

Short Communication

Opportunistic predation and predation-related events on long-tailed macaque and proboscis monkey in Kinabatangan, Sabah, Malaysia

Yosuke Otani^{1*}, Augustine Tuuga², Henry Bernard³ and Ikki Matsuda¹

¹Primate Research Institute, Kyoto University, Inuyama, Japan. *email:y.u.otani423@gmail.com

²Sabah Wildlife Department, Kota Kinabalu, Malaysia.

³Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia.

ABSTRACT. We report two cases of predation and predation-related events on long-tailed macaques and proboscis monkeys living in sympatry in the lower Kinabatangan, Sabah, Malaysia. An adult male Long-tailed macaque was preyed on by an estuarine crocodile while feeding on fruits at low tree branches above the river. We found a solitary male Proboscis monkey who has large wounds on the cheek and left thigh. It would appear that the male was injured by a large predator such as a Sunda clouded leopard. These cases indicate the strong predation pressure on primates who habit in riverine forest as previously indicated. For better understanding of anti-predation strategies among primates, more information on predation events is necessary.

Keywords: Predation pressure; *Nasalis larvatus*; *Macaca fascicularis*, Clouded leopard, crocodile.

INTRODUCTION

Predation is an unavoidable factor when discussing ecological and sociological features of mammals (e.g., Korpimäki, 1996). With respect to primates, there is no doubt that predation is an important evolutionary force that shapes their behaviour and ecology

(Cheney & Wrangham, 1987; Miller, 2002; Miller & Treves, 2007; Isbell, 1994; Van Schaik & van Noordwijk, 1985; Janson & Goldsmith, 1995). However, predation events are rarely observed and many of these reports are anecdotal accounts. Thus, given the paucity of records, the chronicling of events is essential for the establishment of a more reliable database for the analysis of predation patterns.

Long-tailed macaques (*Macaca fascicularis*) and Proboscis monkeys (*Nasalis larvatus*) are river-refuging primate species in Southeast Asia: they typically return to riverside trees to sleep (van Schaik *et al.*, 1996; Matsuda *et al.*, 2010). The Long-tailed macaque (approximately 3 kg in body weight) is one of the 19 species of the macaque group living in multi-male multi-female groups consisting of several males, females and their offspring with a fission-fusion of subgroups (van Schaik *et al.*, 1983). Proboscis monkeys are endemic to Borneo and are large (adult male: ca. 20 kg; female: 10 kg), sexually dimorphic and primarily arboreal colobine primates (Napier, 1985; Schultz, 1942). Their typical social unit is one male group consisting of one adult male, several females and their offspring. Major predators for both species are pythons, several species of cats and crocodiles

(Long-tailed macaque: van Noordwijk, 1999, Proboscis monkey: Galdikas, 1985; Yeager, 1991; Matsuda *et al.*, 2008). Their common features for example riverine refuging, is strongly suggested to be related to predation threats by the above predators; and roosting in trees along the river at night is relatively effective in guarding against attacks from some predators because they can approach the monkeys only from the landward side (Matsuda *et al.*, 2011). Therefore, it is necessary to augment information about predation for further understanding of the society and behaviour in these two primate species.

In the present paper, we report two cases of predation and predation-related events on Long-tailed macaques and Proboscis monkeys that live in sympatry in the lower Kinabatangan, Sabah, Malaysia.

MATERIALS AND METHODS

We conducted this study in the riverine forest along the Menanggul River, a tributary of the Kinabatangan river in Sabah, Borneo, Malaysia (118°30' E, 5°30' N) from January to May 2012 (census five days per week). The mean minimum and maximum temperatures were approximately 24 and 32°C, respectively, and total precipitation at the site was 2,510 mm (June 2005–May 2006) and the river level varied by approximately one metre daily throughout the year (see Matsuda *et al.*, 2009, 2010 in details). The riverine forest is inhabited by Proboscis monkeys, Long-tailed macaques, Pig-tailed macaques (*Macaca nemestrina*), Silver langurs (*Trachypithecus cristatus*), Hose's langurs (*Presbytis hosei*), Bornean gibbons (*Hylobates muelleri*) and Orangutans (*Pongo pygmaeus*). As reported by Matsuda *et al.* (2008), Clouded leopards (*Neofelis diardi*) and estuarine crocodiles (*Crocodylus porosus*) are potential predators of Proboscis monkeys at the study site.

