Distribution of Mammals in Deramakot & Tangkulap Forest Reserves, Sabah, Malaysia

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Hiromitsu Samejima* and Robert Ong†

Introduction

Medium to large mammals of Borneo include various endangered species such as Orangutan and Tembadau and also several important species for the subsistence of local people such as Sambar Deer and Bearded Pig. Thus, these animals are considered as a key element of the forest value and attract international and domestic attentions widely.

Therefore, the distribution of the medium to large mammals in a Forest Management Unit (FMU) is important information for the sustainable management. The information can contribute to select conservation area in the FMU properly, to evaluate performance of current management scheme, and to improve the effectiveness and efficiency of the management. Furthermore, the information also may able to highlight the un-realized economical value of FMU. For example, discovery of high density of orangutan (Ancrenaz et al. 2005) in Malua Forest Reserve, Sabah contributed to launch "the Malua Wildlife Habitat Conservation Bank / Malua BioBank (http://www.maluabank.com/)" in 2008 and attract various conservation investments from domestic and oversea entities (Sabah Forestry Department 2008). If a forest management license holder could find a high density area of a charismatic wildlife inside his FMU, he also may be able to develop ecotourism like Danum Valley and Tabin Forest Reserves in that area.

However, there are only a few censuses of mammals over a FMU until now (WWF Malaysia 1982, Ambu 2000). One of the main reasons is the technical difficulty to conduct such a census in a large spatial scale. Therefore, we developed a novel census method: "Random Camera Trapping System", and conducted in Deramakot and Tangkulap Forest Reserves (827km^2), Sandakan, Sabah in 2007-2010. Using this census method, anybody (ex. Non-special stuffs of logging companies) can obtain distribution data of various species economically. In this book, we show the results of our census to exhibit the current situation of the community of medium to large ground-dwelling vertebrates in the FMUs and also the effectiveness of the Random Camera Trapping System as a tool for FMU management.

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Deramakot & Tangkulap Forest Reserves

Deramakot and Tangkulap Forest Reserves are continuous forest reserves in Sandakan Division, Sabah, Malaysia at latitude 5°14-30' north and 117°11-35'east (Fig. 1). Both Forest reserves are allocated as Class 2 (Commercial Forest Reserve) and managed as Forest Management Unit (FMU) 19A and part of FMU 17A (with Sungai Pinanga Forest Reserve A). The area is totally 827km^2 and the altitude is 20-330m above sea level (Fig. 2). Most of the area is covered by lowland mixed dipterocarp forests. However, low-lying area along the Kinabatangan River is covered by freshwater swamp forest (Sabah Forestry Department 2005b, a).

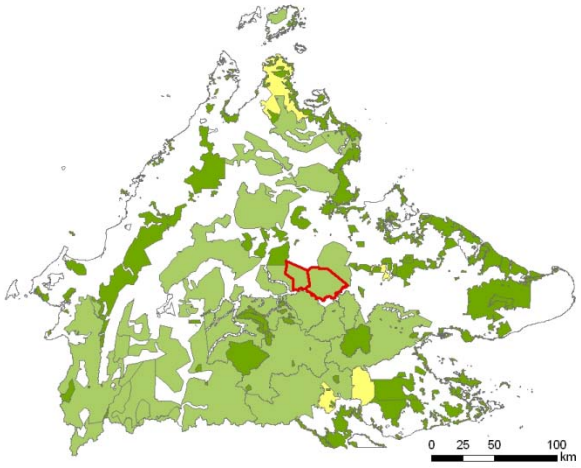


Figure 1. Deramakot (right), Tangkulap (left) and other forest reserves in Sabah. Dark green: total protected forest reserves and national park, Light green: Production forest

Commercial logging was started in 1956 in Deramakot and 1970's in Tangkulap and harvested all the area at least once by conventional logging system. The logging activity was ceased in Deramakot in 1987 and Sustainable Forest Management was started to be conducted by Sabah Forestry Department with cooperation of GTZ (Deutsche Gesellschaft fur Technische Zusammenarbeit). The logging in Deramakot was re-started again in 1995, but with Reduced Impact Logging system and have harvested about one fourth of the total area of Deramakot until 2009. On the other hand, conventional logging had been conducted again all over Tangkulap in 1990's and stopped in 2002. Besides, southern parts of Deramakot were burned out during 1983 and 1997 (Sabah Forestry Department 2005b, a).

Sabah Forestry Department drew a Forest Stratum Maps of Deramakot and Tangkulap based on the aerial photos taken in 2001 and SPOT image taken in 2003 respectively (Fig. 3). The forest was classed into four stratums based on densities of large crowns-tree. According to the map, Deramakot has wider range of good and moderate forests (Density of tree DBH ≥60 cm is more than 9 tree ha^{-1}) than Tangkulap.

Besides, there are about 11 villages along the Kinabatangan and Milian Rivers south of Deramakot and Tangkulap Forest Reserves. Some of the villages have long history, more than hundreds years. Some of the villagers are used to hunt wildlife as their subsistence foods.

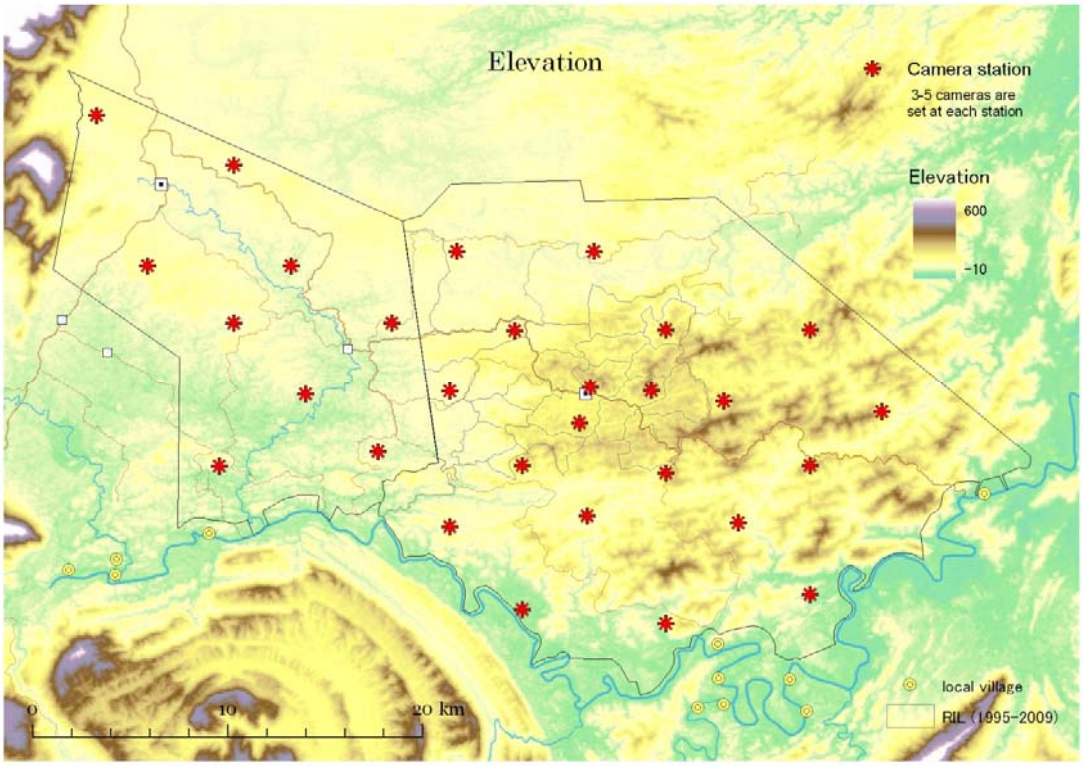


Figure 2. Elevation of Deramakot (right) and Tangkulap (left) Forest Reserves

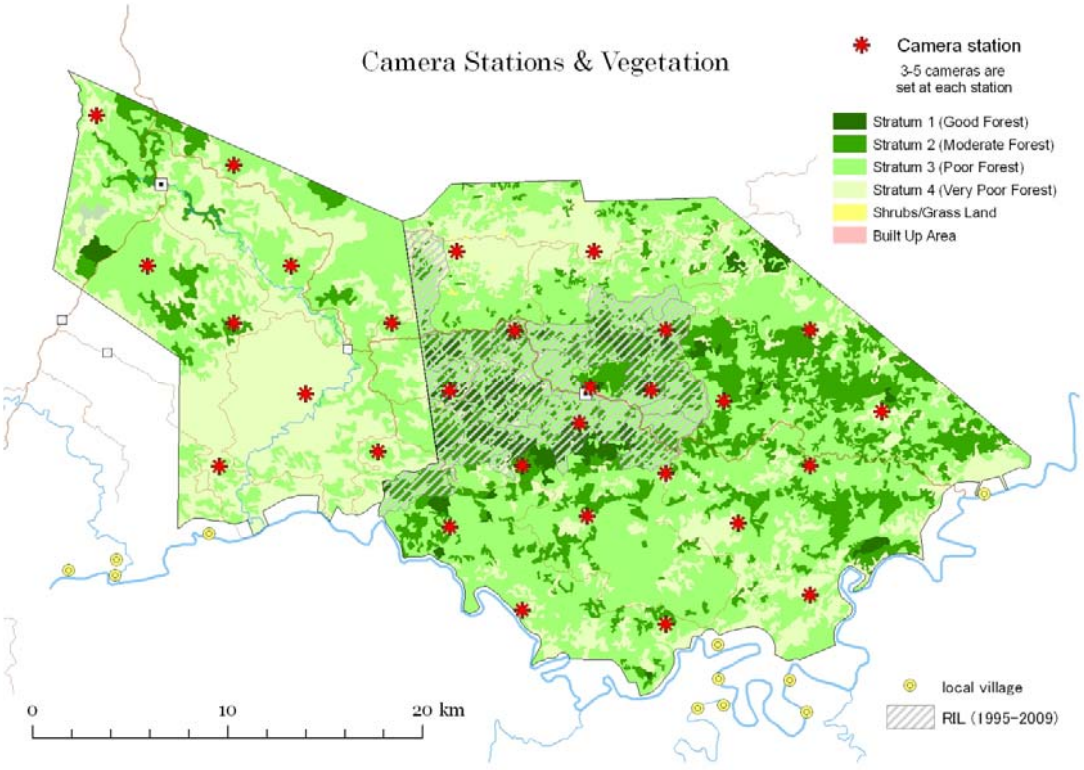


Figure 3. Forest stratums of Deramakot and Tangkulap Forest Reserves

Methods ~Random Camera Trapping System~

We established 29 plots that cover Deramakot and Tangkulap Forest Reserves in a systematic manner (Fig. 4). The plots were about 5 km apart each other. Each plot was a circle with a 1 km diameter. Using the statistical software R 2.10.0 (http://cran.r-project.org/), we randomly selected 9–12 setting points to place cameras within each plot. We used an automatic film camera with a passive infrared sensor (Field Note II, Marifu, Iwakuni, Japan) in this study. We first set cameras at three points in each plot and shifted the cameras to the other three points every 3–5 month. We located each setting point using a GPS (GPSmap60CSx, Garmin Ltd., Osath, KS) and set a camera on a tree about 50 cm above the ground. Each camera faced to open ground and its field-of-view was about 2–7 m^2. Films and batteries were changed every one to two months.

After we developed the films, we keyed in the data (setting point / date / time / species / no of individuals) of all the photos. We identified the species based on Payne et al. (2005), Myers (2009), and Phillipps and Phillipps (2009). Then we selected data of medium to large mammals (from Moon Rat to Asian Elephant), terrestrial birds and Monitor Lizards. The data of photos captures same species repeatedly in 30 minute were discarded.

For each species, we calculated the numbers of photos taken per unit active camera-days for each plot. The periods when a camera did not work due to full exposure of the film or mechanical failure were excluded from the active periods. We also calculated number of species taken during a 980 camera-days randomly selected in total active camera-days. We iteratively calculated the number 500 times and calculated average number of species for each plots.

