# Predation accounts of translocated slow lorises, *Nycticebus coucang* and *N. javanicus*, in Sumatra and Java

**Robithotul Huda, Richard Moore** and **Karmele L. Sanchez**

IAR Indonesia. Jl. Curug Nangka Kp. Sinarwangi, RT. 04/05, Kel. Sukajadi, Kec. Tamansari, Bogor, West Java 16610

Corresponding author: Robithotul Huda; *Email: huda@internationalanimalrescue.org*

**Abstract**

Incidences of primate predation are seldom witnessed in the wild and even less so at night. The slow lorises (Genus: Nycticebus) are small-bodied nocturnal primates found across Southeast Asia. Here we provide accounts of predation events that occurred during behavioural monitoring in a seven-year translocation programme of radio-collared Javan (*N. javanicus*) and Sunda (*N. coucang*) slow lorises. From 2010 to 2017, a total of 30 Sunda slow lorises and 45 Javan slow lorises were fitted with radio collars and were released into their respective habitats. Seven Sunda slow lorises and four Javan slow lorises fell victim to predation during this period. Six were confirmed cases, and five were suspected. Predators included felids (leopard cats and Javan leopards), reptiles (reticulated pythons and common water monitors) and raptors (changeable hawk-eagles). With all the cases presented here, the backgrounds of the slow lorises (i.e. time spent in the illegal trade and rehabilitation) need to be taken into consideration as the animals' abilities to avoid predators may have been affected. Nevertheless, as predation accounts in nocturnal primate species are so rarely observed, this collection of observations involving slow lorises may help to provide additional information to better understand certain aspects of predator-prey relationships.

**Abstrak**

Kejadian pemangsaan pada primata sangat jarang terlihat di alam liar apalagi di malam hari. Kukang (Genus: Nycticebus) merupakan satwa nocturnal berbadan kecil yang bisa ditemukan di Asia tenggara. Laporan ini bertujuan untuk memberikan gambaran tentang peristiwa pemangsaan dari hasil pemantauan perilaku dalam program translokasi Kukang jawa (*N. javanicus*) dan Kukang sumatera (*N. coucang*) yang telah berjalan selama tujuh tahun. Sejak tahun 2010 hingga tahun 2017, sebanyak 30 Kukang sumatera dan 45 Kukang jawa dipasang radio transmitter sebelum dilepasliarkan ke habitatnya. Tujuh kukang sumatera dan empat kukang jawa menjadi korban pemangsaan pada periode ini. Enam kasus terkonfirmasi dan lima kasus masih pendugaan. Pemangsa tersebut adalah Felidae (kucing hutan dan macan tutul jawa), Reptil (ular sanca batik dan biawak) dan Raptor (Elang brontok). Kukang yang diteliti merupakan hasil perdagangan illegal dan pemeliharaan yang telah direhabiliasi, sehingga kemungkinan kemampuan untuk menghindari predator (anti predasi) telah berkurang. Namun demikian, karena kasus pemangsaan terhadap Kukang masih sangat jarang, maka informasi ini sangat penting dalam membantu memahami aspek-aspek tertentu dalam kaitanya antara Predator dengan mangsanya.

*Key words: Indonesia, nocturnal primate, predation, slow loris, translocation*

## Introduction

Predation among wild primates by snakes, raptors and carnivores is a constant threat to their survival and is undoubtedly a powerful selection pressure in their life histories (Burnham et al., 2012). Quantifying the scale of predation is essential in determining and understanding certain aspects of primate ecology (Terborgh and Janson, 1986); however, incidences of primate predation are seldom witnessed in the wild (Cheney and Wrangham, 1987; Isbell, 1990) and even less so at night (Isbell, 1990; Bearder et al., 2002; Hart, 2007; Burnham et al., 2012). Indeed, when both the prey and the predator are nocturnal, direct observations of predation events are virtually unobtainable (Isbell, 1990) explaining why most reports are anecdotal (Peetz et al., 1992).