We conducted boat-based observation five days a week up to 6,000 m from the river mouth early in the morning (0600–0900) and in

the late afternoon (1500–1800). Through boat-based observations, we recorded primate species, their numbers, behaviour and location of primates at riverbanks. In addition, we performed *ad libitum* sampling on the river.

RESULTS AND DISCUSSION

Observation 1. Predation on an adult male Long-tailed macaque by an estuarine crocodile

An adult male Long-tailed macaque was preyed on by an estuarine crocodile on 12 March 2012. From around 1200 hours, we observed a group of Long-tailed macaques (40 m from our boat) on the right side of the riverbank, at a distance of 2,520 m from the river mouth. A few group members fed on fruits of *Cayratia trifolia* (Vitaceae) on the lower branches (1–3 m above the river). At 1230 hours, estuarine crocodile, 3–4 m in body length, suddenly appeared on the surface of the river and preyed on a male Long-tailed macaque eating fruits at the lowest branch (approximately 1m from the water). After the predation, group members raised the alarm and ran away.

The crocodile may look for a predation opportunity from beneath the surface of the water. Long-tailed macaques are often found close to the river as they feed on fruits of *C. trifolia*, usually found along rivers. Additionally, these primates have an agonistic behaviour. There is a possibility of greater amount of food at the river bank compared to the forest (van Schaik *et al.*, 1996). In the late afternoon on 9 February and 19 May 2012, we observed twice a male Long-tailed macaque chased by another male, jumped into the river to escape. In addition, at the study site, we frequently observed Long-tailed macaques swimming across the river (Ikki Matsuda, per obs), possibly to expand their ranging area for searching food sources. For these reasons, the riverine habitat seems to be worth for Long-tailed macaques, despite high exposure to predation threats from crocodiles. Further studies to assess the cost and benefit of using

the river and river bank among Long-tailed macaques are necessary to understand the primate's adaptation to these places. Anyhow, to stand ready near long-tailed macaques would be a proper feeding strategy for crocodiles.

Observation 2. Suspected attempt at predation on an adult male Proboscis monkey by a Clouded leopard

At 0637 hours on 28 February, we found a solitary male Proboscis monkey resting at a tree (~5 m from ground level), at a distance of 1,000 m from the river mouth. We observed wounds on the cheek and left thigh (Figure 1). The cheek was cut horizontally for ~15 cm. The thigh was hollowed widely. The estimated size



Figure 1. An injured adult male proboscis monkey; the individual were wounded on the cheek and left thigh.

of wounds on the length, the width, and the depth were ~20 cm, ~6 cm, and ~4 cm, respectively. At 1520 hours on 29 February, we saw the same injured male moving on the ground, at a distance of 1,200 m from the river mouth. At 1715 hours the same day, we once again found the male resting on a tree (~7 m from ground level) at the same place (1,200 m from the river mouth). Flies gathered on the scars, and the male waved the flies away. Throughout the two observation days (approximately 33 h), the injured male moved at least 200 m along the river. In all observation cases, the male was alone and we confirm that there were no other primate groups including Proboscis monkeys, within 200 m from the male along the river.

