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Short Communication: Felids of Sebangau: Camera trapping to estimate activity patterns and population abundance in Central Kalimantan, Indonesia

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Abstract. *Adul, Ripoll B, Limin SH, Cheyne SM. 2015. Felids of Sebangau: Camera trapping to estimate activity patterns and population abundance in Central Kalimantan, Indonesia. Biodiversitas 16: 151-155.* We present data from a seven year camera trapping project in the Natural Laboratory of Peat-Swamp Forest in the Sebangau Catchment, Central Kalimantan, Indonesia (2008-2015). The project has identified four of the five felids on Borneo: Sunda clouded leopard (*Neofelis diardi;* macan dahan), flat-headed cat (*Prionailurus planiceps;* kucing tandang), marbled cat (*Pardofelis marmorata;* kucing batu) and leopard cat (*Prionailurus bengalensis;* kucing kuwuk). All of these species are protected by Indonesian Law (PP. 7/1999) and are listed on the IUCN Red List. The four species have clearly defined activity budgets, especially the smaller cats, to allow niche partitioning. We have identified this forest block as an important area for numbers of all four species in the global context of cat populations. The bay cat (*Pardofelis badia* (kucing merah) has not been found in tropical peat-swamp forest at time of writing.

Keywords: Activity patterns, camera trapping, felids, population abundance, Sebangau

INTRODUCTION

Robust population density estimates or estimates of total population size of any of the four threatened Bornean felids are completely lacking and the extent of hunting and trade of these species and their prey in Indonesian Borneo is unclear. Peat-swamp forest is the dominant lowland forest type in Indonesian Borneo and represents 68,000 km^2 of land (Page et al. 1999), thus these forests may be of vital importance for the future of felids, in particular the Sunda clouded leopards (Cheyne et al. 2013) and flat-headed cats (Wilting et al. 2010). The Sebangau (sometimes spelled Sabangau) catchment (5,600km^2) has a history of disturbance, selective logging (legal and illegal), fire and hunting yet the forest remains relatively contiguous with good forest cover, which is important for the conservation of felids (Nowell and Jackson 1996). The effect of different macro-habitat types, micro-habitat characteristics and disturbance on these felids remains unstudied. Initial data from Sebangau suggest that there is a density of 1.81 clouded leopards/km^2 in the forest across all three habitat types (Mixed Swamp Forest (MSF, Low Interior (LIF) and Tall Interior Forest (TIF), but this preliminary study suggests that the Sebangau could hold a substantial population of Sunda clouded leopards (Cheyne et al. 2013).

This research is a joint venture between the Orangutan Tropical Peatland Project (OuTrop), CIMTROP and the Wildlife Conservation Research Unit, University of Oxford and aims to facilitate the conservation of Borneo's endangered wild cats by merging pioneering ecological research, host country capacity building and environmental education within Indonesia. Our research activities will provide an insight into the relative abundance of each species, and the long-term impacts of various forest management practices on these little known felids - information which is essential to facilitate the development of effective management and conservation measures. This initiative is currently the only research project focusing on the ecology of Borneo's wild cats in Kalimantan. Additionally this project is now the longest running felid and prey project in Kalimantan and we hope that with funding to continue this important project in the long-term (>6 years) we can make a significant contribution to the understanding of these elusive and charismatic species as well as facilitating training and capacity building for local scientists and communities.

The objectives of this long-term project are: (i) To study the status, behavior and ecology of the four felid species found in Sebangau. (ii) To investigate the density and population size. (iii) To investigate the community structure, niche partitioning and intra-guild relationships. (iv) To assess the impacts of habitat alteration and habitat requirements of mammals in the study area.

MATERIALS AND METHODS

Study site

This study aims to identify the felid biodiversity, population and behavior in the Natural Laboratory for Peat-Swamp Forest (NLPSF) in the Sebangau catchment, Central Kalimantan, Indonesia. The study was initiated in May 2008 and has been running continuously since then in the 50km^2 NLPSF. Robust population density estimates or estimates of total population size of any of the threatened Bornean felids are lacking, particularly in Indonesian Borneo. Sebangau is a seasonally flooded forest and is underwater for 9 of 12 months. It is the largest area of contiguous lowland rainforest remaining in Kalimantan (5,600km^2, Figure 1; Page 2002).