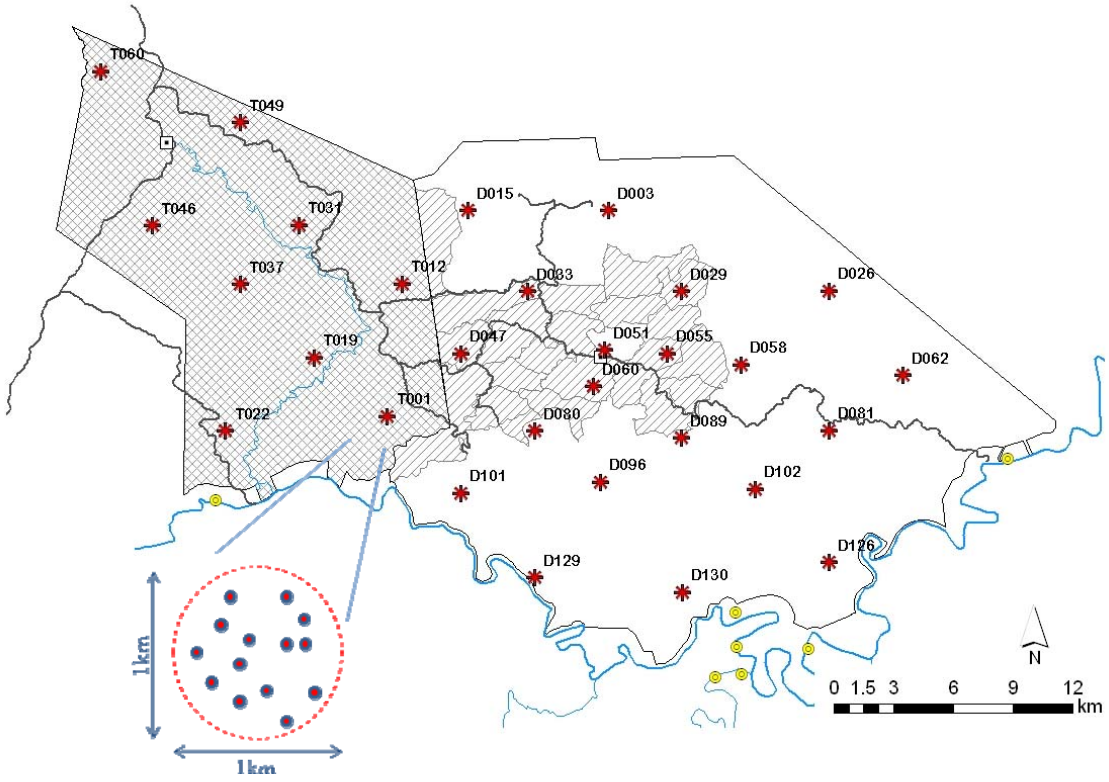


Figure 4. 29 plots inside Deramakot and Tangkulap FR. We set 9-12 setting points in each plot.

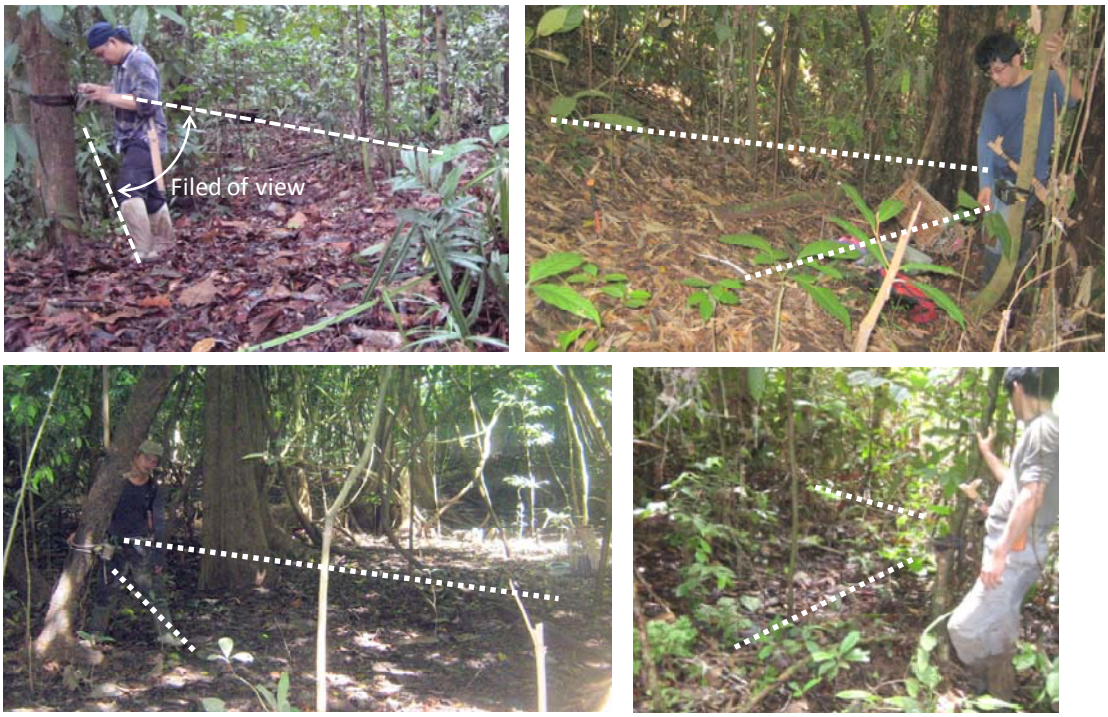


Figure 5. Setting points of infrared sensor cameras

Results

With increase in active camera days, the number of species taken at each plot has peaked (Fig 6). At each plot, 138-561 photos of 16-27 species were captured in the 980 camera-days (Fig.7). And totally, 7918 photos of 36 species of mammals, 3 species of ground-dwelling birds and one monitor lizard were photographed. In addition, Elying Lemur (*Cynocephalus variegatus*), Slow Loris (*Nycticebus coucang*), Silvered Langur (*Presbytis cristata*), Proboscis Monkey (*Nasalis larvatus*), Bornean Gibbon (*Hylobates muelleri*) and Masked Palm Civet (*Paguma larvata*) are observed by ourselves or recorded by Onoguchi and Matsubayashi (2008) in Deramakot. Thus, 41 species of medium to large mammals were confirmed to inhabit Deramakot in total. They constitute 77.8% of the species recorded in Borneo (Payne and Francis, 2005).

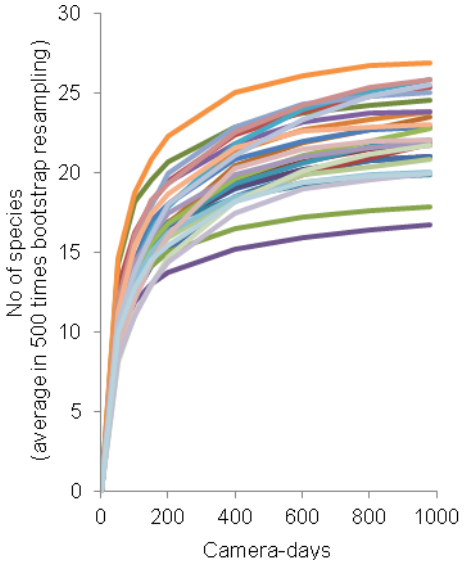


Figure 6. Averaged number of species at each plot

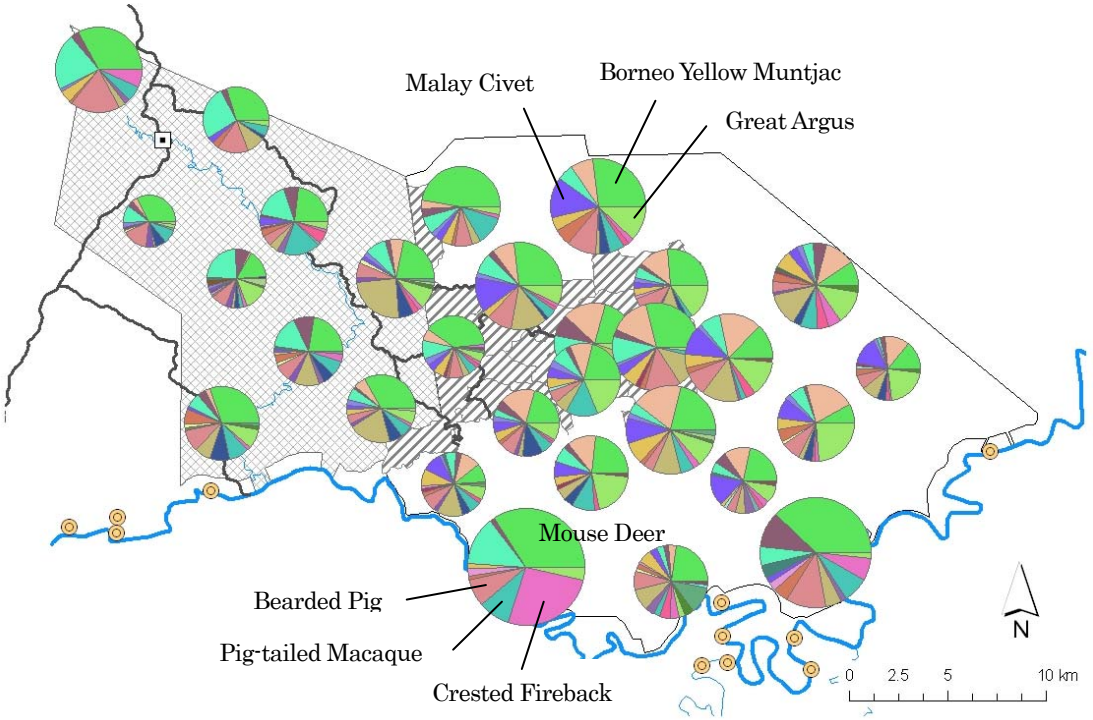


Figure 7. Species composition at each setting area

Species Diversity

The average number of species captured in the 980 camera-days was high at plots in southern and eastern Deramakot (Fig. 8).

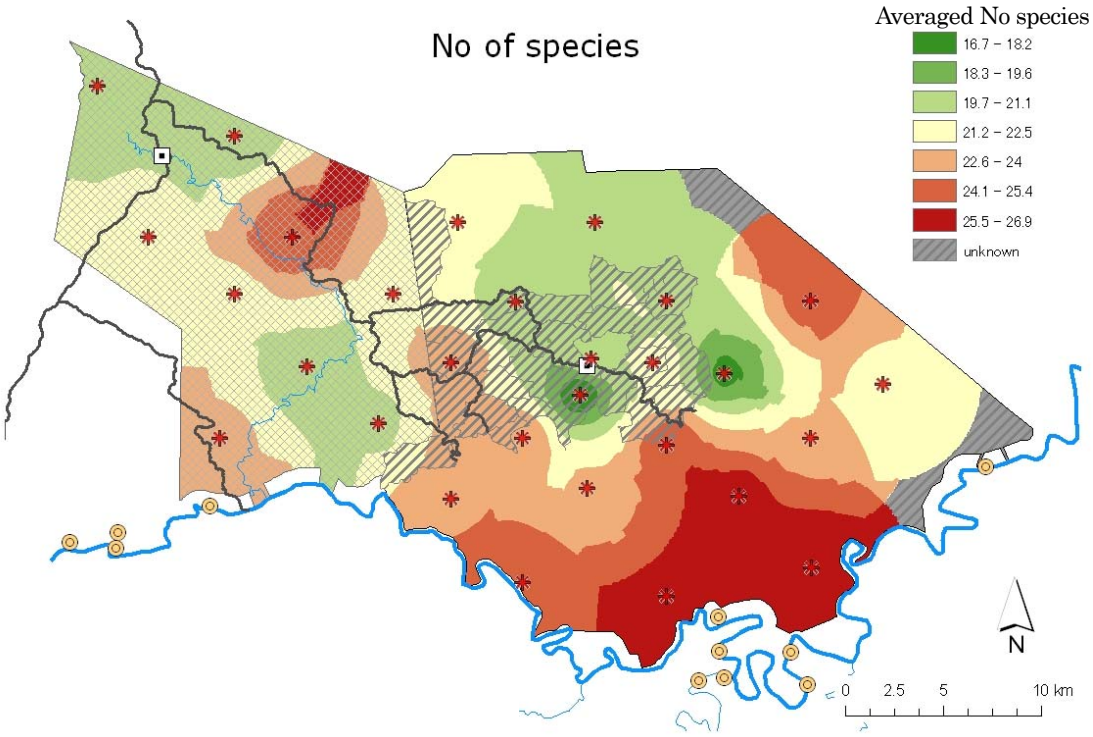


Figure 8. Distribution of species richness. Estimated by Inversed Distance Weighted Method with 5 km range

Distribution of individual species

The size of circle shows the amount of mean trapping rates at each plot.