The male may have been injured by a large predator such as a Sunda clouded leopard. Inter-and intra-group agonistic behaviour in Proboscis monkeys occur infrequently throughout the year (Matsuda *et al.*, 2010, 2012) and even in all-male groups, no serious conflicts are reported (Murai, 2004). In addition, the scar on his thigh was observed to be extremely large and could not have been caused by another Proboscis monkey. Crocodiles and Clouded leopards would be the potential predator of Proboscis monkeys in the study site (Matsuda, 2008; Yeager, 1991). If the male was attacked by a crocodile while crossing the river, the damage would have been more serious. The morphology of the wounds appears to be similar to a suspected predation case on the Orang utan (11 cm long and 4 cm deep) by a Clouded leopard in Danum Valley, Sabah, Malaysia (Kanamori *et al.*, 2012), supporting the observation that this Proboscis monkey male may have been attacked by a Clouded leopard.

Due to his wounds, the injured male may have difficulty in moving from one tree to another. Proboscis monkeys are generally arboreal where predation pressure is usually lower compared to ground level, although in locations that have less terrestrial predators such as Clouded leopards, Proboscis monkeys are known to frequently travel on the ground

(Bernard *et al.*, 2011). A Clouded leopard was reported to have attacked infant and juvenile Proboscis monkeys at the study site (Matsuda *et al.*, 2008), suggesting that the injured male Proboscis monkey walking on the ground was most likely exposed to high predation pressure. This supports the assumption that this Proboscis monkey could not travel properly from tree to tree because due to the severity of his wounds. Since we did not see the male for seven months after the last observation day, and factoring in Proboscis monkeys typically return to riverside trees to sleep (Matsuda *et al.*, 2011), it is possible to consider that the male has died. This may be due to the fact the male could not forage on trees due to his serious wounds. There is also a possibility that the male was preyed on while walking on the ground.

Matsuda *et al.* (2011) suggests that sympatric primate species in this study site, i.e., Proboscis monkeys, Long-tailed macaques, Pig-tailed macaques, Silver leaf monkeys, Gibbons and Orangutan, are exposed to a relatively high predation pressure by terrestrial predators, and to avoid them during night, these primates prefer to use the riverine habitat at night. However, Matsuda *et al.* (2011) does not discuss the effects of the threat of aquatic predators on their behaviour as there is no observation of predation/predation-related events by aquatic predators in this study site. Therefore, the first case reporting of predation on a primate species by a crocodile in the study site is worth considering in terms of the effects of predation threats by aquatic predators on primate behavioural strategies against such attacks. We confirm that the predation pressure on Long-tailed macaques and Proboscis monkeys by terrestrial predators would be strong as it has been previously indicated, and it must be the prime fatal peril for primates. For better understanding of anti-predation strategies among primates, more information on predation/predation-related events through direct observation, is necessary.

ACKNOWLEDGEMENTS

We express our sincere thanks to the Economic

Planning Unit of the Malaysian Government. We particularly thank the staff of the Sabah Wildlife Department for their permission to conduct our research in Lower Kinabatangan Wildlife Sanctuary. We thank our research assistants, especially A. B. Etin and S. Ahmad for their support. We are also greatly indebted to the people of Sukau for their hospitality. Advice and support has been generously supplied by G. Hanya. This study was financed in part by the MEXT Grant-in-Aid for JSPS Fellows (#11J04699) to YO and AS-HOPE. This study was conducted in compliance with animal care regulations and applicable Malaysian laws.