Methods

By using passive infrared camera traps we investigated the distribution, habitat associations, activity and density of cat species. Pairs of camera traps were placed along animal trails, human trails, logging roads and watering areas. Photographic capture rates of species were used to calculate a Relative Abundance Index of (RAI) for each cat species and capture-recapture techniques will be used to estimate the density of different species in which individuals can be distinguished from one another due to their distinctive pelage patterning. Time of the picture and date were used to describe the daily activity patterns.

Relative abundance index

The capture probability at each location was not uniform (repeated measures analysis of variance, $F = 0.68$, $df = 12$, $P = 0.942$). This does not affect the calculation of the relative abundance index, which discounts all locations where felids have not been captured. The relative abundance index was calculated as

$$\text{RAI} = \sum_{i=1} d_i 100 / \sum_{i=1} tn^i$$

Where i is a trap location and tn is a trap night at the ith location and d is a detection of the species at the ith location. Detection is one capture per location during one trap night (Kawanishi and Sunquist 2004, Azlan and Lading 2006, Azlan and Sharma 2006). This index cannot account for frequency of trail use and degree of arboreality, all of which will affect detection (Giman et al. 2007). To calculate the relative abundance index we assumed that photographs represent independent contacts between animal and camera and that the population is closed (Rowcliffe and Carbone 2008, Rowcliffe et al. 2008). To ensure the assumptions of a closed population were met only data from a 90 day period were analyzed.