Slow lorises (Genus: Nycticebus) are small-bodied nocturnal primates found across South-east

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Asia (Nekaris and Bearder, 2011). Owing to their cryptic and nocturnal nature, they are one of the least known primate taxa (Bearder, 1999; Nekaris, 2014). Not surprisingly, information regarding the predation of slow lorises is limited to a few actual accounts. Known predators of slow lorises include orangutans (*Pongo abelii*) (Utami and van Hoof, 1997; Hardus et al., 2012), changeable hawk eagles (*Nisaetus cirrhatus*) (Hagey et al. 2007), marbled cats (*Pardofelis marmorata*) (Streicher and Nadler, 2003) and pythons (*Python reticulatus*) (Wiens and Zitzmann, 1999). Another likely predator group is monitor lizards (*Varanus sp.*) (Kenyon et al., 2014). Despite being protected by Indonesian laws, slow lorises have been among the most commonly traded primate species for more than two decades (Nijman et al., 2015). International Animal Rescue (IAR) Indonesia, a primate rehabilitation centre in Bogor, West Java was established in 2006 and has received slow lorises rescued from the pet trade since 2008. In 2010, a systematic translocation programme for slow lorises was initiated. Here we provide accounts of predation on Javan (*N. javanicus*) and Sunda (*N. coucang*) slow lorises that occurred during the post-release monitoring phase of the translocation programme over a seven-year period. All the slow lorises in this study derived from the illegal pet trade and were almost certainly wild caught individuals.

## Methods

*Release protocol*

Slow lorises selected for translocation were fitted with a radio collars and monitored post-release using R1000 Com-Spec receivers with Biotrack antennas for up to 13-months (mean = 3.5 months) at three study sites between 2010 and 2017. Data on ranging, behaviour and feeding ecology were collected during the monitoring period. The release programme followed the guidelines of the IUCN for the reintroduction of primates (IUCN/SCC, 2013). The lorises spent one month in a habituation cage at the release site prior to release.

*Release sites*

Sunda slow lorises were released in Batutegi Protected Forest, Tanggamus Regency, Lampung and Bukit Barisan Selatan National Park in Sumatra. Javan slow lorises were released in Mount Sawal Nature Reserve, Ciamis and Mount Salak in Halimun-Salak National Park, West Java. Batutegi Protected Forest consists of primary and secondary rain forest covering an area of 58,174 ha with elevations ranging from 200 – 1,750 m asl. Bukit Barisan Selatan National Park is located in the Bukit Barisan Mountains and crosses the provinces of Lampung, Bengkulu and South Sumatra. The park has an area of 356,800 ha and consists of a mix of montane, lowland tropical, coastal and mangrove forest ranging from 0 – 1800 m asl. Mount Sawal Nature reserve comprises secondary rain forest with elevations ranging from 600 – 1,764 m asl. Mount Salak covers an area of approximately 76,000 ha ranging from 400 – 2211 m asl. Primary forest is still present at higher altitudes, but secondary forest dominates the lower regions.

*Predation records*

When the predation of a slow loris occurred, the events and circumstances leading up to the predation were recorded in chronological order, along with the location, the habitat type, and any additional evidence found at the scene.

## Results

A total of 30 Sunda slow lorises and 45 Javan slow lorises were fitted with radio collars and released into their respective habitats. The IAR Indonesia team recorded six Sunda slow lorises (20%) and six Javan slow lorises (13%) predations during the study period. In five of the cases, the predator could be confirmed, and in the remaining cases the predators were assumed based on evidence found at the scene of the event.

