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Possible predation attempt by a marbled cat on a juvenile Phayre's leaf monkey

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Abstract. The marbled cat (*Pardofelis marmorata*) is arguably one of the least known Southeast Asian felids. Based mainly on indirect evidence, a nocturnal and predominantly arboreal lifestyle has been assumed while little is known about its diet. Here we report how a marbled cat injured a juvenile male Phayre's leaf monkey (*Trachypithecus phayrei crepusculus*; 33 months old) at the neck and shoulder within the Phu Khieo Wildlife Sanctuary, Thailand. The event suggests that this small cat may prey on individuals with a body mass exceeding its own and confirms that it can be active during early morning hours indicating a crepuscular-diurnal activity. There are also first indications that individual differences in monkey behaviour such as preferred feeding height, could influence predation risk.

Key words. crepuscular-diurnal, Phu Khieo WS, prey size, Thailand

INTRODUCTION

The marbled cat (*Pardofelis marmorata*) is a small wild cat, about the size of a house cat with adults weighing between 2.5 and 5.0 kg (Grassman & Tewes, 2000; Sunquist & Sunquist, 2002; Wilson & Mittermeier, 2009). Its slender body, long tail, and large feet suggest a mainly arboreal lifestyle, but this has not been confirmed (Sunquist & Sunquist, 2002). The species is rated as Vulnerable C1+2a(i) (IUCN, 2013).

Until recently, marbled cats had been described as mainly active at night (Sunquist & Sunquist, 2002; 'apparently nocturnal'; Wilson & Mittermeier, 2009:141). However, when their activity pattern was analysed using camera-trap photos from Thailand (Lynam et al., 2013), all of the 10 events occurred after sunrise and before sunset. Bootstrap sampling placed the peak activity at around 0900 hours and most activities before noon (Lynam et al., 2013). Additional sightings support a mainly diurnal activity pattern for marbled cats: only one of 11 events occurred at night (Table 1). Similarly, most of the 37 camera trap photos from Laos, PDR were taken during the day (Johnson et al., 2009, bottom of Table 1). Furthermore, out of seven additional events for which no specific time was given, three occurred during the day (Table 1). In contrast, the only marbled cat tracked with a radio collar was active mainly at night and during crepuscular hours. However, this activity assessment was based only on 84 readings from a single individual over four weeks, which is not sufficient to discern a clear pattern (Grassman & Tewes, 2000: 35). Taken together, these observations cast doubt on a strictly nocturnal activity pattern and suggest some degree of crepuscular-diurnal activity, which should also be reflected in the prey species targeted.

While the marbled cat activity pattern remains equivocal due to limited data, even less is known about their diets with marbled cat feeding habits completely unknown (Grassman et al., 2005). In connection with their presumed arboreal lifestyle, it is likely that birds (Wilson & Mittermeier, 2009) and even smaller-bodied primates are part of the diet rather than small, terrestrial rodents that comprise the diet of the similarly sized leopard cat (Rabinowitz, 1990; Grassman, 2000; Rajaratnam et al., 2007; Fernandez & de Guia, 2011; Shehzad et al., 2012). Here we report an encounter between a marbled cat and an immature Phayre's leaf monkey (*Trachypithecus phayrei crepusculus*) in the wild suggesting that immature monkeys could be a prey species of this cat.

MATERIAL AND METHODS

Between January 2001 and January 2009, four habituated groups of wild Phayre's leaf monkeys at Phu Khieo Wildlife Sanctuary, Thailand (16.08–16.58 N, 101.33–101.92 E, Kumsuk et al., 1999), were followed on foot from dawn to dusk for at least four consecutive days every month (mean = 8.7 days, Koenig & Borries, 2012). At the time of the observed encounter, the group being followed (group PB) had 24 members, which was slightly larger than the population average of 19 members (Koenig & Borries, 2012). Group PB had been followed for four consecutive days preceding the event thus providing the location of the group's sleeping site.