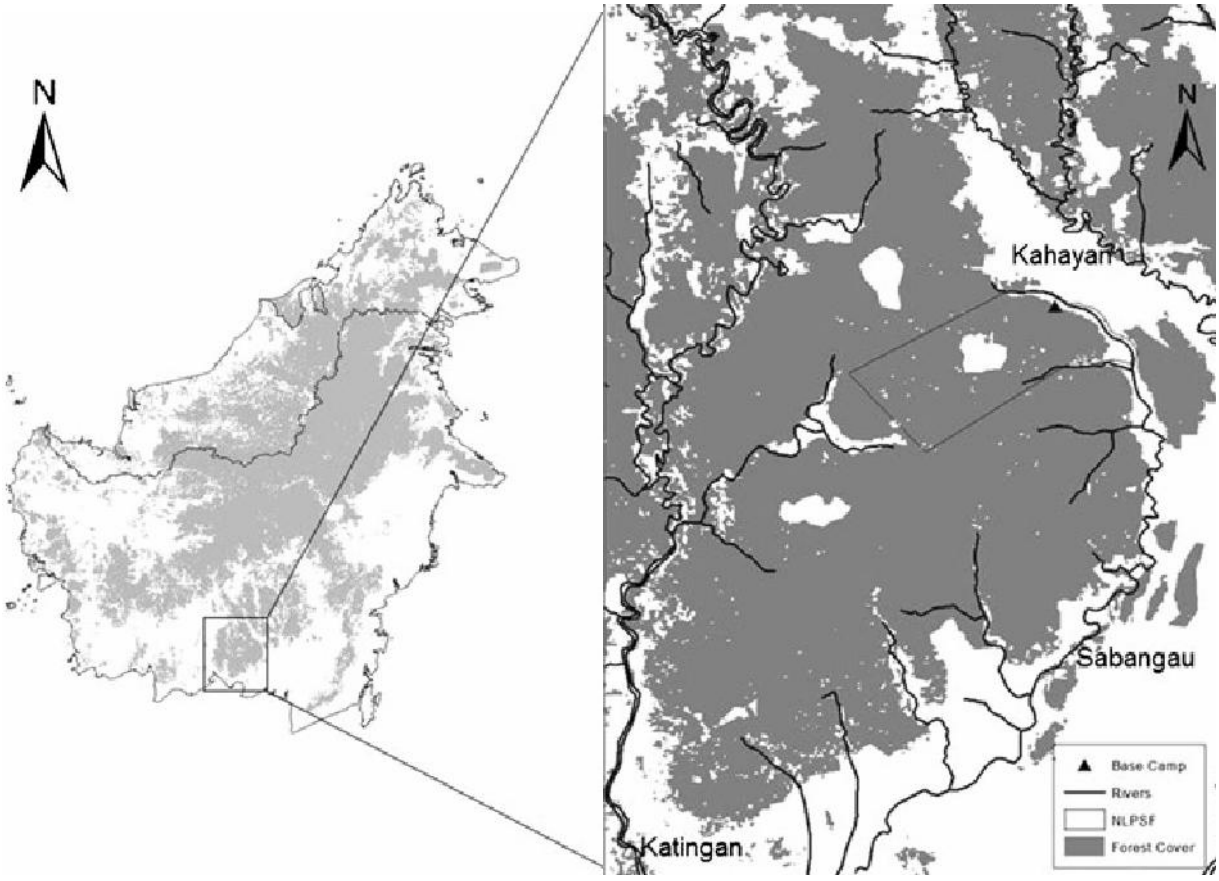

Figure 1. Location of the Natural Laboratory for the Study of Peat-Swamp Forest (NLPSF) within Sebangau tropical peat-swamp forest and Borneo. Forest cover is shaded gray, non-forested areas white. Adapted from (Ehlers Smith et al. 2013)

RESULTS AND DISCUSSION

Distribution and population

All felids in Sebangau are non-endemic i.e. they have ranges that also extend outside Borneo (Figure 2; IUCN 2013).

Activity patterns

Data are presented on the % of total photo captures for each of the four felids. Data are from May 2008 - April 2015.Clouded leopards are active throughout the day though more captures are obtained at night (1700-0500h) thus they are predominantly nocturnal (Figure 3).

Flat-headed cats have a more irregular capture rate though again active throughout the day, more captures are obtained at night thus they are predominantly nocturnal (Figure 4).

Leopard cats have a more regular capture rate. They appear to be active both during the day and night though appears to avoid the hottest time of the day (1100-1300h, Figure 5).

Marbled cats have a regular capture rate with the majority of photos taken during the day (0500-1600h) suggesting they are diurnal (Figure 6).

Relative abundance index all felids

Clouded leopards are the most commonly captured cat on the camera traps, followed by leopard cat, flat-headed cat and marbled cat (Figure 7).

