

Short Communication: Infanticide of Javan slow loris (*Nycticebus javanicus*) in captivity

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Abstract. Sushadi DS, Phadmacanty NLPR, Wahyudin M, Wirdateti 2021. Short Communication: Infanticide of Javan slow loris (*Nycticebus javanicus*) in captivity. *Biodiversitas* 22: 1606-1611. Over the past decade, the population of Javan slow loris (*Nycticebus javanicus*) in the wild has continued to decline. Various conservation efforts by the government and NGOs have been carried out, but still have not yielded significant results. Many studies have highlighted the impact of poaching and forestland conversion as a cause, but the natural behavior of *N. javanicus*, especially infant care interactions, is poorly studied. We investigated the case of a 5-day-old Javan slow loris baby named Monda, found dead in captivity. Monda was born in captivity and impounded with its mother and an adult male. She was found dead decapitated with a sign of injury on the right arm. Microscopic fecal examination of the other lorises showed hair and bone fragments in the male feces. Based on this finding, it is possible that infanticide also occurs in slow lorises in its natural habitat but may have been underreported.

Keywords: Behavior, cannibalism, captivity, infanticide, *Nycticebus javanicus*

INTRODUCTION

Infanticide is the predominant cause of infant mortality in more than 50 primate species (Palombit 2015) and becomes even more crucial for threatened animals. With a low reproduction rate, along with distress in their habitat, the negligence of the parent in raising the baby to continue the survival of the species is a big loss. Javan slow loris (*Nycticebus javanicus*), which since 2008 has the status of Critically Endangered (Nekaris et al. 2020) and is in CITES Appendix 1, are also at risk of this threat. As an endemic animal of Java island, its population continues to decline (Nekaris and Starr 2015), thus comprehensive studies as an effort to save it are very urgent to do. However, there is a potential for maladaptive behavior, such as infanticide, which has been recorded in some primate species (Opie et al. 2013). Both the parent itself and other males have been recorded as having infanticides, such as in *Saguinus fuscicollis* and *S. mystax* (Culot et al. 2011).

In general, slow lorises are solitary nocturnal animals. Despite being solitary, slow lorises form a stable intrafamily social unit, called spatial group. The spatial group of *N. javanicus* usually consists of one male, one female, and up to 3 younger individuals, but might vary. During the day, one spatial group usually occupies a bamboo tree as a sleeping group and sleeps close to each other (Winarti 2011; Wirdateti 2012). For their night activities, the same group will share overlapping space in the same home range. Adult males will usually separate themselves, while the mother is always carrying the infant. Thus, *N. javanicus* is categorized as solitary animals living in groups (Wiens 2002; Winarti 2011). Interactions in a

spatial group were seen to be positive, such as allogrooming, following, pant-growling, and click-calling. However, only 3% of their active time is spent in spatial groups. This evidence may suggest a social monogamous system, despite polyandrous activity has also been reported (Wiens 2002; Wiens and Zitzmann 2003).

Nycticebus javanicus is threatened by deforestation and wildlife trade, which includes exotic pet trade, traditional medicine, and bushmeat (Nekaris and Jaffe 2007), while their reproduction rate is low. With 188 days of gestation period (Izard et al. 1988), these species give birth to an average of only one offspring a year. Weaning ages range from 3-4 months, but a new offspring will be completely independent at about 20 months of age. During these times, infant care is fully carried out by the mother and the male is not involved, thus the survival of the infant is fully its mother responsibility (Wiens and Zitzmann 2003).

Infant care interactions in primates are fundamental, given that as an altricial creature infant primates need full parental care at birth (Blumberg and Sokoloff 1998). Unlike precocious animals, infant primates are either left in their nests or carried by their parent (Ross 2001). The parent is fully responsible for meeting feed needs, guarding against predators, and teaching survival skills when entering the weaning age (Izard 2006). Although some species show biparental care patterns in infant rearing (Storey and Zeigler 2016), most of the time it is mother's responsibility (Maestripieri 2001). In prosimians, particularly *N. javanicus*, maternal care is predominant (Izard 2006). This means that negligence of the mother in caring for its infant could be fatal.