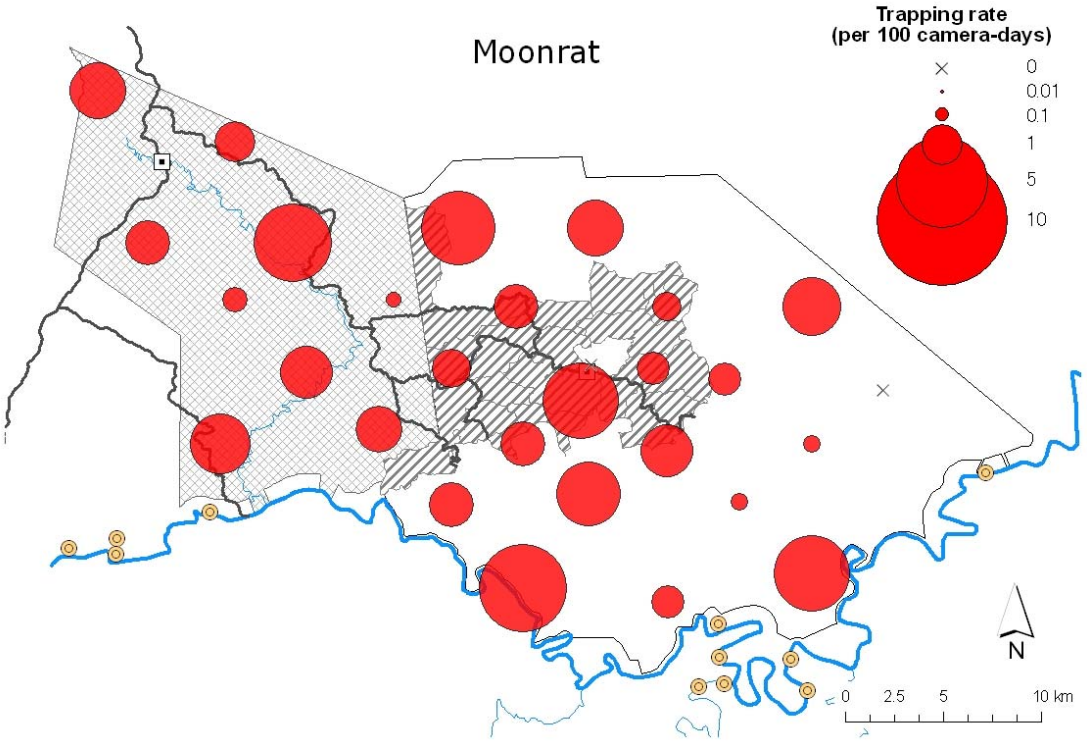
Red list status: Threatened status in IUCN Red list 2011 (IUCN 2011)

Local names: SG: Orang Sungai (Kampung Balat)

Distribution information is based on IUCN (2011)

Moonrat

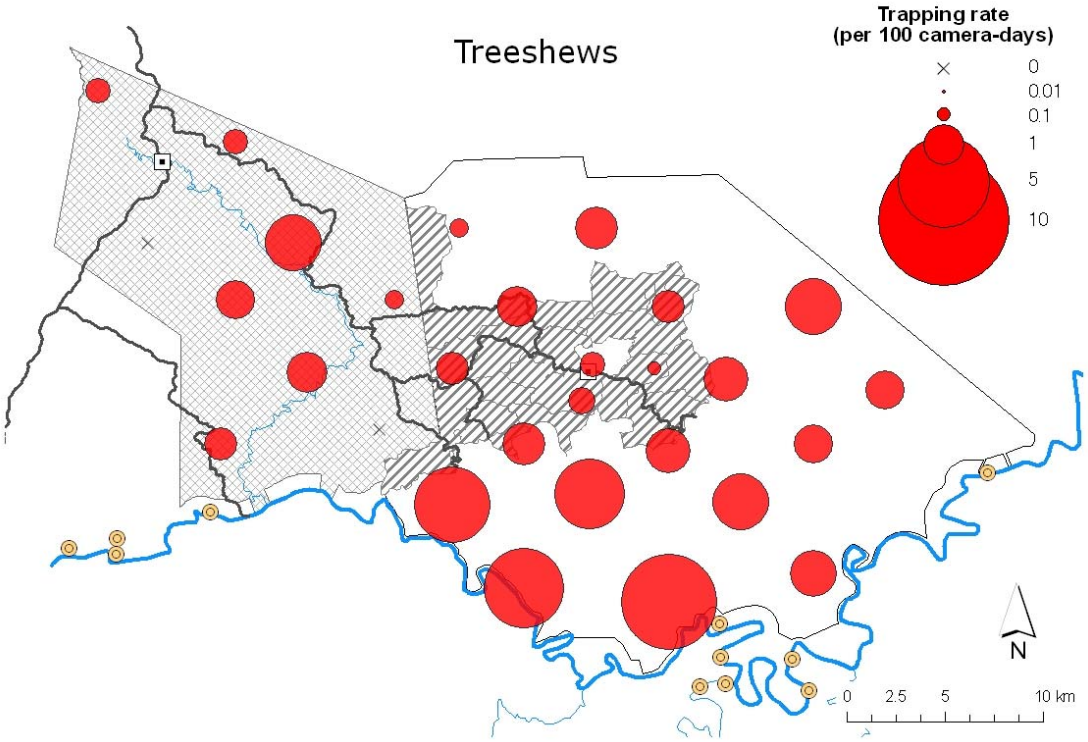
Echinosorex gymnura



SG: Tikus aputih

Distribution: Peninsular Myanmar, Thailand, Malaysia, Sumatra, and Borneo

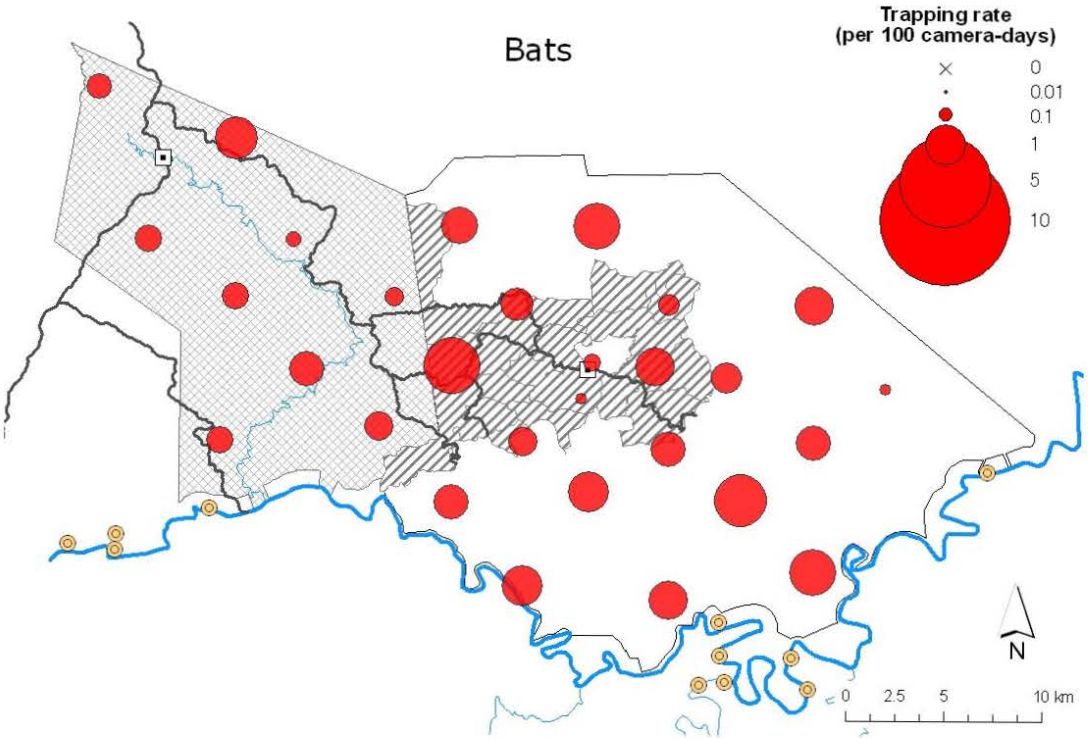
Treeshrews



SG: Boasing

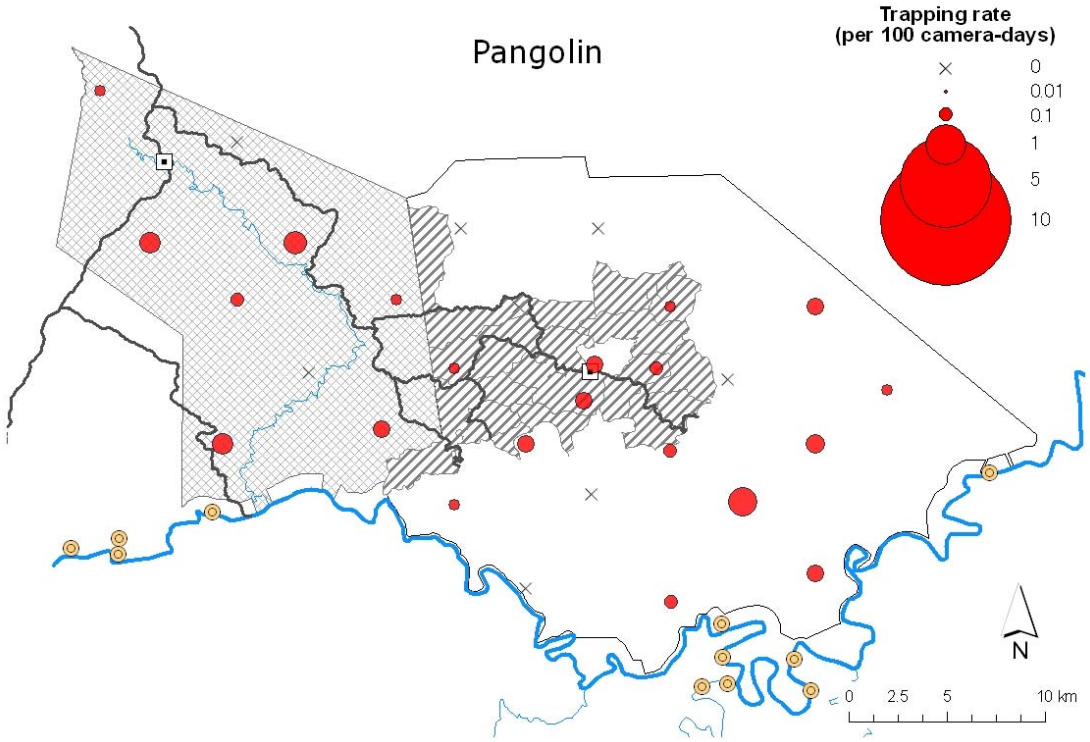
Basically arboreal.

Bats


Bats
Trapping rate
(per 100 camera-days)
0
0.01
0.1
1
5
10
N
0
2.5
5
10 km

Sunda Pangolin

Manis javanica



Red list status: Endangered

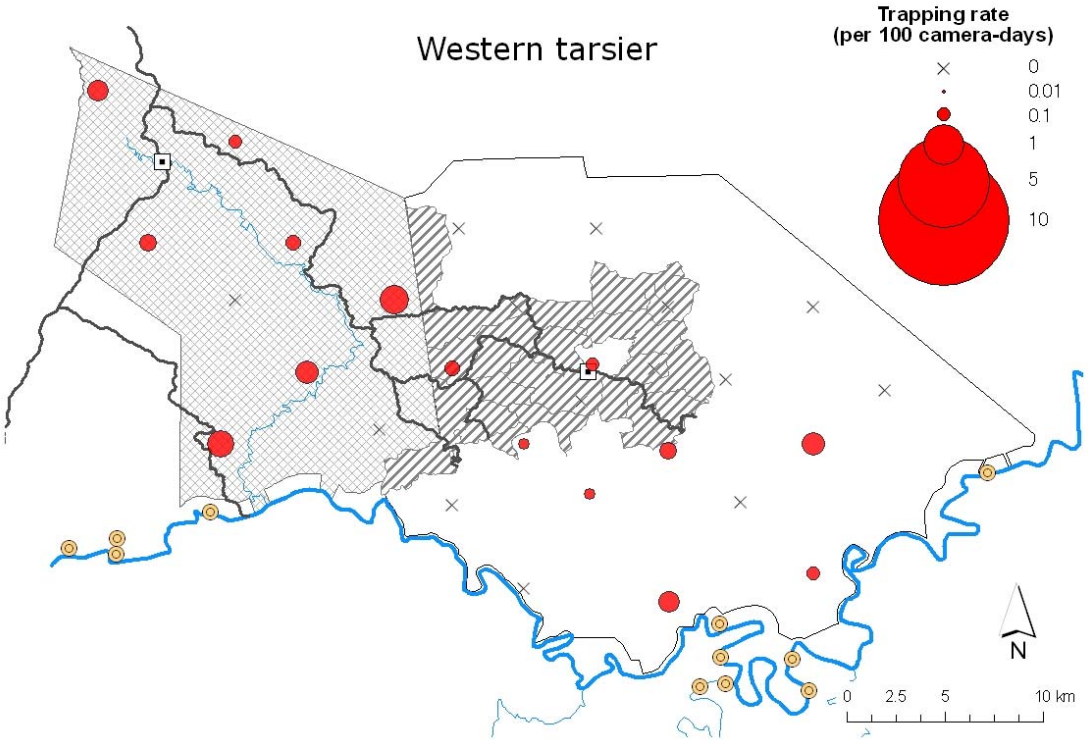
SG: Tengiling

Distribution: Myanmar, Thailand, Laos, Cambodia, Vietnam, Borneo, Sumatra, and Java

The meat and scale are traded in high price and hunting pressure is increasing now.

