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Records of five Bornean cat species from Deramakot Forest Reserve in Sabah, Malaysia

Here we report records of all five Bornean cat species, the leopard cat *Prionailurus bengalensis*, the Sundaland clouded leopard *Neofelis diardi*, the Bornean bay cat *Pardofelis badia*, the flat-headed cat *Prionailurus planiceps* and the marbled cat *Pardofelis marmorata* from Deramakot Forest Reserve (FR). Deramakot FR is a commercial forest reserve, where a reduced impact selective logging system is practised. All cat species except the leopard cat seem to occur in low numbers. Our results suggest that even commercially used forests may harbour these endangered cat species.

Little is known about Bornean felids and almost all information comes from incidental sightings. In addition, most of the few previous research activities focused on completely protected areas comprising either primary forests or older secondary forests. However, from a long-term perspective these protected areas by themselves are too small and too isolated to support viable populations of some of the rare Bornean carnivores. Consequently, it is likely that only a sustainable management of larger, commercially used areas adjacent to protected areas will ensure their survival. With this prospect in mind, the project Conservation of Carnivores in Sabah (ConCaSa) of AM & AW started in July 2008 to evaluate the consequences of different forest management strategies on two carnivore families, the Felidae and Viverridae, in the Malaysian part of Borneo. We investigate and compare their diversity, abundance and occupancy in three commercially used forests (Deramakot Forest Reserve (FR), Tangkulap FR and Segaliud Lokan FR) which were subjected to different management regimes in the past.

Here we report preliminary findings on felids from our first study site, Deramakot Forest Reserve (05°22'N, 117°25'E), which encompasses an area of approximately 550 km². In this forest reserve a reduced-impact logging system is employed for timber harvesting with lower impact on the physical environment and all hunting activities are strictly forbidden (Lagan et al. 2007). Deramakot Forest Reserve was certified as "well managed" by the Forest Stewardship Council and received this certification as the first natural forest in Southeast Asia in 1997.

From July 2008 till January 2009 ConCaSa project carried out field work in the northwestern part of Deramakot FR in an area of approximately 112 km². A network of camera traps consisting of two cameras at each station was set up on a grid system. Altogether 48 camera trap locations were established and each camera pair was placed for 42 days at each location. This led to a total camera-trapping effort of 1916 trap nights during the systematic camera-trapping. The mean distance between the camera-traps was 1.7 km with a minimum of 1.2 km and a maximum of 2.4 km. In addition, night spotlight surveys were performed from the back of a pickup car to record activity and behaviour of encountered felids and viverrids. Parallel to this project, HS conducted another research project in Deramakot and applied a different camera-trapping approach, with 60 single cameras set up throughout the entire forest reserve.

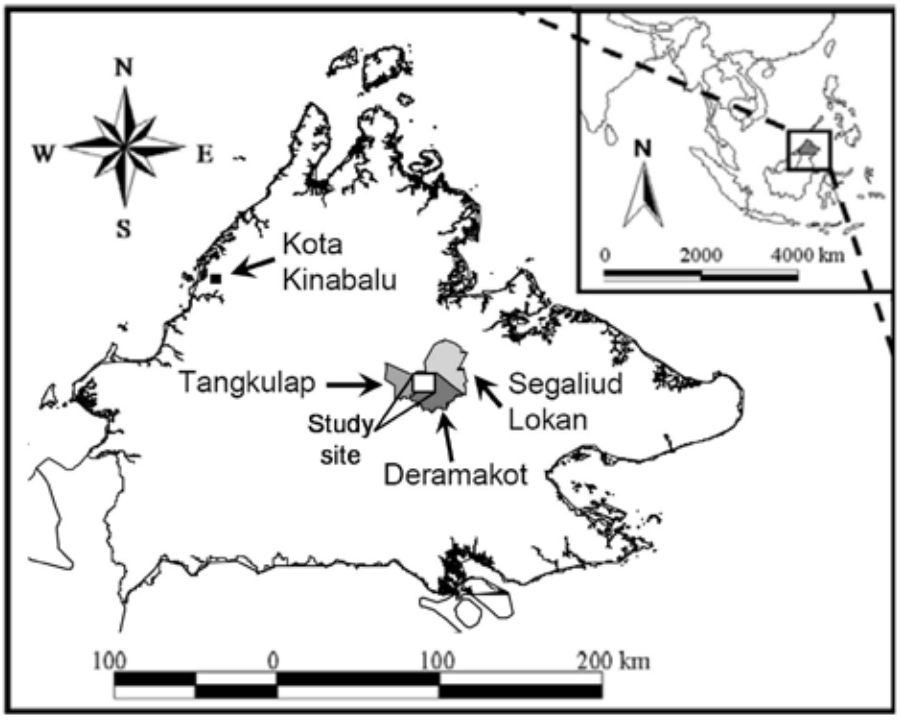

Fig. 1. Map of the study site in Deramakot Forest Reserve in the Malaysian part of Borneo. In addition the neighbouring forest reserves (Tangkulap and Segaliud Lokan), where we currently continue our project, are indicated.