On 11th May 2012, a female Sunda slow loris was released from the habituation cage in Batutegi

**Table 1.** Incidences of slow loris predation observed at the Yayasan IAR Indonesia release programme from 2010-2018.

| Case | Date | Species | Sex | Predator | Evidence | Location | Survival (days) |
|---|---|---|---|---|---|---|---|
| 1 | 21.10.12 | *N. coucang* | F | Reticulated python | Confirmed | Batutegi Protected Forest | 150 |
| 2 | 28.1.13 | *N. coucang* | M | Raptor | Suspected | Batutegi Protected Forest | 330 |
| 3 | 11.4.13 | *N. coucang* | F | Reticulated python | Confirmed | Batutegi Protected Forest | 9 |
| 4 | 14.8.13 | *N. coucang* | M | Reticulated python | Confirmed | Batutegi Protected Forest | 3 |
| 5 | 18.7.15 | *N. coucang* | M | Reticulated python | Confirmed | Batutegi Protected Forest | 240 |
| 6 | 14.9.15 | *N. javanicus* | M | Leopard cat | Suspected | Mount Sawal, Ciamis | 330 |
| 7 | 15.8.15 | *N. javanicus* | F | Leopard cat | Suspected | Mount Sawal, Ciamis | 90 |
| 8 | 13.9.15 | *N. javanicus* | F | Javan leopard | Suspected | Mount Sawal, Ciamis | 0 |
| 9 | 12.8.17 | *N. javanicus* | M | Javan leopard | Suspected | Mount Sawal, Ciamis | 0 |
| 10 | 19.10.17 | *N. coucang* | M | Chbl. hawk-eagle | Confirmed | Bukit Barisan Selatan NP | 30 |
| 11 | 9.1.18 | *N. coucang* | M | Water monitor lizard | Confirmed | Bukit Barisan Selatan NP | 95 |

Forest, Lampung. On 21th October 2012 (150 days after release), the slow loris telemetry signal emerged from a python located on the ground in some bushes. At 6am the following day, the remains of the slow loris and the radio collar were retrieved after they were regurgitated from the python. The length of the python was 190cm and weighed approximately 13 Kg.

On 8th August 2012, a male Sunda slow loris was released from habituation cage in Batutegi Forest. On 13th June 2013 (330 days after release), the carcass of the slow loris was found. The head had been ripped off, the fur on the head had been plucked out and the muscle had multiple beak-sized holes. A raptor was the suspected predator.

**Figure 1**. The 1.9 m reticulated python that preyed upon a Sunda slow loris in Batutegi.

On 2nd April, 2012, a female Sunda slow loris was released from the habituation cage in Batutegi Forest. On 11th April 2013 (nine days after release), the telemetry-signal from the slow loris lead to a python located at the base of a bamboo thicket. The length of the python was 170 cm and weighed approximately 11 kg.

On 11th August, 2013 a male of Sumatran slow loris was released from the habituation cage on Talang Randai Island in Batutegi Forest. On 14th August, 2013 (three days after release), we found the signal coming from a python located in a hole in the ground. The following day, the python regurgitated the remains of the slow loris and the radio collar. The length of the python was 180 cm and weighed approximately 11kg.

On 10th November, 2014, a male Sunda slow loris was released from habituation cage in Batutegi Forest. On 18th July, 2015 (240 days after release), the signal from the slow loris came from a python located in some bushes on the ground. The length of the python was 350 cm and weighed approximately 15 kg.

On 5nd December, 2014, a male Javan slow loris was released from the habituation cage in the Mount Sawal Nature Reserve. On 14th September

2015 (330 days after release), the carcass of the slow loris was found. The remains included fur, the jaw bone and some internal organs. Footprints of a leopard cat (*Prionailurus bengalensis*) were identified in the mud near to the remains. Prior to the event, the monitoring team had observed a leopard cat in the same area as the slow loris' remains on numerous occasions.

On 16th May, 2015, a female Javan slow loris was released from the habituation cage in the Mount Sawal Nature Reserve. On 15th Augustus 2015 (90 days after release), the carcass of the slow loris was located. All that remained of the slow loris was some fur and what appeared to be the stomach of the animal. A leopard cat's footprints were found in the mud near to the remains.