Western Tarsier

Tarsius bancanus



Red list status: Vulnerable

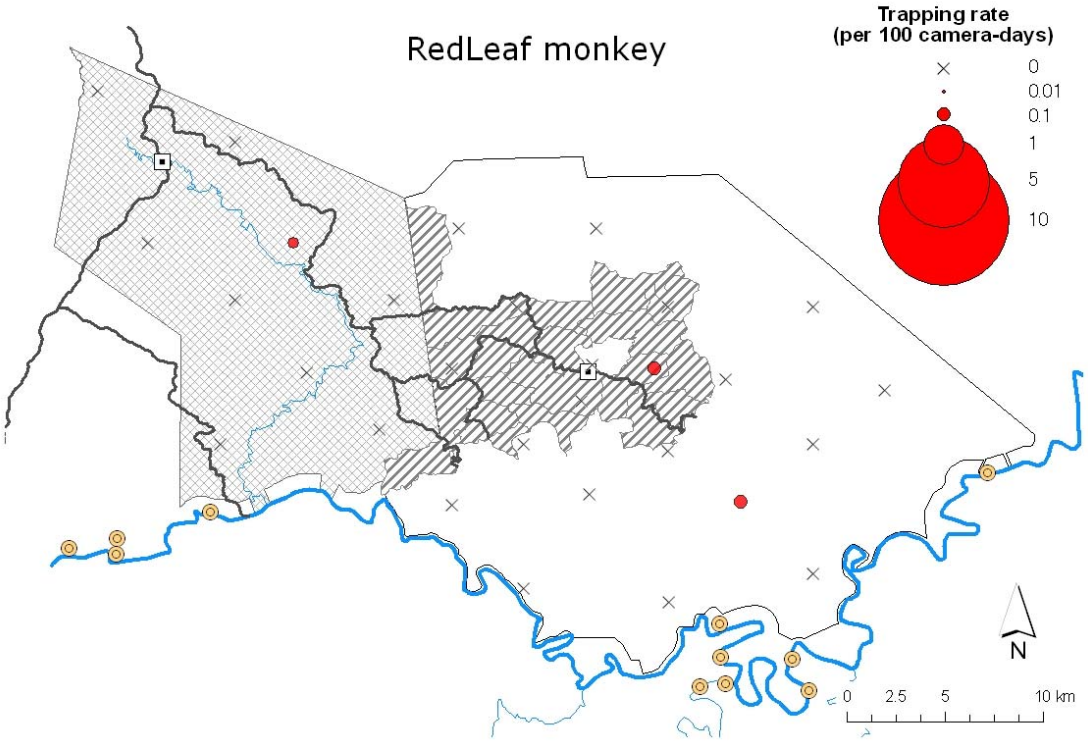
SG: Lotong lotong

Distribution: Southern Sumatra and Borneo

This species is basically arboreal.

Maroon Leaf Monkey / Red Leaf Monkey

Presbytis rubicunda

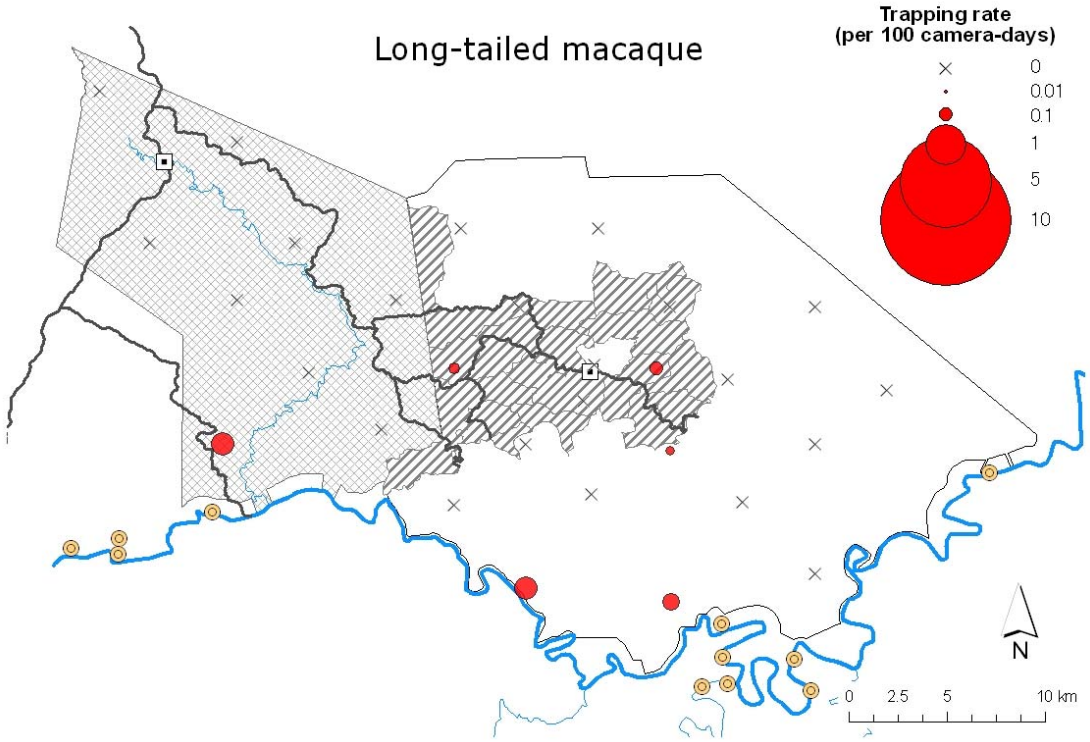


Distribution: Borneo endemic

This species is basically arboreal and taken images by chance.

Long-Tailed Macaque / Crab-eating Macaque

Macaca fascicularis



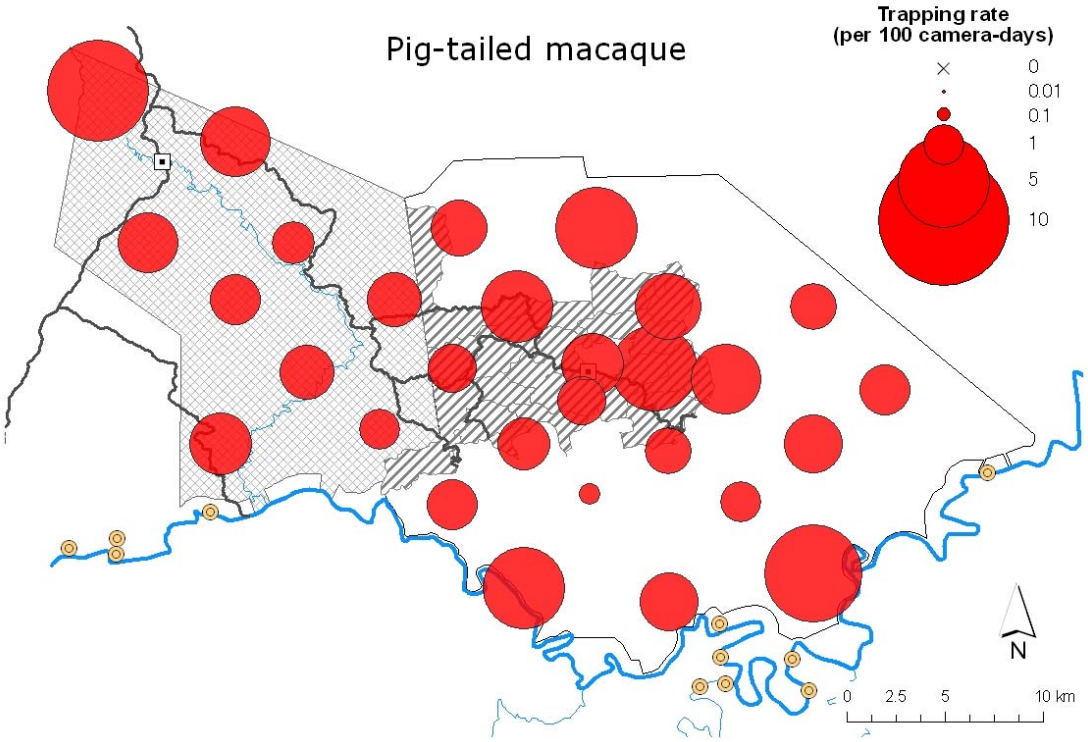
SG: Kara

Distribution: Myanmar, Thailand, Laos, Vietnam Cambodia, Malaysia, Sumatra, Java, Nusa Tenggara, and Philippines.

This species is basically arboreal and taken images by chance.

Southern Pig-Tailed Macaque

Macaca nemestrina



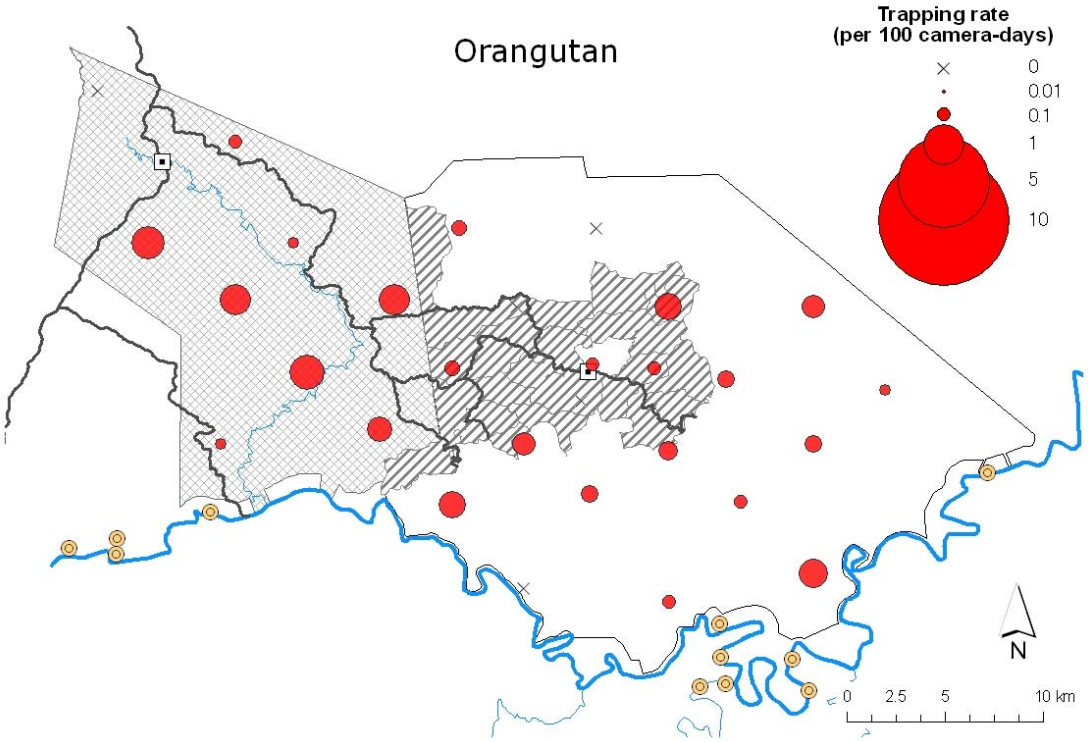
Red list status: Vulnerable

SG: Gebuk

Distribution: Peninsular Thailand, Malaysia, Sumatra and Borneo

Bornean Orangutan

Pongo pygmaeus



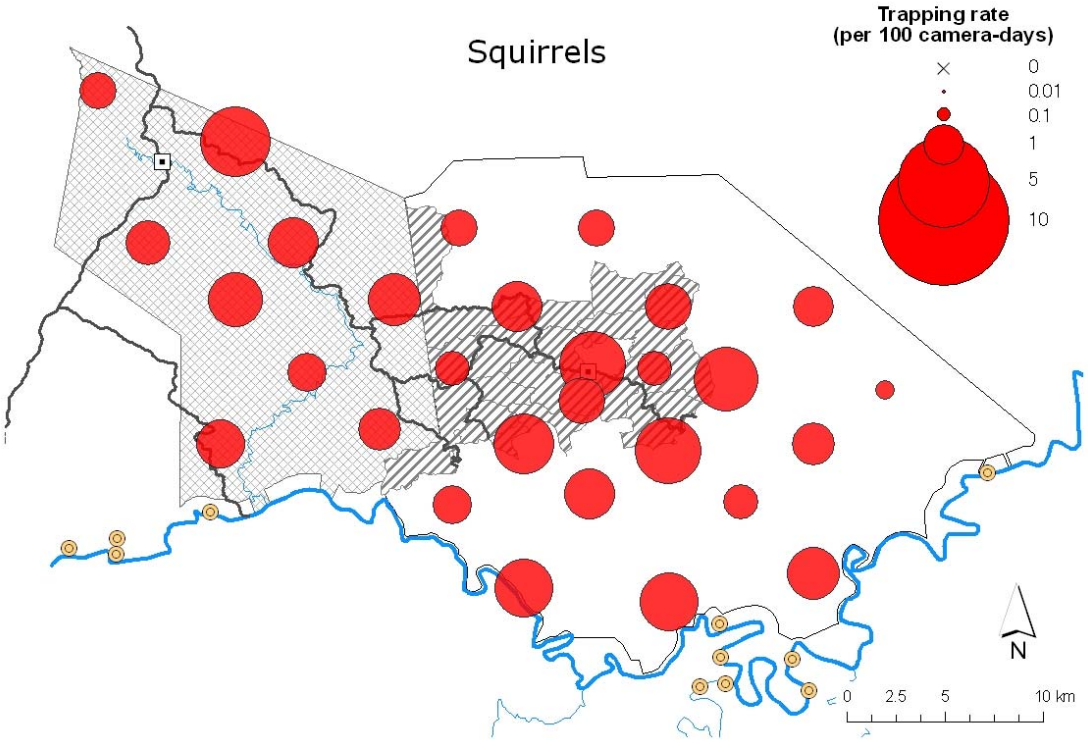
Red list status: Endangered

SG: Kagiu

Distribution: Endemic to Borneo

This species is known as arboreal, but many adult males walking on forest floor were captured by our cameras.