Between January 2007 and May 2008, one of us (KO-L) observed juvenile Phayre's leaf monkeys using systematic, observational methods (Altmann, 1974; Martin & Bateson, 2007). These data allowed us to compare individual feeding

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Table 1. Marbled cats sighted (*) or photographed, sorted by time of day. For Thailand only cases not included in Lynam et al. (2013) are listed. Additional data on diurnal/nocturnal sightings at the bottom. ** http://www.conservationindia.org/gallery/camera-trapping-mammals-in-pakke; ***http://programs.wcs.org/laoswildlifephotoexhibition/en/01Cats.html#marbled.

Date	Time (hours) Or period	Site	Country	Comments	Reference
15 July 2012	0552	Imbak Canyon Conservation Area	Sabah, Malaysia	1 individual	Bernard et al., 2013
13 August 2012	0620	Imbak Canyon Conservation Area	Sabah, Malaysia	1 individual	Bernard et al., 2013
23 September 2008	0630–1030	Phu Khieo Wildlife Sanctuary	Thailand	1 individual*	present study
2010	0640	Pakke Tiger Reserve	Arunachal Pradesh., India	1 individual	Lyngdoh et al., 2011
29 June 2001	0741–1235	Bukit Barisan Selatan National Park	Sumatra, Indonesia	2 individuals, 1 melanistic	Cheyne & Macdonald, 2010; Wibisono & McCarthy, 2010
?	0900	Phu Khieo Wildlife Sanctuary	Thailand	1 individual*	Grassman et al., 2005
17 January 2013	1032	Pakke Tiger Reserve	Arunachal Pradesh., India	2 individuals	R. Langlang**
30 September 2008	1035	Bukit Barisan Selatan National Park	Sumatra, Indonesia	1 individual	Morino, 2009
19 January 2002	1130	Phu Khieo Wildlife Sanctuary	Thailand	2 individuals*	Grassman & Tewes, 2002
19 August 2009	1255	Sabangau	Kalimantan, Indonesia	1 individual	Cheyne & Macdonald, 2010
2010	1518	Pakke Tiger Reserve	Arunachal Pradesh., India	1 individual	Lyngdoh et al., 2011
05 September 2009	2333	Sabangau Forest	Kalimantan, Indonesia	1 individual	Cheyne & Macdonald, 2010
?	day time	Nam Et-Phou Louey National Protected Area	Laos, PDR	2 individuals	***
2008–2009	diurnal	Sabangau Forest	Kalimantan, Indonesia	1 individual	Cheyne & Macdonald, 2011
2008–2009	diurnal	Sabangau Forest	Kalimantan, Indonesia	1 individual	Cheyne & Macdonald, 2011
2008–2009	nocturnal	Sabangau Forest	Kalimantan, Indonesia	1 individual	Cheyne & Macdonald, 2011
2008–2009	nocturnal	Sabangau Forest	Kalimantan, Indonesia	1 individual	Cheyne & Macdonald, 2011
2008–2009	nocturnal	Dermakot Forest Reserve	Sabah, Malaysia	1 individual*	Azlan et al., 2009
2008–2009	nocturnal	Dermakot Forest Reserve	Sabah, Malaysia	1 individual*	Azlan et al., 2009
2003–2006	mostly diurnal	Nam Et-Phou Louey National Protected Area	Laos, PDR	$P < 0.005$ 37 photos	Johnson et al., 2009

heights and to identify the earliest drinking and play bouts of immatures, which were used to interpret the event. Details will be reported elsewhere (Ossi-Lupo, in prep.).

RESULTS

Sequence of events. On 23 September 2008, two of us (ZMP and SD) reached group PB at 0559 hours in the morning. At 0630 hours, several males and females began emitting alarm calls. This vocalisation is usually heard when a potential predator has been detected, for example, a cat (clouded leopard; Lloyd et al., 2006), a larger snake such as a python, or when individuals are startled. The vocalising monkeys all monitored the same spot on the ground about 2 m from a narrow, shallow creek (approximately 1.0–1.5 m wide and 3–5 cm deep) at 16.46 N, 101.63 E, and 800 m above sea level.

When the two observers approached the location, they detected an adult marbled cat of unknown sex on top of a monkey on the ground. The cat's body was aligned with the monkey's, covering it so that the monkey's exact position (on its back, stomach or side) could not be determined. The cat appeared to be chewing in the region of the monkey's neck. Almost instantly the cat became aware of the people and ran away, leaving the monkey behind.