Based on conditions in the field, *N. javanicus* is one of the most demanded animals for illegal poaching (Nekaris and Starr 2015). Apart from being in great demand as pets, on Java, these animals are considered to have mystical powers. Many people use *N. javanicus* limbs such as bones and skull as amulets and black magic (Nijman and Nekaris 2014). Moreover, they are also widely hunted and burned-alive for “*minyak kukang*” (loris oil), a potion believed to give mystical power to attract the opposite sex in humans (Gardiner 2019). Therefore, when a dead *N. javanicus* is found decapitated or with incomplete limbs, people generally assume it was died as a sacrifice and associate it with black magic. Yet it is possible that the death was caused by cannibalism such as infanticide, given that its predators such as snakes and eagles rarely leave the carcasses of their prey (Hawkeswood 2017). However, only a study could provide an answer to this hypothesis.

We present a case study of a *N. javanicus* infant who died while being kept in captivity with its mother and another adult male. Necropsy was carried out to reveal the cause of death, as well as microscopic fecal examination to observe a gut content of other lorises. If it is proven that the infant died as a result of cannibalism, it might provide a new perspective on the possibility of something similar happening in in-situ populations. The factors identified as the cause could also be eliminated in the future, both in ex-situ and in-situ conservation.

MATERIALS AND METHODS

Animal maintenance and collection of the carcass

Female *N. javanicus* baby named Monda was captured-born in good health on October 23, 2019. She was captured in Bhumisatwa experimental facility, Research Center for Biology-LIPI, along with her mother and another adult male from different spatial group who was captured from same location in the wild in June 2019. The pregnancy is

undiscovered at the first encounter and the two adults intendedly placed together for other ex-situ research purposes. The enclosure has been designed with additional enrichment according to the natural habitat of the slow loris and is protected from the presence of other animals.

Monda's birth was unexpected and since another enclosure still needs to be prepared before she and her mother can move, they were continuously kept together with the male. Monda and her mother occupy a different resting box apart from the male. The feed given consisted of fruits and crickets, followed feed intake standard for non-human primates (Rothman et al. 2012). Since her birth, the mother was observed breastfeeding and grooming her, same behavior as described by Fitch-Snyder and Ehrlich (2003) on *N. bengalensis* and *N. pygmaeus*.

Five days later, on October 28 in the morning, Monda was found dead decapitated (Figure 1). The previous day, no changes in behavior were observed from Monda, her mother, or the male. Monda's carcass was then collected and stored in a freezer for necropsy the next day.

Procedures for necropsy and fecal examination

Necropsy was carried out on October 30, 2019 by following the non-human primate necropsy protocol (Blanchard and Russell-Lodrigue 2012). Inspection and measurement of all organs were performed, unless for the head region. The anatomical pathology of the organs was presented descriptively to analyze the cause of Monda's death.

Fecal examination was also performed on the mother and the adult male. The two were kept in separate cages after Monda's death, then each feces were sampled for two consecutive days. Sampled feces was then diluted with water and examined for the presence of hair and bone fragments microscopically. Identification of the animal species was then carried out on the hair and bone fragments found in the feces.



Figure 1. Monda with her mother in their resting box (*up*); and Monda's carcass (*down*)

RESULTS AND DISCUSSION

General condition examination revealed that the head, as well as the skull, were missing, with hemorrhagic lesions and hyperemia at the distal of the neck muscles. The atlas bone on the cervical spine is missing, so we only able to observe from the axis bone to the distal of the body. There was also severe inflammation along the right arm which indicated Monda's resistance prior to her death. No pathological findings were observed in any organs other than the head (Mcaloose and Stalis 2011) which indicates all the organs are in good health. Some of measured organ parameters are shown in Table 1 and the results of necropsy are presented in Table 2.