Squirrels



There are several species of squirrels including Hose-Tailed Squirrel (*Sundasciurus hippurus*), Tufted Ground Squirrel (*Ratufa affinis*), Prevost's Squirrel (*Callosciurus prevostii*), Four Striped Ground Squirrel (*Lariscus hosei*), Giant Squirrel (*Ratufa affinis*), etc.

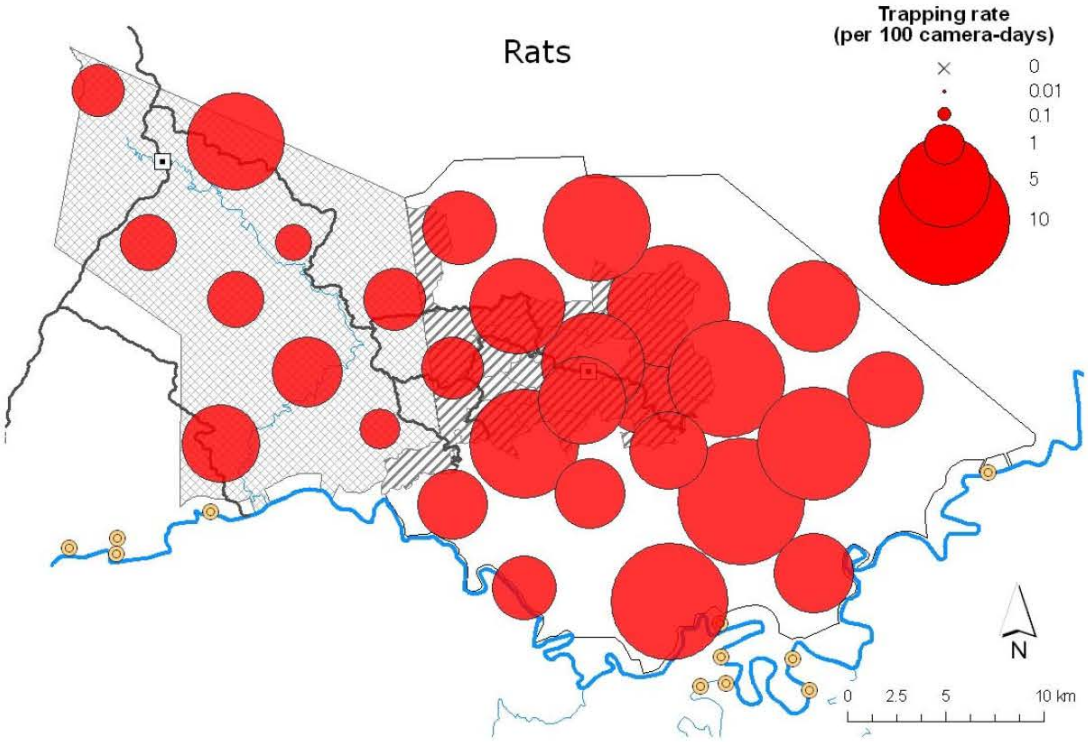
Hose-Tailed Squirrel

Tufted Ground Squirrel

Prevost's Squirrel

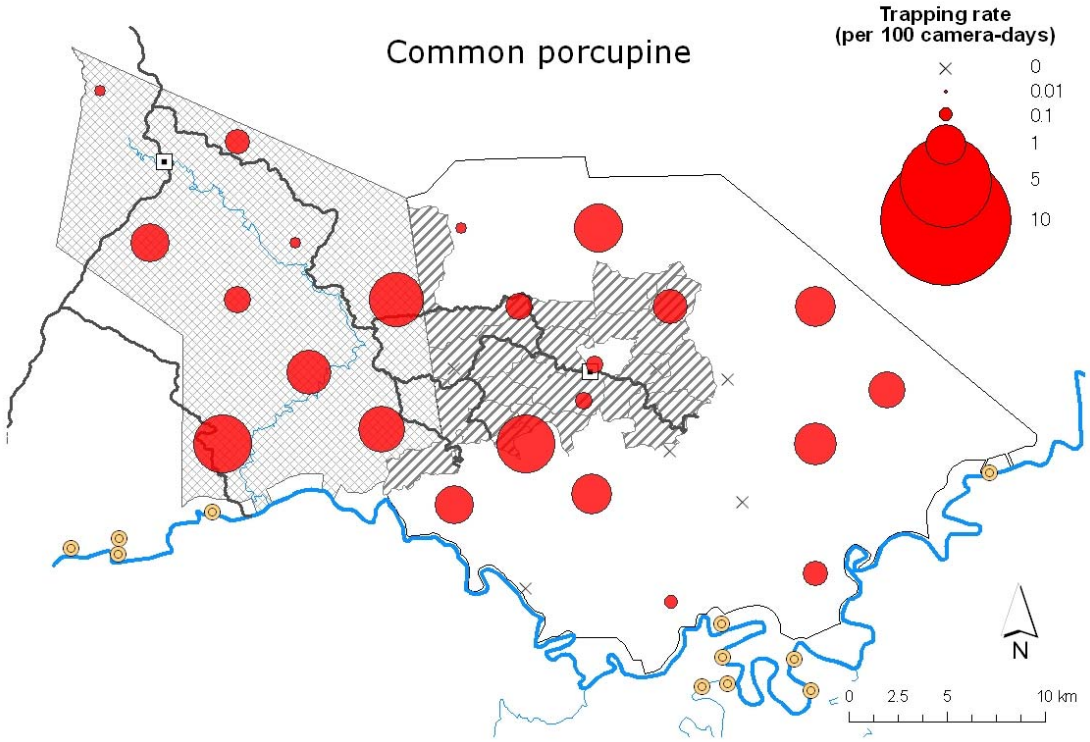
Giant Squirrel

Rats


Rats
Trapping rate
(per 100 camera-days)
0
0.01
0.1
1
5
10
N
0
2.5
5
10 km

Common Porcupine

Hystrix brachyura



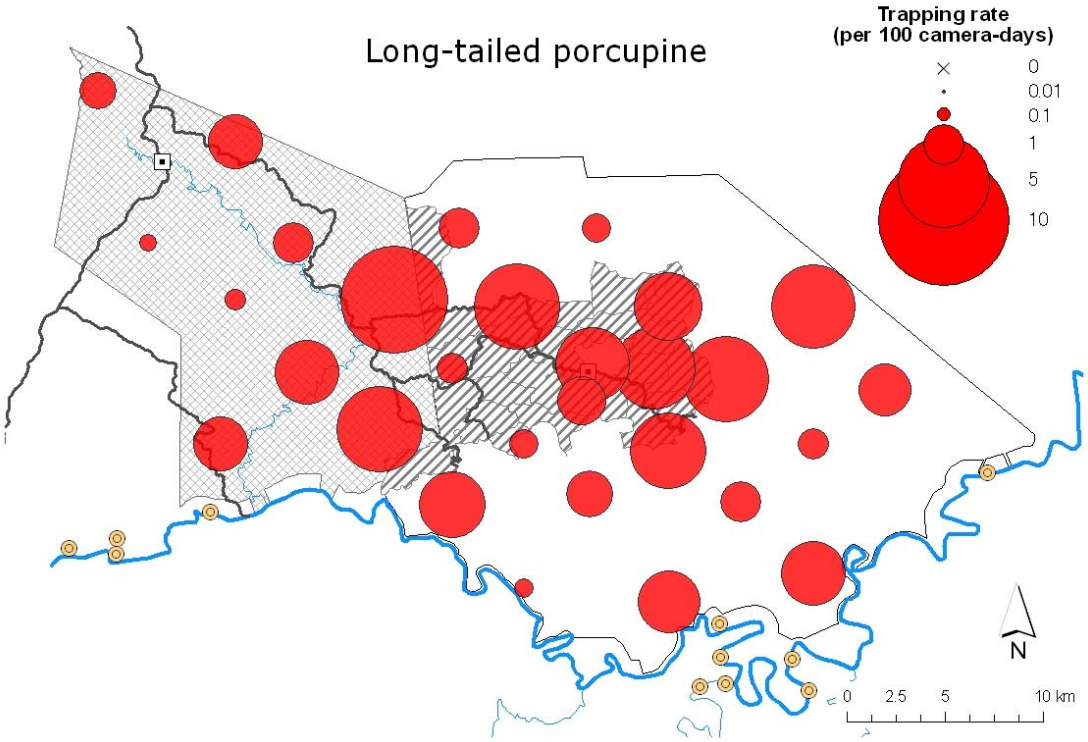
SG: Oton

Distribution: China, India, Myanmar, Thailand, Laos, Vietnam, Cambodia, Peninsular Malaysia, Sumatra, and Borneo.

Images of two to three individuals walking together are taken sometimes.