REFERENCES

- Cheney, D.L. & R.W. Wrangham. 1987. Predation. In: Smuts BB, Cheney DL, Seyfarth RM, Wrangham RW, Struhsaker TT (eds) *Primate societies*. Chicago: University of Chicago Press, pp 227–239.
- Bernard, H., I. Matsuda, G. Hanya & A.H. Ahmad. 2011. Characteristics of night sleeping trees of proboscis monkeys (*Nasalis larvatus*) in Sabah, Malaysia. *International Journal of Primatology* 32: 259–267.
- Galdikas, B.M.F. 1985. Crocodile predation on a proboscis monkey in Borneo. *Primates* 26: 495–496.
- Isbell, L.A. 1994. Predation on primates: ecological patterns and evolutionary consequences. *Evolutionary Anthropology* 3: 61–71.
- Janson, C.H. & M.L. Goldsmith. 1995. Predicting group size in primates: foraging costs and predation risks. *Behavioral Ecology* 6: 326–336.
- Korpimäki, E. & C.J. Krebs. 1996. Predation and population cycles of small mammals. *BioScience* 46: 754–764.
- Kanamori, T., N. Kuze, H. Bernard, T.P. Malim & S. Kohshima. 2012. Fatality of a wild Bornean orangutan (*Pongo pygmaeus morio*): behavior and death of a wounded juvenile in Danum Valley, North Borneo. *Primates* 53: 221–226.
- Matsuda, I., A. Tuuga & S. Higashi. 2008. Clouded leopard (*Neofelis diardi*) predation on proboscis monkeys (*Nasalis larvatus*) in Sabah, Malaysia. *Primates* 49: 227–231.
- Matsuda, I., A. Tuuga & S. Higashi. 2009. Ranging behavior of proboscis monkeys in a riverine

- forest with special reference to ranging in inland forest. *International Journal of Primatology* 30:313-325.
- Matsuda, I., A. Tuuga & S. Higashi. 2010.** Effects of water level on sleeping-site selection and inter-group association in proboscis monkeys: why do they sleep alone inland on flooded days? *Ecological Research* 25: 475–482.
- Matsuda, I., A. Tuuga & H. Bernard. 2011.** Riverine refuging by proboscis monkeys (*Nasalis larvatus*) and sympatric primates: implications for adaptive benefits of the riverine habitat. *Mammalian Biology* 76: 165–171.
- Matsuda, I., A. Tuuga, H. Bernard & T. Furuichi. 2012.** Inter-individual relationships in proboscis monkeys: a preliminary comparison with other non-human primates. *Primates* 53: 13–23.
- Miller, L.E. 2002.** *Eat or be eaten*. London: Cambridge University Press.
- Miller L.E. & A. Treves. 2007.** Predation on primates. In: Campbell CJ, Fuentes A, Mackinnon KC, Panger M, Bearder SK (eds) *Primates in perspective*. Oxford: Oxford University Press, pp 525–543.
- Murai, T. 2004.** Social behaviors of all-male proboscis monkeys when joined by females. *Ecological Research* 19: 451–454.
- Napier, P.H. 1985.** *Catalogue of primates in the British Museum (natural history) and elsewhere in the subfamily Colobinae*. London: British Museum (Natural History).
- Schultz, A.H. 1942.** Growth and development of the proboscis monkey. *Harvard Bull Mus Comparative Zoology* 89: 279–314.
- van Noordwijk, M.A. 1999.** The effects of dominance rank and group size on female lifetime reproductive success in wild long-tailed macaques, *Macaca fascicularis*. *Primates* 40: 105-130.
- van Schaik, C.P., van M.A. Noordwijk, de R.J. Boer & den I. Tonkelaar. 1983.** The effect of group size on time budgets and social behaviour in wild long-tailed macaques (*Macaca fascicularis*). *Behavioral Ecology and Sociobiology* 13: 173-181.
- van Schaik, C.P. & van M.A. Noordwijk. 1985.** The evolutionary effect of the absence of felids on the social organization of the Simeulue (*Macaca fascicularis fusca*, Miller 1903). *Folia Primatologica* 44: 138-147.
- van Schaik, C.P., van A. Amerongen & van M.A. Noordwijk. 1996.** Riverine refuging by wild Sumatran long-tailed macaques. In: Fa JA, Lindburg DG (eds.) *Evolution and Ecology of Macaque Societies*. Cambridge: Cambridge University Press, pp.160–181.
- Yeager, C.P. & T.K. Blondal. 1991.** The proboscis monkey of Brunei Bay: Conservation status and ecotourism potential. *Brunei Museum Journal* 7: 112-116.