Based on inspection of the neck, the head injury was thought to be due to predatory behavior from other animals. Given that the enclosure is fenced and has a concrete floor, which is preventing predators to enter, we suspected that Monda died as a result of cannibalistic behavior by her mother or the adult male, thus we confirm it by examining their feces. Under normal circumstances, their feces should not contain anything other than fruit or crickets. Follow-up examination on the feces of the adult male showed that there were mammalian hairs and bone fragments identified as Monda's (Figure 2), while nothing suspicious found in the mother. This finding confirmed the infanticidal behavior of the adult male.

Cannibalism is often found in almost every animal taxon and its most common form is infanticide (Nishimura 2010). In principle, intraspecific infanticide, especially in wild animals, can be carried out by males or females who are or are not genetically related to the infant (Hrdy 2016). Filial infanticide by mother is most likely occurs when the infant is born with a defect that likely will disrupt its future development (Lukas and Huchard 2019) as recorded in Felidae family (Packer 2001). However, based on the necropsy results, Monda's physical and organs condition were good and did not appear to have any pathological conditions. On the other hand, recorded cases of male infanticide in primates have also been reported (Opie et al. 2013).

More specific causes of infanticide are also summarized in Ramsay et al. (2020) into four hypotheses: limited resources, exploitation, maladaptive behavior, and sexual selection (Dixson 2012). High competition for limited resources, such as food or shelter, is the motive for the first hypothesis (Hrdy 1979). In primates, it has bigger chance to occur in species with high population density, as recorded in chimpanzees (*Pan troglodytes*) (Townsend et al. 2007) and spider monkeys (*Ateles hybridus*) (Rimbach et al. 2012). This perhaps could also be associated to the exploitation hypothesis, where infanticide is carried out for the purpose of nutritional benefit (Van Schaik and Van Noordwijk 2019) since it is not only reduced competition for resources, but also serves as the source of feeding for the executor. However, these two hypotheses are unlikely to occur in this case since there are unlimited resources in captivity with adequate food and shelter. Also, only small part of the head was consumed, which made little sense if exploitation was the motive. The same applies to maladaptive behavior hypothesis which emphasizes

distress due to human disturbance in their habitat as a cause of infanticide. The enclosure was isolated and far enough from human disturbance. There were also restrictions on access and addition of appropriate enrichments provided to ensure the welfare of the animals that apparently do not support this hypothesis.

The last one, sexual selection, is a hypothesis that puts the male as the executor (Manguette et al. 2019). It suggests that males kill infants to force the mother back into her estrus cycle again, thus giving the male the opportunity to sire the next offspring (Van Schaik and Van Noordwijk 2019). In this hypothesis, the male is not predicted to have genetic relationship to the infant, as demonstrated on colobus monkeys (*Colobus vellerosus*) (Teichroeb and Sicotte 2008) and golden snub-nosed monkeys (*Rhinopithecus roxellana*) (Yao et al. 2016), Hanuman langurs (*Semnopithecus entellus*) (Heistermann et al. 2001), and mountain gorilla (*Gorilla beringei beringei*) (Robbins et al. 2013). Infanticide of Monda is likely in accordance with this since the male is not related. Also, it is suggested that *N. javanicus* are likely non-seasonal breeders (Wiens and Zitzmann 2003), so the effort to kill the infant might give a benefit to the male to sire the mother's next offspring.

So far, studies of slow loris behavior in in-situ habitats have not found any cannibalistic or infanticide behavior (Kappeler et al. 2017) and no record on ex-situ studies. The study by Rode-Margono et al. (2014) showed that *N. javanicus* almost never socializes in the wild and spends most of its time sleeping and looking for food. However, there have been several findings of slow loris carcasses by the villagers, mostly defective without head or limbs (Nijman and Nekaris 2014). This finding is believed by them to be part of black magic activities using slow lorises, although there was also no evidence that the death was caused by humans (Nekaris et al. 2013). While infanticide is very difficult to directly observe and might be underreported to date, our result just encourages that this behavior is possible to occur in this species.