On the 11th September, 2015 three Javan slow lorises (including 2 females and an infant) were placed inside a temporary habitation cage on Mount Sawal to await release. The habituation cage was 4.5 x 1.5 x 2 m, was half a metre off the ground and consisted of a wood frame and wire mesh. On the 13th September 2015, on arrival at the cage, the wire mesh of the cage had been ripped open and all three slow lorises had disappeared. The tears in the mesh appeared to have been made by the claws of a large animal. On a nearby tree, claw marks from a Javan leopard (*Panther pardus melas*) were identified and leopard hair was also found on the ground (Fig 2).

On the 1st August 2017, one male Javan slow loris was placed inside a temporary habitation cage on Mount Sawal to await release. The cage was 3 x 3 x 2 m and made of bamboo and strong twine mesh. On 12th August 2017 at approximately 22:00, the monitoring team found the habituation cage had been ripped open and the slow loris had disappeared. Slow loris fur was found at the scene and fresh footprints made by a Javan leopard were identified (Fig 3).

On 18th September 2017, a male Sunda slow loris was released from habituation cage in Bukit Barisan Selatan National Park in Sumatra. On the 19th October 2017, the transmitter signal emerged from a changeable hawk eagle's nest (*Nisaetus cirrhatus*) in a tree approximately 20m above ground (*Dipterocarpus sp*.). At least one fledgeling

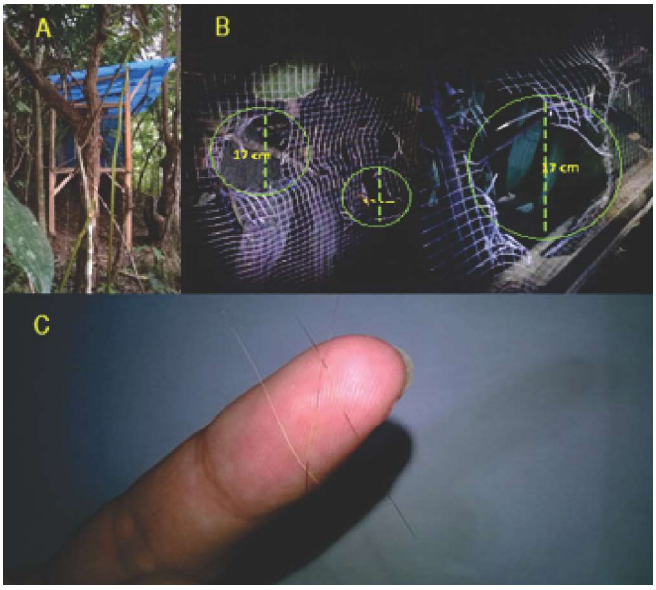


**Figure 2**. (a) the habituation cage; (b) tears in the wire mesh suspected to have been made by a Javan leopard; (c) hairs found on the ground near to the habituation cage.

**Figure 3**. (a) Ripped mesh of the habituation cage. (b) Footprints of a Javan leopard was found next to the habituation cage.

remained in the nest. The team climbed nearby trees to confirm the collar was indeed in the nest.

On 29th August 2017, a male Sunda slow loris was released from habituation cage in Bukit Barisan Selatan National Park. On the 9th January 2018, we zeroed in on a the radio-collar signal emerging from a common water monitor lizard (*Varanus. s. salvator*) located in undergrowth next to a small body of water. The monitor lizard was 1.55m long and weighed approximately 5 kg.

## Discussion

All predation events reported in this study occurred in the wild and could reflect natural levels of predation. Nevertheless, our study subjects may have been more susceptible to attacks owing to the varying amounts of time spent in captivity. Animals that have undergone periods of isolation away from predators can begin to lose the appropriate anti-predator behaviours necessary for survival in the wild (Griffin et al. 2000). The length of time spent in captivity and how much the animal was affected by this differed for each individual. When released into a new and unknown habitat, translocated animals typically have to contend with new types of predators, aggressive conspecifics defending their territories and finding suitable and adequate food (Beck 2010). Wild animals that naturally move into new habitats are known to be at higher risk of predation (Isbell 1990). Newly translocated animals, likely affected by a stint in captivity, are probably even more at risk of falling prey to predators, starvation and disease. Furthermore, some of the slow lorises may have originated from a habitat either void of predators or with a different predator composition and in such cases they may never have learnt area-specific anti-predator behaviour during their early stage of life.