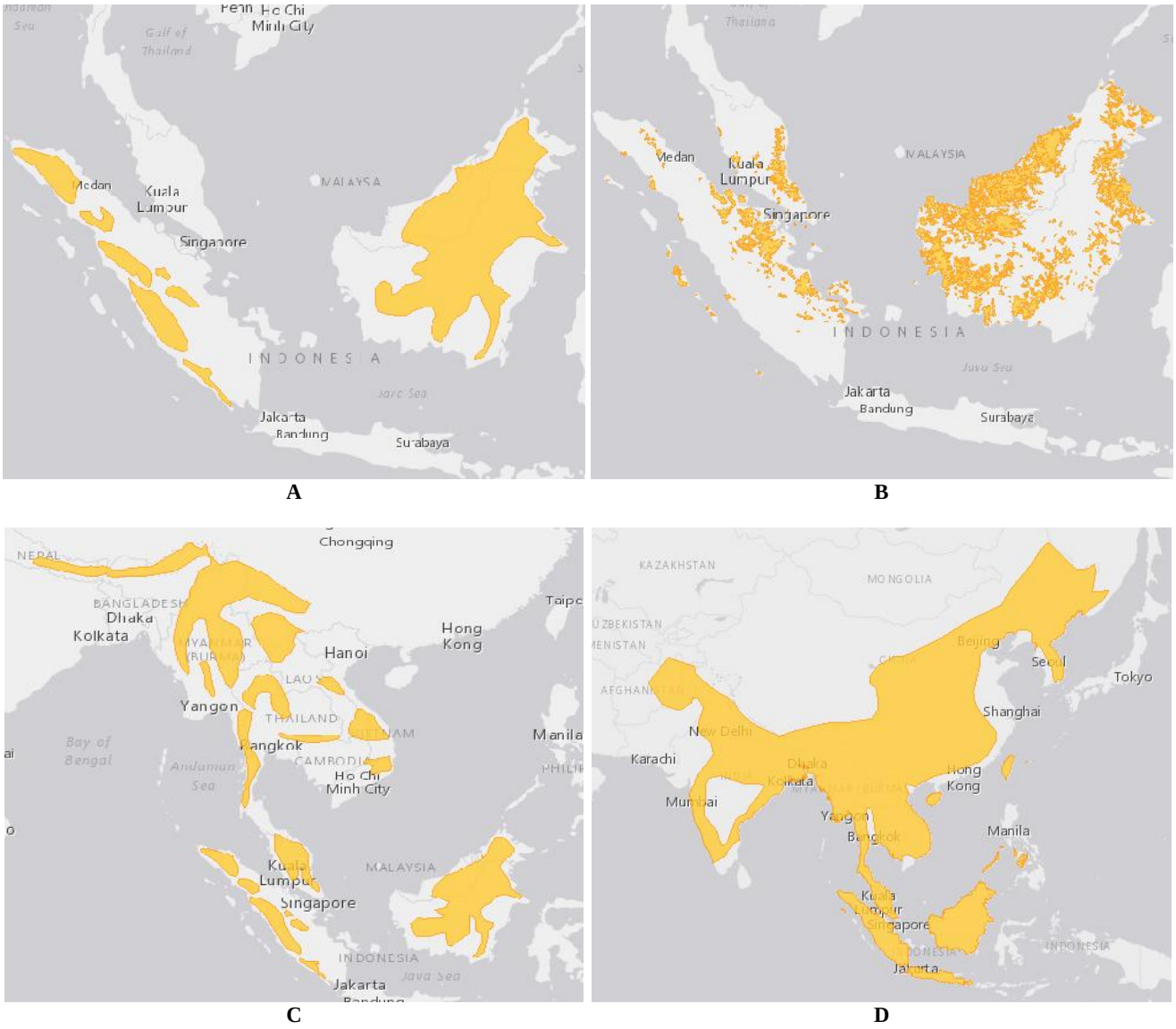

Figure 2. Natural distribution of Sebangau felids. A. Sunda Clouded Leopard - *Neofelis diardi* IUCN Vulnerable, B. Flat-Headed Cat - *Prionailurus planiceps* IUCN Endangered, C. Marbled Cat - *Pardofelis marmorata* IUCN Vulnerable, D. Leopard Cat - *Prionailurus bengalensis* IUCN Least Concern (IUCN 2013)

Table 1. Summary of global populations and records from the NLPSF

	Global population estimates (IUCN 2013)	NLPSF individuals	Sebangau individuals (Cheyne et al. 2013)	Total independent photos	Number of known individuals
Clouded leopard	<2,500	1-4	40-246	152	9 ♂ 1 ♀
Leopard cat	>50,000	~200	NA	74	NA
Marbled cat	<10,000	~100	NA	41	NA
Flat-headed cat	<2,500	~150	NA	30	NA

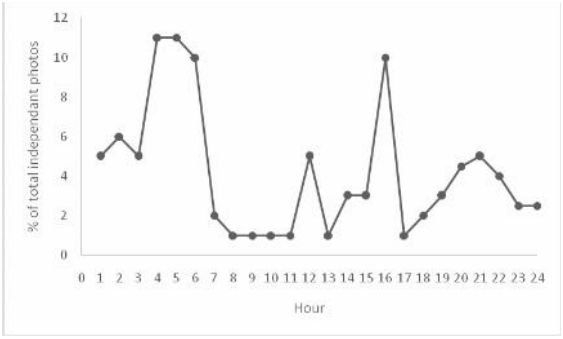

Figure 3. Activity patterns of clouded leopards in Sebangau.

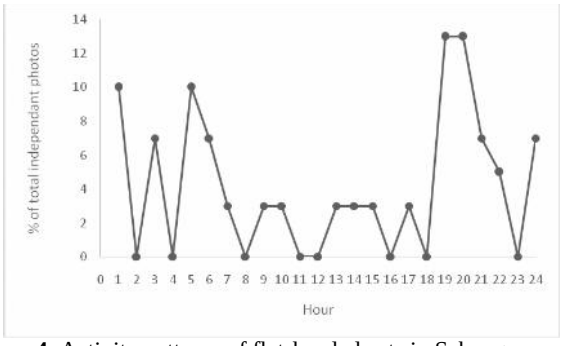

Figure 4. Activity patterns of flat-headed cats in Sebangau.