The observers, who were on the same side of the creek as the monkey, retreated about 10 m perpendicular to the creek, at which point, both the monkey and the cat were no longer in sight. At 0645 hours, the monkey jumped on a liana and pulled itself up to about 2.5 m above the ground. It was identified as Bm7.2, a 33-month-old juvenile male (born 28 December 2005). He had a large gash on his right side from the neck down to the shoulder, approximately 8 cm long and 1 cm wide, and he was bleeding from the mouth. The gash was a clean-cut line unlike a chewing mark. Soon, his right hand lost its grip; the right arm appeared to be limp.

At about 0700 hours, Bm7.2 shut his eyes and seemed less attentive. His body began to sag and at 0707 hours he fell back to the ground, remaining out of the observers' sight for the remainder of the event. From 0755 to 0900 hours, the marbled cat would regularly cross the creek about 3–4 m from where the monkey had last been seen in an area more densely vegetated than the encounter spot. It roamed both sides of the creek, keeping a distance of 3–20 m from the encounter spot. Around 0900 hours the creek crossing stopped, the cat climbed a tree to a height of one meter above the ground, chewed on some leaves, and sat (eyes open) at a distance approximately 25 m from the monkey's presumed location. At 0930 hours, the cat returned to the ground and resumed crossing the creek. Just before 1030 hours, after the monkey group had moved away from the area, one of us (ZMP) searched for Bm7.2 within a 10 m radius of the encounter spot. The search was discontinued once the marbled cat was spotted again. The monkey's body could not be detected and was thus not recovered. The juvenile might have found cover in the undergrowth. Before the observers left the area to follow the monkey group, the marbled cat was photographed (Figs. 1, 2). Subsequent searches of the area at a later time were equally unsuccessful. Bm7.2 was never seen again and we assume that he died and was consumed by the cat.

Throughout the event, members of the leaf monkey group vocalised loudly (alarm calls) with the volume and frequency of the vocalisations increasing for example at 0724 hours and at 0755 hours, when the marbled cat reappeared. With time, however, the frequency and intensity of the vocalisations decreased and the last bark was heard at 1003 hours. From 0900 hours onward, some of the monkeys resumed feeding but remained in the area. Around 1015 hours the group began to move away. Bm5.1, a 62-month-old sub-adult male, was the most active member of group PB. Initially he was barking and later positioning himself about 3 m above the injured juvenile male. He did not resume feeding as most other group members did.

DISCUSSION

The observed event adds Phayre's leaf monkeys to the list of potential prey species for marbled cats in Thailand. It also

Fig. 1. Marbled cat sitting, facing the spot where it had bitten a juvenile Phayre's leaf monkey at 06:30. Note the long tail covering the front paws (Photograph by: Surachest Dtubpraserit©).

provides some insight, albeit still speculative, into the natural history of this lesser known cat. Interestingly, 25 percent of the cases compiled from the literature documented encounters with pairs of similarly sized, presumably adult marbled cats (3 out of 12, top of Table 1). However, it seems premature to suggest pair living and during the encounter described here we had no indication of a second cat.

Did the cat attack the juvenile monkey? Because the encounter had already happened when we arrived at the scene, we do not know for certain if the cat attacked the monkey or if the monkey was already impaired prior to the encounter. However, observers had been with the group the preceding night and that particular juvenile had appeared healthy and otherwise unimpaired. Occasionally, Phayre's leaf monkeys fall out of trees, but to our knowledge this has never resulted in serious injury.

In addition, immediately after the encounter was detected, a long gash was observed on the monkey's right neck and shoulder. The clean-cut edges suggest the gash had been inflicted by canines. Marbled cats have relatively long canines (Grassman et al., 2005), seemingly with the capability of causing an injury such as the one observed. Similarly, the bleeding from the mouth could indicate an accompanying rupture of the lungs. All together, the sudden alarm vocalisations, the cat's position on top of the monkey, as well as the gash on the neck—often typical of a bite inflicted on smaller prey in the attempt to dislocate the neck (Wilson & Mittermeier, 2009)—suggest an attack as the most plausible and parsimonious explanation.

