

Observations of intra- and inter-specific interactions of Small-toothed Palm Civets *Arctogalidia trivirgata* in the Danum Valley Conservation Area, Borneo

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<http://www.smallcarnivoreconservation.org>
ISSN 1019-5041

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Associate editor:

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Abstract.

I reported intra- and inter-specific interactions of Small-toothed Palm Civets *Arctogalidia trivirgata* in a lowland tropical rainforest in Borneo. They did not exhibit aggressive or escape behaviours toward conspecific co-feeding individuals, but did not tolerate co-feeding of other civet species in a fruiting tree. These observations suggest that there may be differences in Small-toothed Palm Civets' reactions to conspecifics including same-sex individuals and different civet species, indicating that they do not always tolerate co-feeding animals. The observations reported in this study are a first step to describe social structure of Small-toothed Palm Civets, and suggest the existence of loosely associated groups. Further field study is required to elucidate social structure of frugivorous/omnivorous carnivorans.

Keywords: *Arctogalidia trivirgata*, co-feeding, inter-specific interaction, social structure

Small-toothed Palm Civets *Arctogalidia trivirgata* are small carnivorans usually weighing 2–2.5 kg as adults (Nowak 2005). They are widely distributed in South-East Asia and are one of the least known civet species because of their arboreal and nocturnal habits (Nowak 2005). They feed primarily on fruits, small animals, and flower nectar (Harrison 1961, Nowak 2005, Moore & Wihermanto 2014). While there are no published studies on the social structure of Small-toothed Palm Civets, several authors observed group feedings of 2–4 adults (Duckworth 1997, Borissenko *et al.* 2004, Duckworth & Nettelbeck 2007, Eaton *et al.* 2010, Moore 2011, Willcox *et al.* 2012, Murali *et al.* 2014), also with some observations of solitary feeding (Low 2010, Moore & Wihermanto 2014, Raman & Zakhuma 2014), suggesting social structure flexibility. This paper reports several observations of Small-toothed Palm Civets in terms of their intra- and inter-specific interactions in feeding trees in the Danum Valley Conservation Area.

The Danum Valley Conservation Area (4°57'N, 117°48'E) is a 438 km² protected area in North-Eastern Borneo. Approximately, 90% of the area is mature lowland evergreen dipterocarp forest between 180 and 900 m asl. (Marsh & Greer 1992, Newbery *et al.* 1999). The study was conducted in a 5 km² on the eastern boundary of the area, from July 2012 to February 2013. Mean annual rainfall was 2700 mm (1986–1992) and mean daily maximum, minimum, and mean temperatures were 30.9, 22.5, and 26.7°C, respectively (Marsh & Greer 1992).

Case 1. Co-feeding Small-toothed Palm Civets in fruiting fig trees

Around 00h00 on 20 July 2012, I observed four adult Small-toothed Palm Civets feeding in a fruiting *Ficus binnendijkii* tree. I could neither observe their sex or behaviours due to limited visibility nor hear growling or any other aggressive sounds.

At 15h42 on 11 February 2013, I observed a Small-toothed Palm Civet coming to a fruiting tree (*Ficus* sp.) to feed. At 16h38 and 16h43, two more Small-toothed Palm Civets moved to the same tree. They were all adult size and at least one individual was male. They did not demonstrate antagonistic behaviour even though they fed on the same branch. At 17h28, one of the civets moved out from the tree and at 21h50, the last individual moved out from the tree.

Case 2. Inter-specific interactions between Common Palm Civets and Small-toothed Palm Civets in a fruiting fig tree

At 21h50 on 18 January 2013, I observed a Small-toothed Palm Civet and a Common Palm Civet *Paradoxurus hermaphroditus* in a fruiting *Ficus fistulosa* tree. The fruits were immature judging by their hardness and size. The Common Palm Civet suddenly rushed away from the tree within 10 minutes. At 20h30 on 23rd January, I observed the same Small-toothed Palm Civet feeding in the tree. At 20h59, the Small-toothed Palm Civet ran out from the tree suddenly and growled. At 21h06 I observed that the same Common Palm Civet had moved to the tree and it fed on fruits until 23h55. At 3h00, the Small-toothed Palm Civet came to the tree to feed until 5h35. At 20h20 on 7 February, I observed a new Common Palm Civet feeding in the tree. At 21h40, the same Small-toothed Palm Civet visited the same tree, but the Common Palm Civet did not drive the Small-toothed Palm Civet out. At 22h22, they were within 2 m of each other, and the Common Palm Civet rushed away from the tree and they both growled. The Small-toothed Palm Civet ran toward the upper part of the tree and continued to feed. In all of the observations, growling was the only aggressive behaviour observed.

In case 1, three adult Small-toothed Palm Civets visited the feeding tree during daytime, and continued foraging for over five hours. Although I was unable to determine their sex, at least two individuals were of the same sex among the three observed civets. They arrived and left the tree separately, suggesting a weak association between co-feeding conspecifics, but they were not aggressive towards each other. These interactions contradict those of Common Palm Civets. Nakabayashi *et al.* (2012) reported that a male Common Palm Civet exhibited antagonistic behaviours toward another male in a feeding tree but not toward a female conspecific. Further, I observed antagonistic behaviours between two female Common Palm Civets in a fruiting fig tree. When they were 1–2 m apart they ran out from the tree with emitting strong musk odours. Common Palm Civets may not tolerate co-feeding of same-sex individuals. Conversely, Small-toothed Palm Civets did not exhibit

aggression or escape behaviours toward co-feeding conspecifics including same-sex individuals.

In case 2, inter-specific behaviours were aggressive. Duckworth (1997) also reported an aggressive encounter of a Small-toothed Palm Civet and a Common Palm Civets in Laos. Body size determines dominance hierarchy among frugivores in fruiting trees (French & Smith 2005) and as these two civet species are of a similar size, species-specific dominance may be hard to establish. Given that Eaton *et al.* (2010) observed four Common Palm Civets and five Small-toothed Palm Civets co-feeding in a tree without interactions in Java (J. Eaton *in litt.* 2012), the exhibition of aggression may be affected by various factors such as resource abundance. Observations in this study suggest that there may be behavioural differences in Small-toothed Palm Civets' reactions to same-sex conspecifics and different civet species, indicating that they do not always tolerate co-feeding animals.

Small-toothed Palm Civets utilise relatively eclectic food items besides fruits and animal material such as nectar, palm pith, and tree bark sap (Moore & Wihermanto 2014, MN pers. obs.). This minimises resource competition between individuals and facilitates non-aggressive co-feeding of same-sex conspecifics. The observations reported in this study are a first step to describe the social structure of Small-toothed Palm Civets, and suggest the existence of loosely associated groups. Even though Small-toothed Palm Civets and Common Palm Civets belong to the same subfamily Paradoxurinae, there is a large difference in tolerance against co-feeding conspecifics. Further field study is necessary to elucidate social structure in frugivorous/omnivorous carnivorans.

Acknowledgements

I thank Glen Reynolds, Mike B. Ola, Arnold James, Azlin Sailim, Jamiluddin Jami, and all friends of The Royal Society for field assistance. I appreciate Abdul H. Ahmad for his support in this research. I am grateful to Michio Nakamura and Shiro Kohshima for their helpful comments. I thank the Sabah Biodiversity Centre and Danum Valley Management Committee for their permission to conduct this research. I am grateful to Sabilah Tahir for assisting with the Malay language. I also thank anonymous reviewers for critical readings. This research was supported by the Japanese Society for the Promotion of Science Core-to-Core Program and Grants-in-Aid for Scientific Research to MN (#25-597).

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