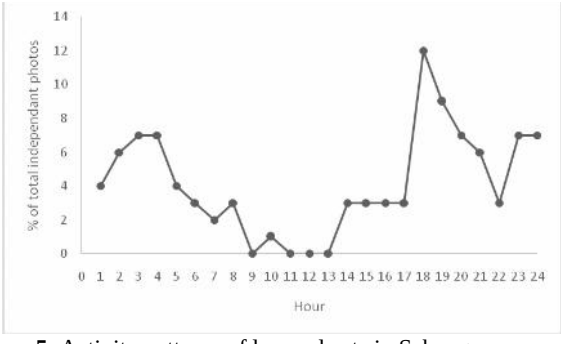

Figure 5. Activity patterns of leopard cats in Sebangau

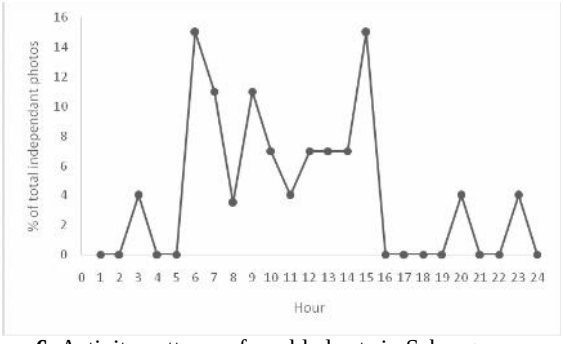

Figure 6. Activity patterns of marbled cats in Sebangau.

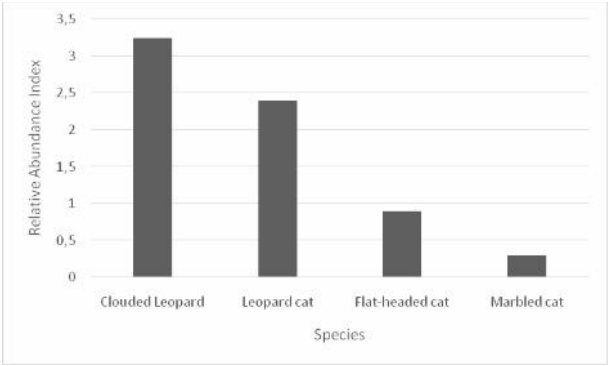

Figure 7. RAI of all felids in Sebangau.

Discussion

These data represent almost double the information presented in (Cheyne and Macdonald 2011). The nocturnal activity of the clouded leopards is confirmed from the present dataset but flat-headed cats appear to be more diurnal than reported in Cheyne and Macdonald (2011). Leopard cats are avoiding the hottest part of the day and we present new information on the marbled cat: based on 41 photos they are predominantly diurnal (more discussion for this information is needed). The clouded leopard is the largest predator in Borneo and a different activity pattern would be expected in the absence of tigers (Seidensticker 1976).

This is the first study for these endangered felids in any tropical peat-swamp forest, although we have been at pains to emphasize the methodological caveats. There is an estimated 68,000 km^2 in of tropical peat-swamp forest in Kalimantan (Page et al. 1997, 1999; Cheyne and Macdonald 2011). We conclude that even with these preliminary density range estimates that tropicalpeat-swamp forest may be more important to cat conservation than previously supposed. If our evidence is typical then, by extrapolation, the totality of peat forest in Kalimantan might harbor a significant population of clouded leopards, leopard cats, flat-headed cats and marbled cats. No bay cats have been reported in peat-swamp forest and more work is needed to determine if bay cats are present in this habitat type. Local surveys suggest that hunting pressure is relatively low, and thus that habitat loss and fragmentation is likely to be the greatest threat.

In conclusions, density of clouded leopards = 0.72 to 4.41 individuals per 100 km^2. (No discussion about this in previous paragraphs); Activity patterns differ for the 4 felid species, especially significant for the Marbled Cat, niche partitioning is related to feeding ecology and activity patterns, but further research and analysis is required to understand this; Population numbers for the small cats are

estimates only and are the subject of further work; Peat-Swamp Forest habitat is critical to preserve populations of the four felid species.

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