Where did the cat first encounter the monkey? When we arrived at the scene, the monkey and the cat were on the ground but this does not mean that the initial encounter took place there. While we can never know with certainty, the comparatively dense lianas at the encounter location could have facilitated a first attack in the trees. It was still early morning and thus likely too early for the leaf monkeys to have descended to the ground to drink from the creek. Most of the drinking events we witnessed occurred in the afternoon, and 1030 hours was the earliest time of the day a juvenile was ever observed to descend to the ground to drink (Ossi-Lupo, unpublished). It was also too early for a first terrestrial play bout of immatures: in this group, playing on the ground was never observed before 0735 hours, and usually after 0800 hours (Ossi-Lupo, unpublished). Typically, the main activity in the first hour of the day was feeding. Interestingly, the particular juvenile male attacked by the cat often fed closer to the ground than the rest of the group (at an average feeding height of 9 m versus 14 m respectively; Ossi-Lupo, unpublished). If this immature male did indeed spend more time at lower heights than most other group members, his higher-risk behaviour could have facilitated the likelihood of encountering a predator. Further research into this aspect is needed to shed light on the influence of individual behaviour on predation risk.

Fig. 2. Marbled cat standing, looking at the spot where it had bitten a juvenile Phayre's leaf monkey at 06:30 (Photograph by: Surachest Dtubpraserit©).

On Sumatra, a marbled cat was detected resting on the forest floor (Morino, 2009) close to a fruiting tree regularly visited by siamangs (*Symphalangus syndactylus*, another primate species). It is possible that this individual was waiting for prey to be attracted to the fruits but we can only speculate as to the eventual location of any potential attack (i.e., in the trees or on the ground).

Body mass of predator and prey. Very few data are available on the body mass of marbled cats (Lekagul & McNeely, 1988; Sunquist & Sunquist, 2002) and only two values refer to an individual of known sex, in both cases female: the one from Kalimantan was 2.7 kg while the one from Thailand (same sanctuary as this study) was 3.7 kg and the individual was described as very lean and slender. This suggests that prime adult females likely exceed 4 kg in mass and consequently adult males could be even heavier. Unfortunately, however, the sex of the individual attacking the leaf monkey was unknown as was its body mass.

The body mass of the juvenile male monkey was also unknown. We can, however, estimate it based on data from a closely related species (Osterholz et al., 2008), the silvered leaf monkey (*Trachypithecus cristatus*). In captivity, a 33-month-old male silvered leaf monkey approximates 5.4 kg (Shelmidine, personal communication). In the wild, adult individuals of this species are between 0.5 kg (females) to 1.3 kg (males) lighter than Phayre's leaf monkeys (Smith & Jungers, 1997). Given that provisioned primates tend to be heavier than wild ones (Altmann & Alberts, 2005), the values for captive, provisioned silvered leaf monkeys might be a good approximation for the larger Phayre's leaf monkeys under wild, unprovisioned conditions. This would mean that the immature leaf monkey was about as heavy as the attacking cat, if not heavier.

Feeding habits of marbled cats. Thus far, the diet of marbled cats has mainly been inferred from its assumed arboreal lifestyle (Lekagul & McNeely, 1988; Sunquist & Sunquist, 2002; Wilson & Mittermeier, 2009). The leopard cat, which has a similar body mass to the marbled cat (Sunquist & Sunquist, 2002) is reported to feed mainly on rodents (Rabinowitz, 1990; Grassman, 2000; Rajaratnam et al., 2007; Fernandez & de Guia, 2011; Shehzad et al., 2012). However, the remains of a spectacled leaf monkey

(*Trachypithecus obscurus*) were found in a scat sample at Kaeng Krachan National Park, Thailand (Grassman, 2000). The spectacled leaf monkey is another close relative of the Phayre's leaf monkey (Osterholz et al., 2008) and adults are almost identical in body mass (Smith & Jungers, 1997). Thus, leopard cats and marbled cats appear to be equally capable of preying on juvenile monkeys. Although our observation does not establish primates as a regular prey item of the marbled cat, it suggests that they make use of a crepuscular-diurnal activity pattern, at least opportunistically, and are able to kill non-adult monkeys.

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