Reticulated pythons were responsible for four of the 11 confirmed predation cases. Because snakes consume prey whole, the radio collars were swallowed along with the slow lorises, making it possible to track and verify the predation event. All of the python predations occurred at the release site in Batutegi Protected Forest and involved the Sumatran Sunda slow lorises as the prey. The dense rain forest in Batutegi is bordered by a large freshwater reservoir with lots of river tributaries that dissect parts of the forest providing an ideal habitat for this water-loving reptile (Das 2012; Mattison 2014).

Slow lorises are arboreal, but will take to terrestrial locomotion over short distances when canopy cover is absent (Rogers and Nekaris, 2011). Young pythons are good climbers and hunt in the lower branches of trees, but become increasingly terrestrial as they grow larger (Mattison, 2014). Based on the dense forest with closed canopy where the predation events took place and the pythons' smaller body sizes (body weights of all four pythons ranging from 11 to 15 kg), the slow lorises were most likely ambushed by juvenile pythons in the trees.

Mammals compose a large proportion of reticulated python diet, which includes rodents, monkeys, pangolins and wild pigs (Shine et al., 1999). Pythons predation on slow loris has been documented previously in West Malaysia and also involved a radio-collared wild slow loris (Wiens and Zitzmann, 1999). Python predation on tarsiers, a similar small-bodied nocturnal primate, have also been recorded on at least three occasions in Sulawesi, Indonesia and the Philippines (Gursky, 2002; Neri-Arboleda et al., 2002; Řeháková-Petrů et al., 2012).

There exists no previous published reports of pythons predation on Javan slow lorises. This lack of observation may be attributed to the difficulties associated with observing rare events involving two nocturnal, cryptic and arboreal species. Another possible explanation is that Javan slow lorises possess better anti-predator strategies, especially towards snakes, than Sunda slow lorises. Nekaris and Munds (2010) proposed that slow loris facemasks may have an aposematic function. However, the most likely reason for the different predation rates between the two species is the lower densities of pythons in the two mountainous release sites. The two release sites, Mount Salak and Mount Sawal in West Java, do not contain

large bodies of water and are at higher elevations with cooler temperatures, making it a less attractive habitat for these large reptiles. Pythons are present at these sites, but are uncommon (Kurniati, 2003).

Another confirmed predation event by a reptile species – the common water monitor - occurred in Bukit Barisan Selatan National Park. Water monitors are predominantly terrestrial but are excellent climbers. These large reptiles feed on a variety of prey including invertebrates and small vertebrates, such as fish, crabs, freshwater turtles, birds, lizards and rats (Das, 2015). Although never confirmed, a monitor lizard was suspected to have predated on a reintroduced pygmy slow loris in Vietnam (Kenyon et al., 2014). As carrion is also component of a water monitor's diet, there is a possibility that the slow loris was dead before the water monitor consumed the animal.

Among the remaining non-confirmed predation cases, leopard cats were potentially responsible for two of the kills (Cases 5 and 6). The diet of leopard cats consists predominantly of small mammals, specifically murids, but also includes herpetofauna and birds (Rajaratnam et al., 2007; Shehzad et al., 2012). Leopard cats are known to possess highly adaptable dietary behaviour (Xiong et al., 2016), only one case of primate predation (*Semnopithecus obscura*) by leopard cat has been documented (Grassman, 2000). Leopard cats are known to possess highly adaptable dietary behaviour (Xiong et al., 2016). Although only one case of primate predation (*Semnopithecus obscura*) by a leopard cat has been documented (Grassman, 2000), they remain opportunistic predators fully capable of capturing and killing slow lorises. Another similar larger felid, the marbled cat (*Pardofelis marmorata*), was observed preying on a pygmy slow loris in Vietnam (Streicher and Nadler, 2003). The evidence found at the scene, however, which included leopard cat footprints, regular sightings of leopard cats in the area, and clear kill signs of a small carnivorous mammal may be coincidental. In both cases, the leopard cats may have merely encountered the slow loris' carcasses after another predator had already killed the animal.