Long-Tailed Porcupine

Trichys fasciculata

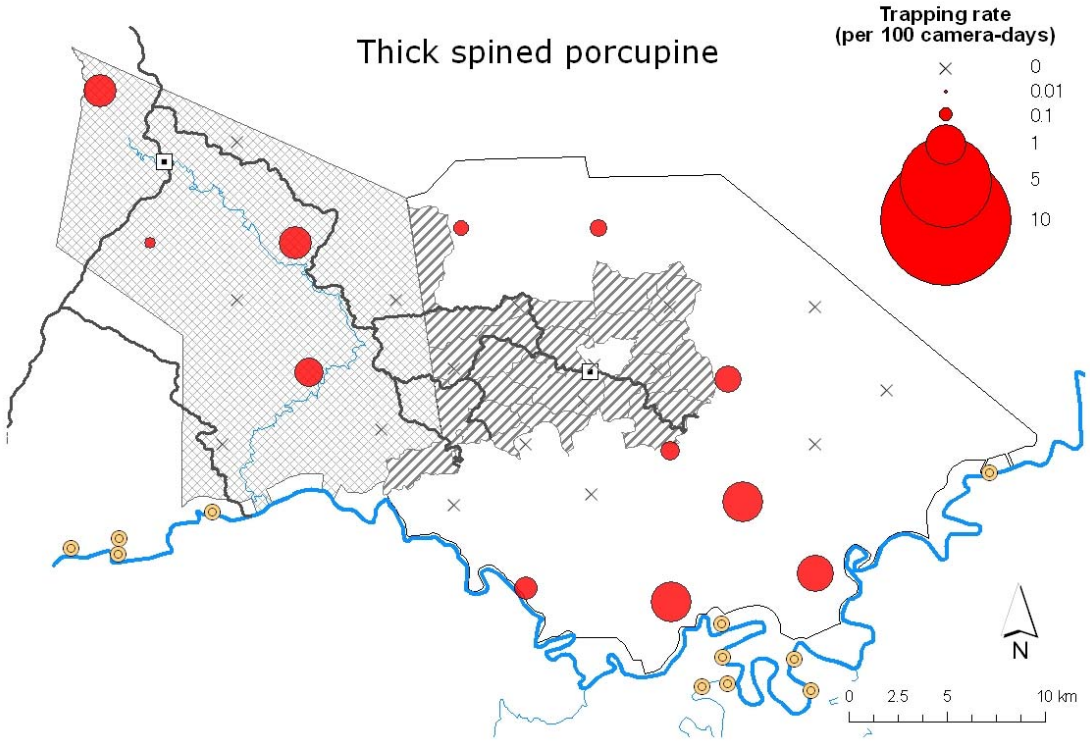


SG: Oton

Distribution: Peninsular Malaysia, Sumatra, and Borneo

Thick-spined Porcupine

Hystrix crassispinis



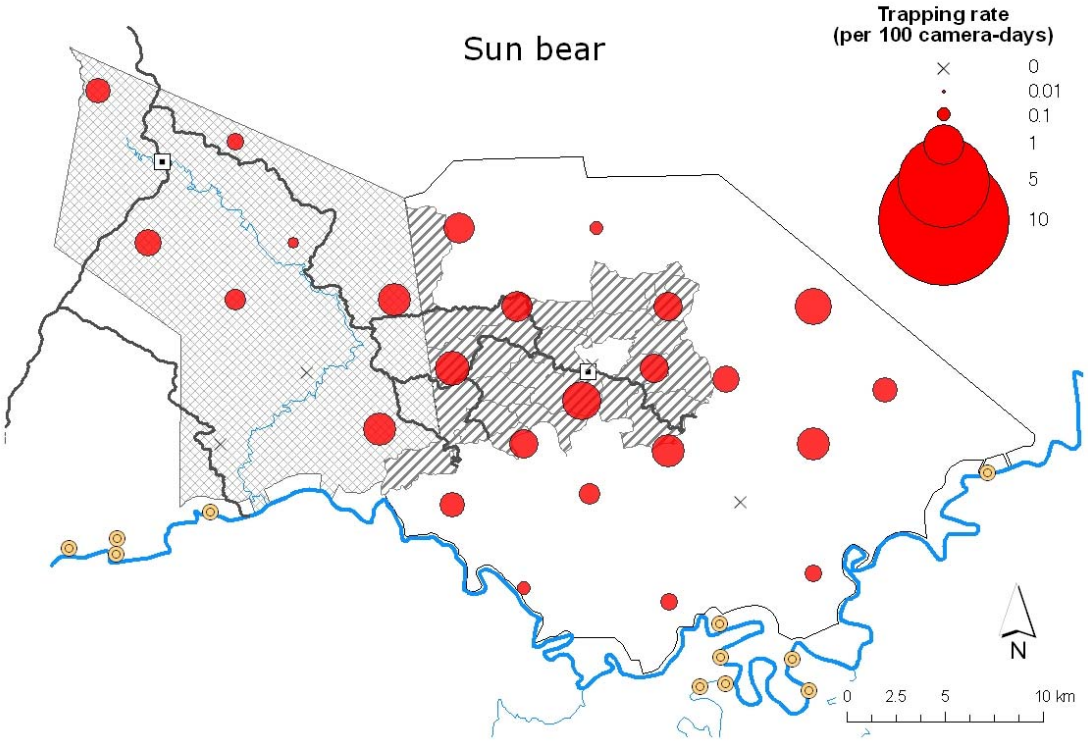
SG: Oton

Distribution: Borneo endemic

The distribution pattern in this forest reserves looks like exclusive with common porcupine. Same as common porcupine, images of two to three individuals walking together are taken sometimes.

Sun Bear

Helarctos malayanus



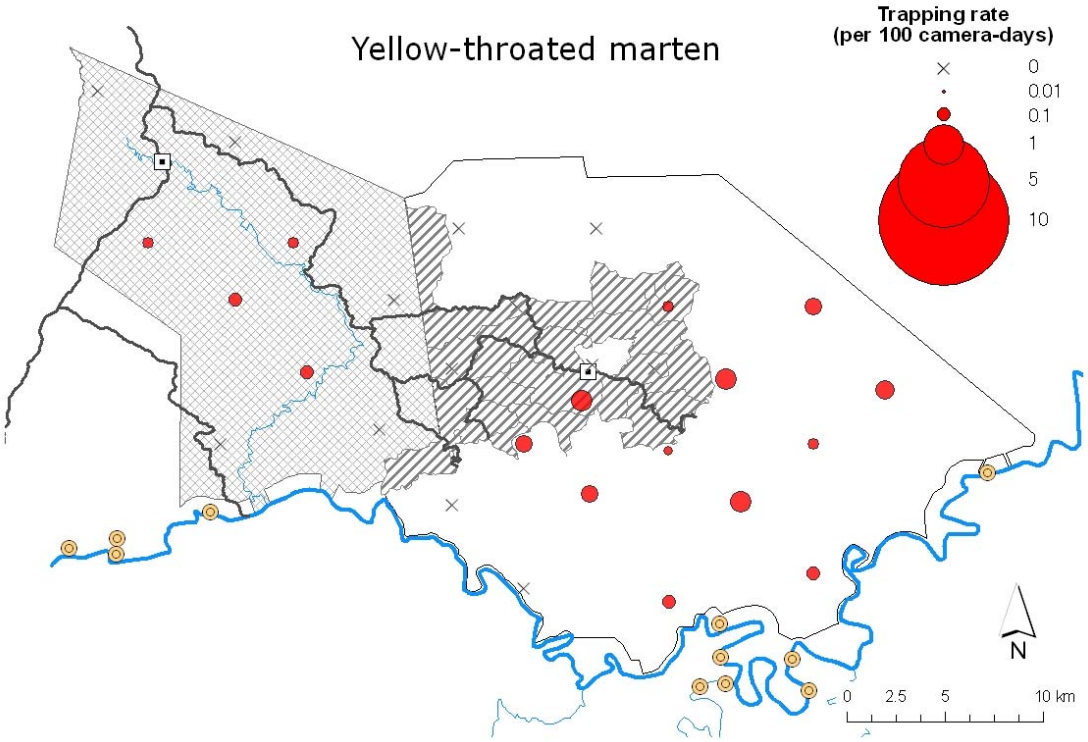
Red list status: Vulnerable

SG: Baruang

Distribution: Myanmar, Thailand, Laos, Vietnam, Cambodia, Peninsular Malaysia, Sumatra, and Borneo

Yellow-throated Marten

Martes flavigula

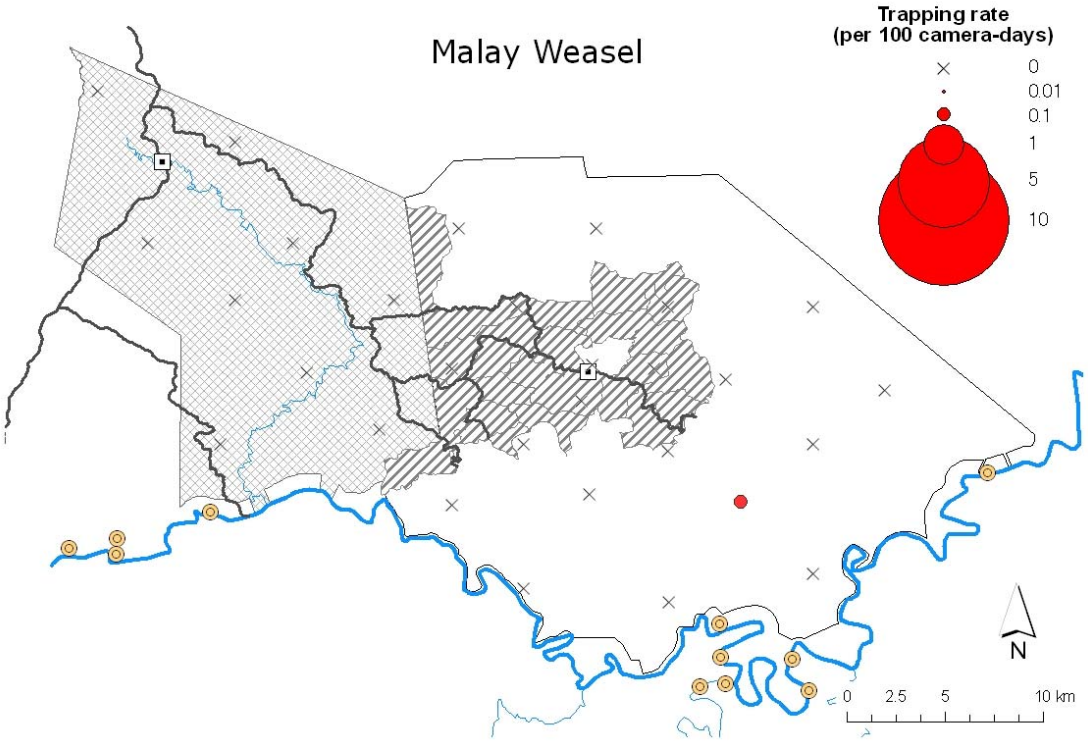


Distribution: Korea, China, India, Nepal, Myanmar, Thailand, Laos, Vietnam, Cambodia, Peninsular Malaysia, Sumatra, Borneo, and Java

This species is partly arboreal.

Malay weasel

Mustela nudipes

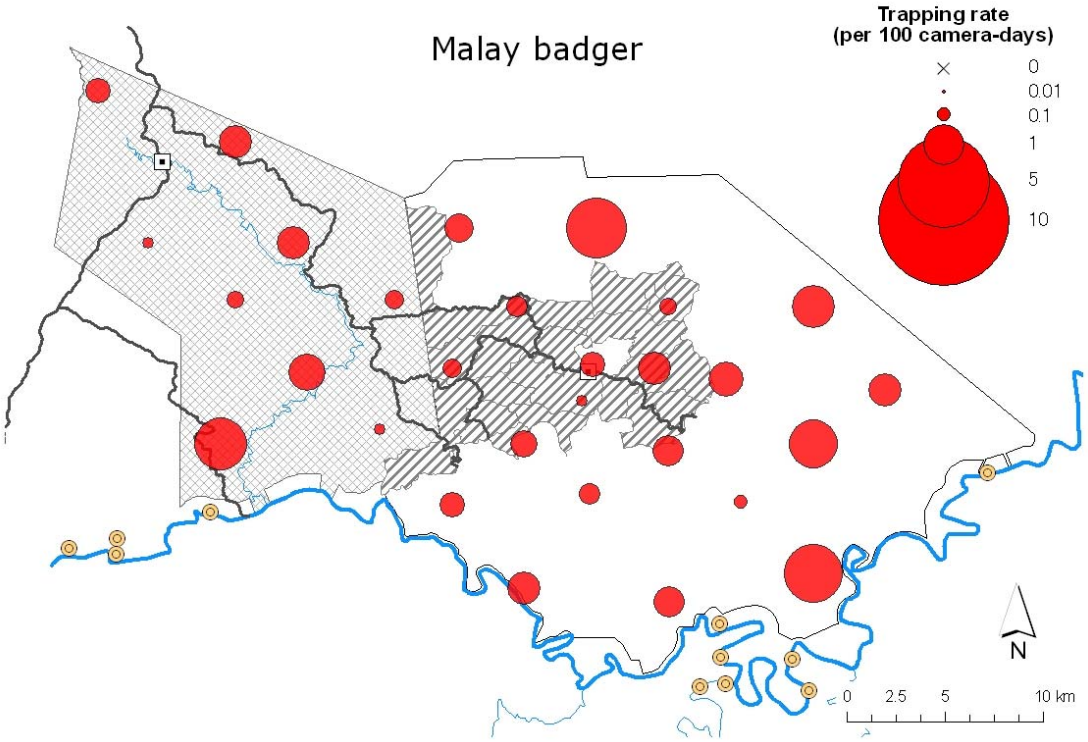


Distribution: Peninsular Thailand, Malaysia, Sumatra, and Borneo

Malay weasel was one of the most elusive species in this area. Only one photo was taken.

Teledu / Malay Badger

Mydaus javanensis

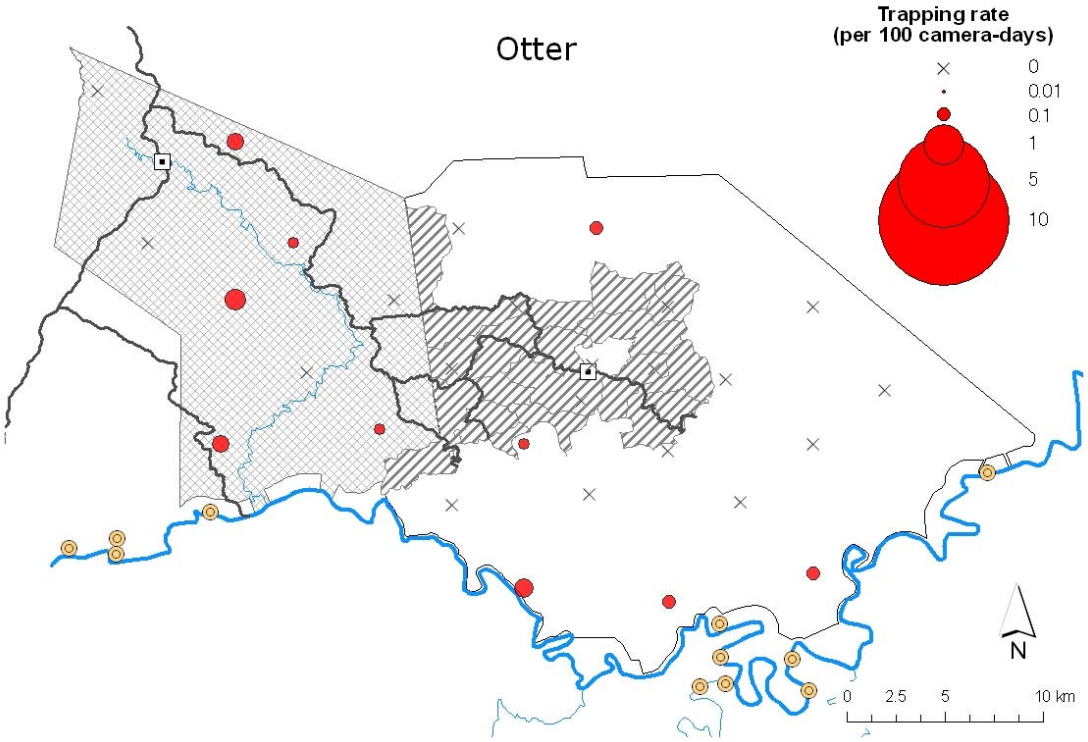


SG: Bilud-tudoh

Distribution: Sumatra, Borneo, and Java

This species is common in Sabah, but rare or does not inhabit in other part of Borneo.

