of their primary quarry diminish in lower elevation forests and seek refuge in the mountain tops.

Up there, neither logging nor intensified hunting pressure caused by increased access via logging roads into the forest, pose major threats to wildlife. However, can all these species actually persist and breed in the mountain tops, or are they just running away from what is happening in lowland forest? Further, can the mountain tops sustain such a large number and diversity of species, especially if these mountain tops are simply islands in a matrix of logged-over forests and slash and burn fields? Will there not be increased competition, both within and among species, for limited and ever decreasing resources? Will not inferior competitors (possibly the Hose's Civet?) be forced to flee from these mountain refuges as superior competitors come to dominate, and then be exposed to snares and other forms of hunting in the lowlands? Will warmer temperatures and drier conditions, caused by a combination of intensified logging pressure and climate change, constrict further the effective habitat of Hose's Civet? Will species such as Hose's Civet, Bay Cat and Otter Civet, which possibly have a high dependency on old growth forest, be able to disperse through a matrix of modified habitat? If not, will these isolated populations of rare and threatened species then be subjected to all the dangers of small populations such as inbreeding and both environmental and demographic stochasticity? These are all questions that urgently require answers.

Nobody has thus far attempted any autecological research on Hose's Civet because no suitable site was previously known. With these findings, the Sela'an-Linau FMU may be invaluable for detailed research on the species' conservation needs, as it seems to be common there. Sadly, small carnivore work in the FMU is currently (September 2010) stalled due to lack of funding, as individual and corporate donors seem to shy away from rare, little-known species.

The Sela'an-Linau FMU is home to one of the world's least known carnivores, and it may be under great threat. It may also be home to two other rare, little known carnivores, the endemic Bay Cat, and the Otter Civet, both of which were reported to have once inhabited the FMU before logging became widespread. Whether they are still there, and if not, whether the Hose's Civet will go their way and be lost forever from this site, is anyone's guess. Time is running out. At WCS, we need your help.

John Mathai *is a Wildlife Ecologist with the Wildlife Conservation Society (WCS) Malaysia Program. He studies the impact of logging on wildlife in production forests in Sarawak, Malaysian Borneo, and uses this information to advise authorities on improved logging practices in the state. His interest is small carnivores, and their role in ecosystem dynamics in the Bornean rainforest. He is a member of the IUCN Small Carnivore Specialist Group.*

For more information on Hose's Civet and other small carnivore work in the Sela'an-Linau FMU, please contact John Mathai at johnmathai11@gmail.com or visit the WCS Malaysia website at www.wcsmalaysia.org.

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