

## Two incidents of venomous snakebite on juvenile blue and Sykes monkeys (*Cercopithecus mitis stuhlmanni* and *C. m. albogularis*)

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**Abstract** Although rarely observed, predation is thought to be an important factor in the evolution of primate life histories and behavior. Here I describe two incidents of snake predation on *Cercopithecus mitis* guenons from Kenya. The first case involved a juvenile blue monkey (*Cercopithecus mitis stuhlmanni*) in the Kakamega Forest, which died following a bite by a Gaboon viper (*Bitis gabonica gabonica*). The snake's attempts to ingest its prey were unsuccessful. In the second incident, a juvenile Sykes monkey (*Cercopithecus mitis albogularis*) at Gede Ruins National Monument died suddenly after suffering symptoms that are characteristic of bites inflicted by black mambas (*Dendroaspis polylepis*). In both cases circumstantial evidence suggests that attacks occurred during extended play sessions in dense vegetation on or near the ground. If so, the observations support the hypothesis that play may be a costly activity.

**Keywords** *Cercopithecus mitis* · Predation · Snake bite · Social play

### Introduction

Predation is assumed to be an important factor in the evolution of primate life histories and behavior (Alexander 1974; Cheney and Wrangham 1987). However, reports of

predation events are extremely rare, making it difficult to assess actual predation rates for most populations, and limiting our ability to understand the adaptive significance of variation in predation avoidance strategies across species, populations and individuals.

Here I provide a detailed description of the circumstances surrounding the lethal bite of a juvenile blue monkey (*Cercopithecus mitis stuhlmanni*) by a Gaboon viper (*Bitis gabonica gabonica*), and describe a second incident for which there is strong evidence that a juvenile Sykes monkey (*C. m. albogularis*) succumbed to a bite from a black mamba (*Dendroaspis polylepis*).

### Methods

The observations were made at two field sites in Kenya, Kakamega Forest in Western Kenya and Gede Ruins National Monument at the Kenyan North Coast. The Kakamega Forest can be characterized as a semi-deciduous submontane rainforest whose species composition shows close association to the Congo-Guinean rainforests of Central Africa (Cords 1986). For a detailed description of the study site, refer to Cords (1986). Several social groups of blue monkeys have been under continuous observation at this site since 1997, with previous intermittent field research going back as far as 1978 (Cords 1986, 1987). Prominent venomous snake species frequently seen in the forest include rhinoceros viper (*Bitis nasicornis*), Gaboon viper (*B. g. gabonica*), and forest cobra (*Naja melanoleuca*).

At Gede Ruins, one social group of Sykes monkeys had been under continuous observation by the author and field assistants since August 2005, and a second group somewhat less regularly since March 2006. The ruin area is

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covered in a mixture of old growth lowland coastal forest and woodland. The most commonly encountered venomous snakes at the site are puff adder (*B. arietans*) and Eastern green mamba (*D. angusticeps*), but black mambas (*D. polylepis*) and several species of cobras (*Naja* spp.) can be spotted regularly as well. Three sightings of a black mamba were made in the general area during the month preceding the incident.

## Results

### Incident #1: Gaboon viper attack on a blue monkey, March 2006

The author followed a focal group of monkeys from 0730 hours, recording social interactions and group movements. At about 0900 hours, the group moved towards the forest edge through a relatively open area in which the monkeys often fed on herbaceous vegetation and fruits of small scattered *Solanum mauritianum* trees. Within minutes, about 10 juveniles of different ages were involved in a play session in which they chased each other through very dense, about 1 m tall herbaceous vegetation. The first monkeys to jump onto the ground carefully scanned the area from a low branch before proceeding, but as play progressed they moved around a wider area on the ground with little caution.

At 1000 hours, after play activity had ceased and the juveniles had retreated into nearby trees to rest or feed, some unidentified individuals gave very loud ground predator alarm calls (“chirps”) of a type most commonly directed at dogs or other large terrestrial animals. One juvenile in particular moved closer to the ground, chirping continuously. Following this monkey led me to discover a 4-year-old juvenile male blue monkey dangling upside down in a small tree about 3 m above ground, with its feet caught in a branch. Its location was very close to a trail and right in the same area where the play session took place during the previous hour. The approaching juvenile jumped on the branch next to the dead monkey, causing the body to fall to the ground. A few other juveniles, but no adult females, also came closer and chirped at the body. The first juvenile, however, seemed suddenly to have spotted something else on the ground. Its alarm call now changed to a typical snake alarm, a more quiet type of “chirp”. After searching the ground for a few minutes, I located a Gaboon viper that was heading straight towards the dead monkey on the ground from about 5 m away. When the snake arrived at the body it immediately tried to engulf its prey head-first (Fig. 1). Its repeated attempts were unsuccessful, however, and after about 20 min the viper eventually abandoned the body. At about 1 m in length, the



**Fig. 1** A Gaboon viper attempting to ingest a juvenile blue monkey, Kakamega Forest, Kenya

snake was likely an almost fully grown specimen (Spawls 2002).