Otters



Red list status: Vulnerable

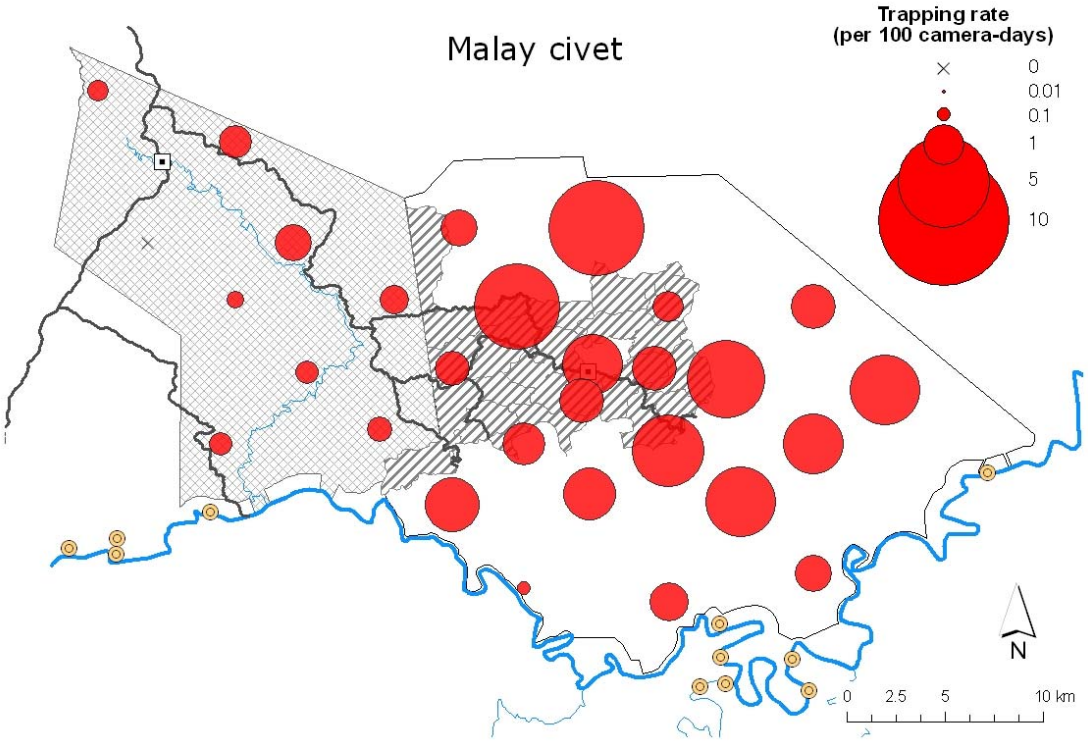
SG: Rongon

Most of images look like Oriental small-clawed otter (*Aonyx cinerea*). However, Wilting et al. (2010) also reported Smooth-coated otter (*Lutrogale perspicillata*) and Hairy-nosed otter (*Lutra sumatrana*) in this area.

Otters generally inhabit along river.

Malay Civet / Tangalung

Viverra tangalunga

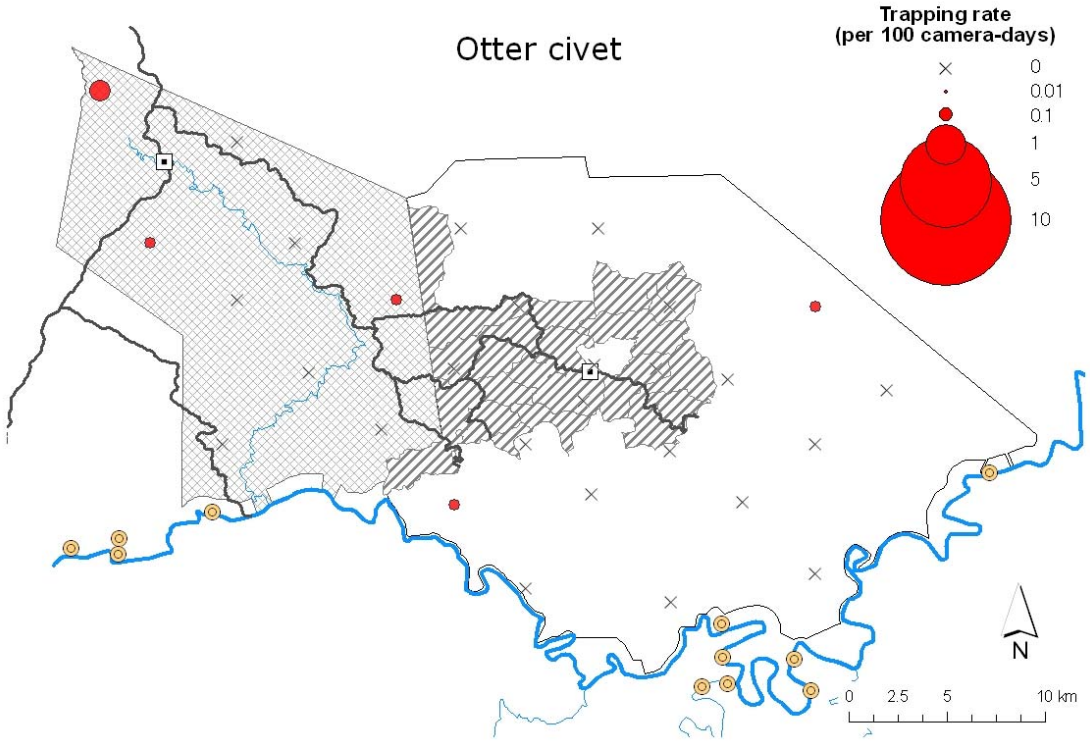


SG: Tingalung

Distribution: Peninsular Malaysia, Sumatra, Borneo, Sulawesi and Philippine.

Otter-Civet

Cynogale bennettii



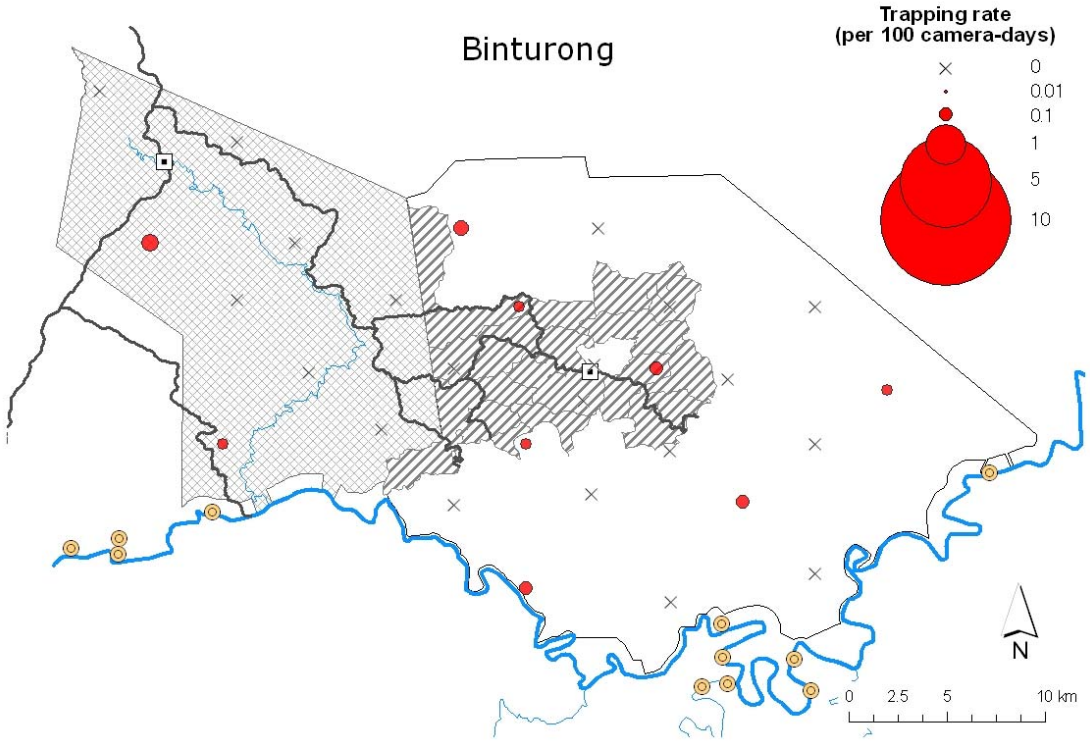
Red list status: Endangered

Distribution: Peninsular Thailand and Malaysia, Sumatra, and Borneo

One of the rarest species in Borneo.
This species is considered to inhabit along river.

Binturong / Bearcat

Arctictis binturong



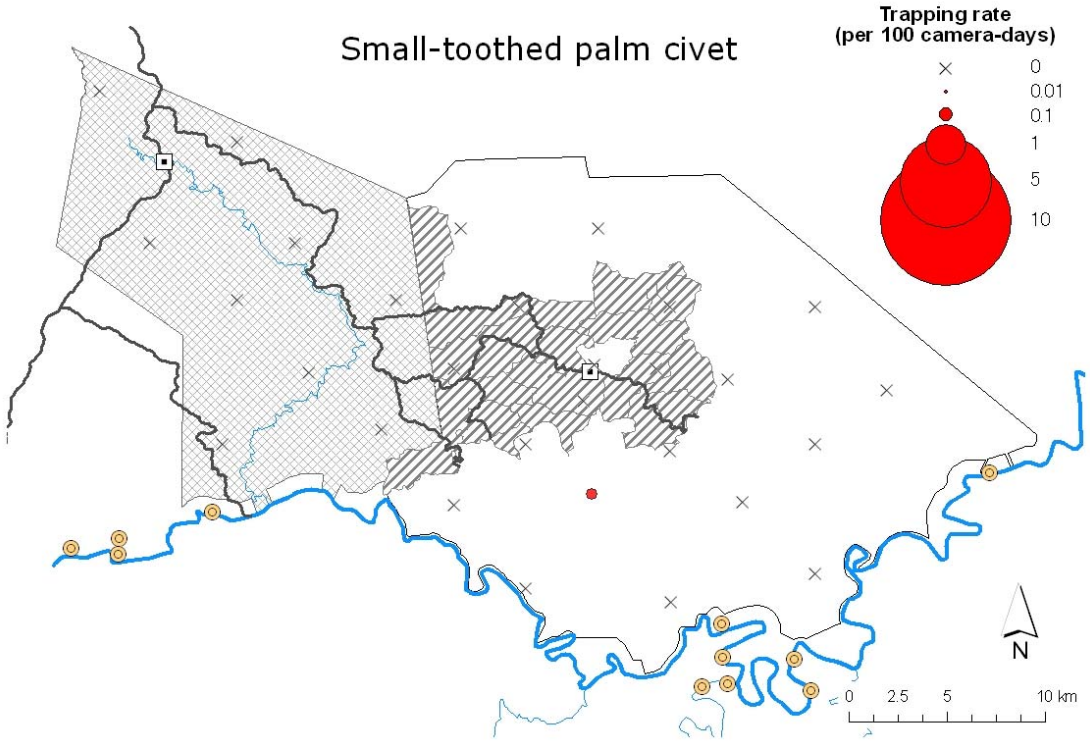
Red list status: Vulnerable

Distribution: India, Myanmar, Thailand, Lao, Vietnam, Cambodia, Peninsular Malaysia Sumatra, Borneo, and Java

This species is partly aboreal.