In another unrelated case that occurred during post-release monitoring, two adult leopard cats were observed rushing towards two Javan slow lorises that had fallen to the ground from a high branch during a loud territorial fight. The two cats appeared to be ready to pounce on the unsuspecting primates that were preoccupied with each other, but were scared off after noticing the monitoring team (B. Muhidin, personal observation). Conversely, Nekaris et al. (2013) reported a seeming ambivalence during encounters between slow lorises and leopard cats; an observation which had also been reported by the IAR Indonesia monitoring team on numorous occasions.

Another larger felid may also have been responsible for two additional predation cases involving four Javan slow lorises (two adult females and an infant); however, these events occurred in a setting that was not deemed representative of wild circumstances. In both cases, the slow lorises were still in habituation cages on Mount Sawal awaiting release. The habituation cages were found torn open and the slow lorises inside had disappeared. Unfortunately, the slow lorises had yet to be fitted with radio-collars making it impossible to track them. The team concurred that only a Javan leopard, known to be present on Mount Sawal (Iqbal 2017), has the power to rip open the wire mesh in such a destructive way. Other evidence found at the scene corroborated this assumption: fresh claw marks on a tree, a Javan leopard footprint and hair found on the torn mesh (Figs 2 and 3). While leopards have been known to prey upon a number of different primate species, it is generally assumed that they avoid arboreal primates in favour of easier terrestrial targets, such as ungulates (Henschel et al., 2005; Hayward et al., 2006). Nevertheless, there is one recorded case of a leopard eating a Potto (*Perodicticus potto*), a similar small-bodied and nocturnal strepsirrhine primate in the Democratic Republic of Congo (Hart et al., 1996).

With only a few of cases of felid predation on nocturnal primates available in the literature, it is possible that such events are rare and opportunistic. The lack of evidence for such events, however,

does not always equate to evidence for absence. For example, single predation events may not always be deemed sufficient or suitable for refereed literature. Additionally, the continuous human presence required for the monitoring of translocated slow lorises post-release will undoubtedly scare away potential felid predators. Nonetheless, if the claim that nocturnal behaviour of primates is associated with reducing predation risks by felids or other mammalian carnivores is correct (Burnham et al., 2012), the absence of evidence for felid predation may not be coincidental.

Two further cases involved predation by raptors. Although the case in Bukit Barisan Selatan National Park was not witnessed directly, the evidence of the collar being located in a changeable hawk eagle's nest was deemed conclusive. In the unconfirmed case, the remains found at the scene and the kill wounds were characteristic of birds of prey (Hardey et al., 2006). Incidences of raptors predating on nocturnal primates are fairly common in comparison to reptiles, felids and other primates (Burnham et al., 2012). Furthermore, as the predation happened during the day, a diurnal raptor species was presumed responsible. The predation of a slow loris by a changeable hawk eagle had previously been reported (Hardey et al., 2006). Raptor species found in the Batutegi Protected Forest - potentially resonsible for the predation - include changeable hawk eagles (*Nisaetus cirrhatus*), black hawk eagles (*Ictinaetus malayensis*) and crested serpent eagles (*Spilornis cheela*).

Our study recorded eleven predation observations of translocated slow lorises over a seven-year period. As predation accounts of nocturnal primate species are rarely observed, our collection of observations involving slow lorises may help to provide additional information to better understand certain aspects of predator-prey relationships. We hope that our results can assist in maximising the survival chances of slow lorises and other nocturnal primate species in future reintroduction programmes, potentially through the development of anti-predator behavioural training against known predators.

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