Table 1. Length and weight of Monda's organs

Indicator	Length (mm)	Weight (g)
SVL (total body length)	93.5	
Circumference (abdomen)	11.9	
Chest size	16.7	
Femur	28.9	
Tibia	33.5	
Metatarsal	23.6	
Humeral	29.3	
Radial-Ulnar	29.1	
Metacarpal	12.4	
Neck	9.5	
Stomach	Diameter = 11.7 Length = 20.1	Emptied = 0.39
Liver	29.5	2.02
Heart	17	0.44
Lung	24.8	0.57
Kidneys	Left = 10 Right = 9	Left = 0.21 Right = 0.18
Duodenum	187	
Jejunum	208	
Ileum	193	
Uterus	12	

Table 2. Necropsy results of Monda with gross lesions and diagnoses

Regions	Organs	Gross Lesions	Diagnoses
Outer Body	Hair and skin	No lesions	
	Mucous membrane	N/A	
	Eyes	N/A	
	Ears	N/A	
Subcutaneous	Fat	No lesions	
Lymph Node	Ln. Mandibularis	N/A	
	Ln. Retropharyngealis	N/A	
	Ln. Prescapularis	No lesions	
	Ln. Axillaris	No lesions	
	Ln. Femoralis	No lesions	
	Ln. Poplitea	No lesions	
Thoracic Cavity	Negative pressure	Present, no lesions	
Respiratory Tract	Sinuses	N/A	
	Pharynx	N/A	
	Larynx	N/A	
	Trachea	No lesions	
	Bronchus	No lesions	
	Lungs	No lesions	
Digestive Tract	Mouth cavity	N/A	
	Tongue	N/A	
	Oesophagus	N/A	
	Gastric	Fedded, no lesions	
	Small intestine	Fedded, no lesions	
	Large intestine	Fedded, no lesions	Autolysis
	Ln. Mesenterica	Pale, exudative	Autolysis
	Pancreas	Pale	
	Liver	No lesions	
	Ln. Hepatica	No lesions	
Circulatory Tract	Heart	No lesions	
	Blood vessels	No lesions	
Lymphoreticular System	Thymus	No lesions	
	Spleen	No lesions	
Urogenital Tract	Kidneys	No lesions	
	Ureter	No lesions	
	Bladder	No lesions	
	Ovaries	No lesions	
	Uterus	No lesions	
	Vagina	No lesions	
Central Nerve System	Brain	N/A	Vulnus morsum
Locomotive System	Muscles	• Hyperemia and hemorrhage on the neck	Inflammation
		• Hyperemia and edema on right radius-ulna to metacarpus	
	Bones	No lesions	
Joints	No lesions		

Note: Some organs on the head are not applicable for a visual inspection (N/A)



Figure 2. Hair (left) and bone fragment (right) of slow loris found in the adult male feces

However, although our result supports sexual selection hypothesis, further motives might be driven by the incident of infanticide in wild populations. Deforestation of their habitats and massive human activity around them could be the stressors. Long-term monitoring in wild populations and further studies such as metabolomic analysis of feces on a group population of *N. javanicus* to determine their feed preferences, may provide answers to this conjecture. It is also important for ex-situ management to always pay attention to the mating system. In addition, measure of cortisol level as an initial screening before the animals enter the enclosure would be very useful as it could be used as a stress indicator later (Nugraha et al. 2017). Given that one individual of *N. javanicus* is known to have a territory of no less than 30 hectares with a range of up to 2 km per day (Rode-Margono et al. 2014), the condition on captivity might be quite contrasted and could be lead to stereotypic behavior (Lutz 2014), which might be present as cannibalism behavior (Moore et al. 2015). Matsumoto et al. (2018) also suggest that poor environmental conditions could be the cause of filial cannibalism.

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