Although the attack itself was not witnessed, there is little doubt that the monkey died from the bite of a Gaboon viper. Two fresh puncture wounds were visible on the monkey’s left forearm (Fig. 1), still bleeding at the time the monkey was first found. Blood was also coming out of the monkey’s mouth. These are typical symptoms of envenomation by *B. gabonica*, whose venom is known to be a strong anticoagulant (Forbes et al. 1969). Furthermore, the body started swelling noticeably, a sign of severe inner tissue damage and bleeding, also typical effects of the species’ venom (Marsh and Whaler 1984; Hyslop and Marsh 1991).

### Incident #2: Fatal snake attack on a Sykes monkey, May 2007

At 1050 hours, museum staff found a “delirious” medium juvenile Sykes monkey sitting alongside a trail in an area that the study group had passed through between 1000 and 1030 hours. A field assistant of the monkey project was able to document the last 15 min until death occurred. She found the monkey sitting up but slumped over, head

hanging down. It fell on its side every minute or two, convulsed a bit, and then pushed itself back into a sitting position. It did not seem to be fully aware of the observers standing nearby. Its ability to move deteriorated quickly. During the last 2 or 3 min of its life, the monkey was lying down, not moving, and its breathing became very shallow. Death occurred at 1115 hours.

Two small puncture wounds were found on the left forearm, about 1 cm apart. The site of the bite was covered in what appeared to be saliva, as was the mouth of the juvenile. The eyelids were half closed, but not swollen. There were no obvious signs of swelling or bleeding anywhere on the body, and no muscle stiffness was noticed. All physical and behavioral symptoms indicate that the monkey was killed by potent neurotoxic venom like the one present in black and green mambas (Spawls 2002). The quick progression to death from a state of limited awareness when the monkey was first found is suggestive of a black mamba bite, whose venom toxicity is about ten times that of the Eastern green mamba (Spawls and Branch 1995). A cobra bite would likely have led to severe local swellings as well as muscle stiffness (Spawls 2002), neither of which were apparent in this case.

Similar to the blue monkey predation event, the juvenile Sykes monkey was found in an area that was covered in very dense vegetation. It was also an area of the home range that is frequently used by juveniles for extended play sessions that involve chasing each other in and out of the dense bushy vegetation alongside the trail. Such a play session occurred on the day of the juvenile's death when the study group passed through the area about 20 min before the monkey was found. Thus, similar to the Kakamega incident, the attack may have occurred during social play on or near the ground.

## Discussion

Although predation by snakes has been reported a number of times, most cases involve constrictor snakes like boas and pythons. Only four reports of attacks on non-human primates by venomous snakes have so far been published (Chism et al. 1984; Correa and Coutinho 1997; Barrett et al. 2004; D.L. Cheney, cited in Isbell 2006), and only two of these cases involved terrestrial vipers. The rarity of observed snake attacks, however, does not necessarily indicate that venomous snake predation is of little importance for the evolution of primate life histories and behavior. Indeed, Isbell (2006) provides evidence that the evolution of primate vision was influenced significantly by an evolutionary arms race with (venomous) snakes as one of the earliest predators of evolving primates.

Both of the fatal incidents described here involved juvenile monkeys likely engaged in social play at the time of attack, which would suggest significant risks associated with this behavior. Play is generally viewed as having immediate costs in terms of energy expenses and risks of injury or predation, and various hypothesized immediate (see Chalmers and Lockehaydon 1984) or delayed benefits (Bekoff and Byers 1981; Fagen 1981; Meaney et al. 1985; Fagen 1993; Byers and Walker 1995; Spinka et al. 2001). It has been difficult, however, to demonstrate the exact nature of the proposed costs and benefits. Although only anecdotal in nature, the two fatal attacks described here support the idea that social play can increase the risk of predation (see also Harcourt 1991), which implies the existence of strong fitness benefits that would outweigh these costs.

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