Leopard cat

The most common cat species in South-East Asia is the leopard cat, the only Bornean cat species not classified as threatened on the IUCN Red List 2008. This species lives in a variety of natural habitats as well as anthropogenically modified habitats (Rajaratnam et al. 2007). Although leopard cats are widespread and common, only Rajaratnam et al. (2007) has studied this species intensively on Borneo. As expected, the leopard cat was the most frequently recorded cat species in Deramakot FR. During systematic camera-trapping we captured more than 280 leopard cat photographs on more than 180 occasions (Table 1). Although it was recorded throughout the entire study site, we obtained most of the photographs in open areas along roads and we hardly recorded this species if the camera was stationed deeper in the forest under a closed canopy. Consistent with these results, this cat was regularly recorded during night spotlight surveys in open areas along roads. On one occasion a male leopard cat was filmed for several minutes and during this observation the animal scent-marked the road with its urine (see video on the Cat Specialist Group website www.catsg.org/catnews).

Sundaland clouded leopard

The Sundaland clouded leopard is the largest carnivore and the only species of the subfamily Pantherinae on Borneo. Recently, Bornean and Sumatran clouded leopards have been re-classified as a separate species distinct from its continental relative *Neofelis nebulosa*, owing to significant genetic and morphological differences between the two species (Buckley-Beason et al. 2006; Kitchener et al. 2006; Wilting et al. 2007a & b). Furthermore, Wilting et al. (2007a & b) suggested to distinguish two subspecies of the Sundaland clouded leopard, *Neofelis diardi borneensis* on Borneo and *Neofelis diardi diardi* on Sumatra. Since 2008, the Sundaland clouded leopard is listed as a distinct species on the IUCN Red List and classified as vulnerable, with both Bornean and Sumatran subspecies each classified as endangered (IUCN red list 2008). In Sabah, clouded leopards have been recorded in several forest reserves, most of which are commercially used and where their long-term survival remains uncertain (Wilting et al. 2006). Although we expected that clouded leopards occur in low densities, it was surprising that during the seven months of camera-trapping the ConCaSa project recorded only two clouded leopard individuals, easily distinguished by their distinct coat patterns, of which one was photo-trapped during a pilot study outside the actual study site. The other clouded leopard individual, a large adult male, was regularly photographed (on ten occasions) within our study site. Although HS recorded other clouded leopards in other areas in Deramakot FR, the only clouded leopard he photographed within the ConCaSa 112 km² study site was also the same male. The maximum distance between photo recaptures exceeded 13 km and, using a minimum convex polygon (MCP), the minimum home range area used by this male exceeded 45 km². Given the small sample size, this is most certainly an underestimate of the true range size yet this size is already comparable or even larger than clouded leopard home-ranges estimated by radio-telemetry in Thailand (Grassman et al. 2005, Austin et al. 2007). Considering that the ConCaSa project just recorded one individual with several recaptures in our study site of 112 km², the density of clouded leopards in Deramakot Forest Reserve seems to be very low.

A few months after our camera-trapping efforts in Deramakot we observed a young male clouded leopard during a night survey in Deramakot. We were able to capture this clouded leopard on a video for several minutes (see video on the Cat Specialist Group website www.catsg.org/catnews).

Fig. 2. A leopard cat along a secondary road (5°26'N/117°22'E; Photo A. Wilting & A. Mohamed).

Additional to our camera-trapping records, we also discovered a juvenile sambar deer *Cervus unicolor* killed by a clouded leopard. This sambar deer was lying next to a secondary road and weighted approximately 30-35 kg. The location where the sambar deer was found was close to a site where we had repeatedly photographed the large male clouded leopard. The kill was very fresh and the clouded leopard had bitten off and removed part of the front right leg. A similar observation of a missing hind leg was made by AW 2005 in Tabin Wildlife Reserve, where a bearded pig *Sus barbatus* of approximately 20-25 kg was killed by a clouded leopard, probably a male given the large size of the clouded leopard tracks next to the kill (Wilting, unpubl. data). The pig was brought up to the first storey of an observation tower by the predator. On discovery the front left leg was missing. Based on these observations it could be speculated that clouded leopards try to cache up their prey or parts of larger kills, in a tree. Such a speculation could be supported by the assumption of Rabinowitz et al. (1987), who stated that trees are used as resting sites above the ground to escape from the terrestrial leeches.

Bornean Bay Cat

Our photograph of the Bornean endemic bay cat is the first confirmed record of this species in Deramakot FR. Since 1928 there was no confirmed record of this species, before it was rediscovered in 1992 in Sarawak (Sunquist, et al. 1994). With the growing number of scientists working on Borneo, the number of records has increases (Meijaard 1997, Azlan & Sanderson 2007). However besides these incidental records almost nothing is known about the ecology of this species and consequently it is considered one of the world's least known felids (Sunquist, et al. 1994, Azlan & Sanderson 2007). Its discovery in Deramakot FR was surprising as all previous records for this species were located farther to the south (Danum Valley - Azlan & Sanderson

Table 1. Number of photographs, occasions and trapping effort of felids recorded in Deramakot Forest Reserve.

Species	No. of photos	No. of occasions	# trap nights / # captures	#sightings /45 night surveys
Leopard cat	288	183	10	9
Sundaland clouded leopard	19	10	192	1[1]
Bornean bay cat	2	1	1916	-
Flat headed cat	4	4	479	-
Marbled cat	-	-	-	2[1]

[1] Sightings were made during night surveys, prior and after the 45 systematic night surveys.

Fig. 3. A male Sundaland clouded leopard along a logging road (5°22'N/117°23'E; Photo A. Wilting & A. Mohamed).

2007; Soak village - Kitchener et al. 2004). Therefore our record expands the distribution range of this species to the north.

Flat-headed Cat

Since 2008, besides the Bornean Bay Cat, a second Bornean cat species, the flat-headed cat, is listed as endangered on the IUCN Red List (IUCN Red List 2008). Similar to the bay cat, almost nothing is known about this species in the wild. From the few accounts, captive observations and their morphology this species is known to be strongly associated with wetlands and waterways (Nowell & Jackson 1996, Bezuijen 2000). Our records from Deramakot FR seem to confirm this association, as all records of the project ConCaSa were from the north-western part of our study site which is flatter and contains more water ponds and lakes than the southern parts of Deramakot FR. All our three camera-trapping stations where we recorded this species were located close to small streams or water ponds. In addition to these records, HS recorded this species farther south of Deramakot FR and Yasuda et al. (2007) also reported its presence in Deramakot. These records were also made close to water resources. To our knowledge, there are more records of flat-headed cats from Deramakot FR than from any other location throughout its distribution range. This suggests that particularly the flat north-western part of Deramakot FR is a very good habitat for this threatened species.

Marbled Cat

The marbled cat, looking like a miniature form of a clouded leopard with a cloud-like spot pattern and a very long tail, seems to be the most arboreal of the Bornean cat species. Owing to their secretive behaviour it is not surprising that marbled cats are rarely encountered in the wild and most of the available information about this species is anecdotal. The marbled cat was the only cat species not photographed by the ConCaSa project in Deramakot FR. However, HS photographed this species several times in other parts of the Deramakot FR. In addition, during preliminary night surveys, AM and AW twice observed a marbled cat. On one occasion, the marbled cat sat in the middle of the road and then disappeared into the forest whereas during the second sighting we were able to observe the cat for over 10 minutes. This cat groomed itself in a cat-like manner whilst sitting on a thick branch at a height of about 25 m. After some time it started to climb through the branches to avoid the spotlight directed at it, and negotiated one passage down the big tree-trunk climbing down head-first. Such an arboreal talent was previously only known from the clouded leopard and the margay Leopardus wiedii in South America (Sunquist & Sunquist 2002).

Fig. 4. A male Bornean bay cat along an old logging road (5°24'N/117°26'E; Photo A.Wilting & A. Mohamed).

Conclusion

Except for the leopard cat, all other four cat species appear to be rare and most probably occur in low densities in Deramakot FR. It is possible that these species occur naturally in low numbers, possibly due to limited prey abundance, suitable water resources (for the flat-headed cat and maybe the bay cat) or intra-guild competition. Our study unequivocally demonstrated the presence of all species of felids in Deramakot FR, showing that this area is one of the few places on Borneo with confirmed records of all five species. To ensure the long-term survival of these cats on Borneo, further efforts need to be taken to assist local stakeholders in improving their forest management practices, as only sustainable forest management practices applied on a large scale are likely to provide appropriate protection for these endangered species.

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Fig. 5. A flat-headed cat along a secondary road (5°25'N/117°23'E; Photo A. Wilting & A. Mohamed).

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Fig. 6. A marbled cat in the selectively logged forest(5°19' N / 117°28' E; Photo Samejima).