Small-toothed Palm Civet

Arctogalidia trivirgata

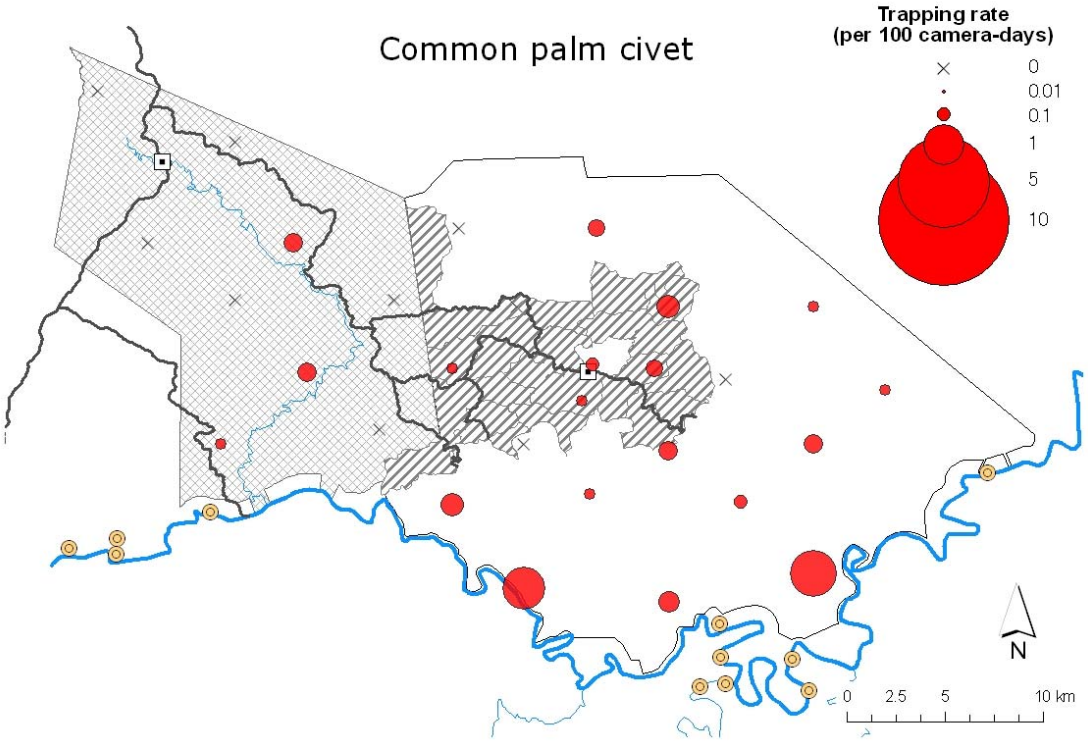


Distribution: Northern India, Myanmar, Thailand, Lao, Vietnam, Cambodia, Peninsular Malaysia Sumatra, and Borneo.

This species is partly arboreal.
Only one photo was taken.

Common Palm Civet

Paradoxurus hermaphroditus



SG: Tingalung

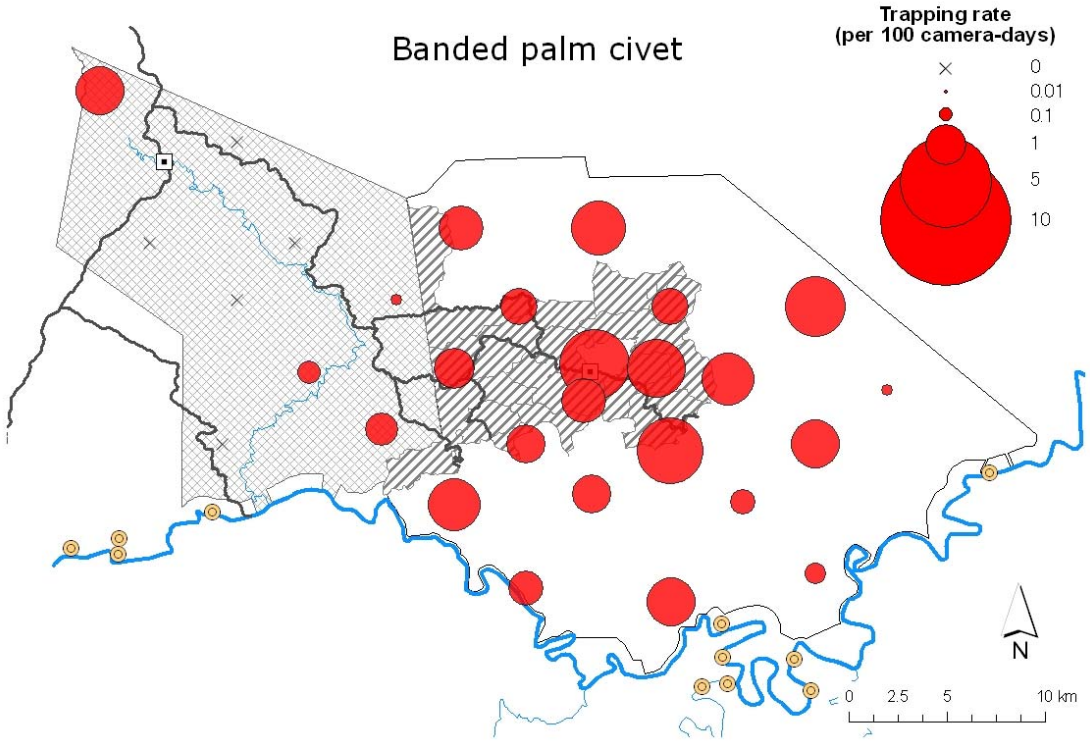
Distribution: Sri Lanka, India, Bangladesh, Myanmar, Thailand, Lao, Vietnam, Cambodia, southern China, Peninsular Malaysia, Sumatra, Borneo, Java, and Philippines.

This species is frequently observed along the logging roads, but was not frequently captured by our cameras inside forest.

This species is partly arboreal.

Banded Civet

Hemigalus derbyanus



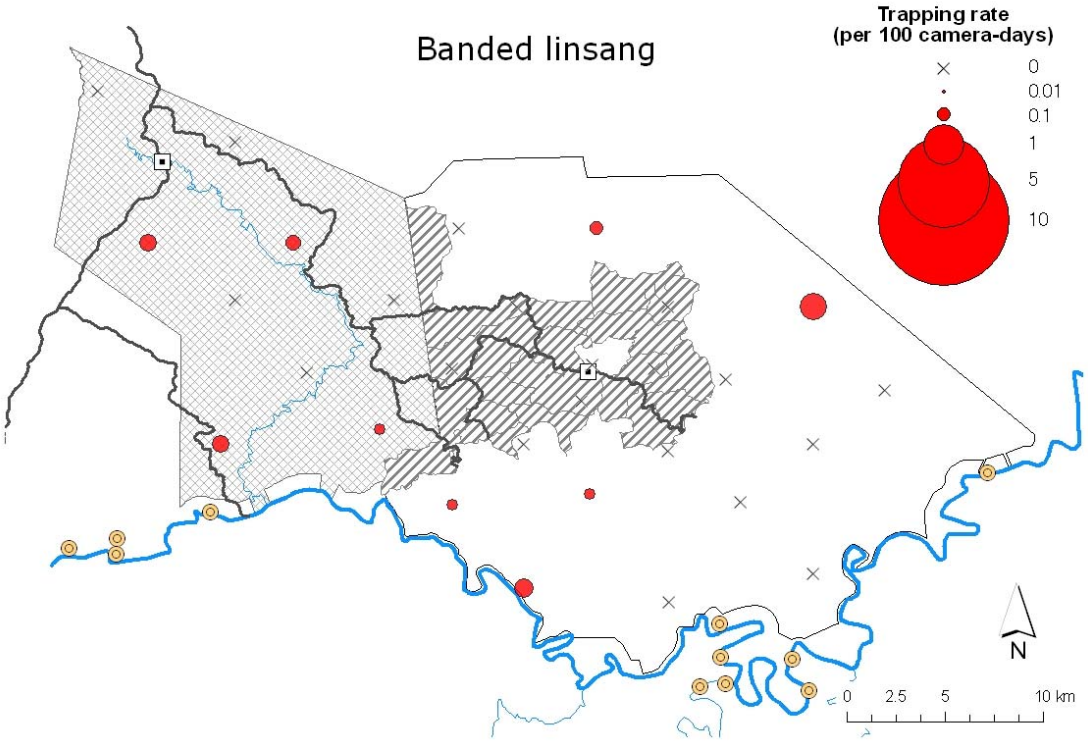
Red list status: Vulnerable

SG: Tingalung

Distribution: Peninsular Myanmar, Thailand and Malaysia, Sumatra, and Borneo.

Banded Linsang

Prionodon linsang

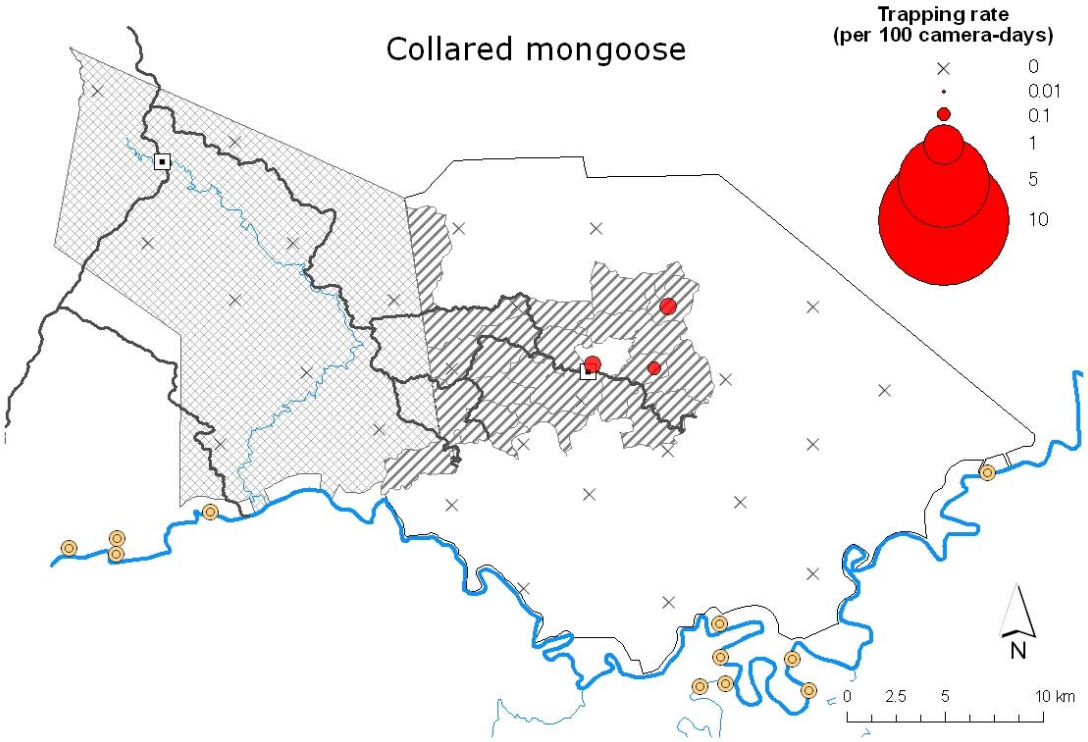


Distribution: Peninsular Myanmar, Thailand and Malaysia, Sumatra, Borneo, and Java

This species is partly arboreal.

Collared Mongoose

Herpestes semitorquatus



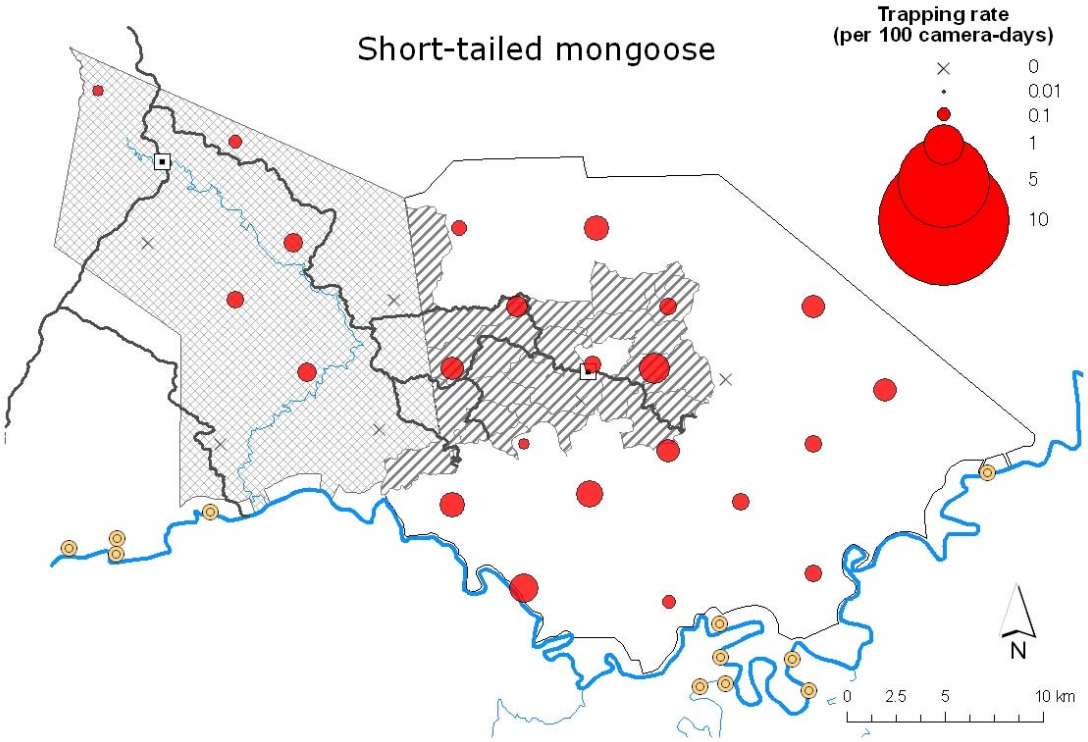
Red list status: Deficient

Distribution: Endemic to Borneo

Some pictures of this species were very difficult to distinguish from Short-tailed Mongoose.

Short-Tailed Mongoose

Herpestes brachyurus

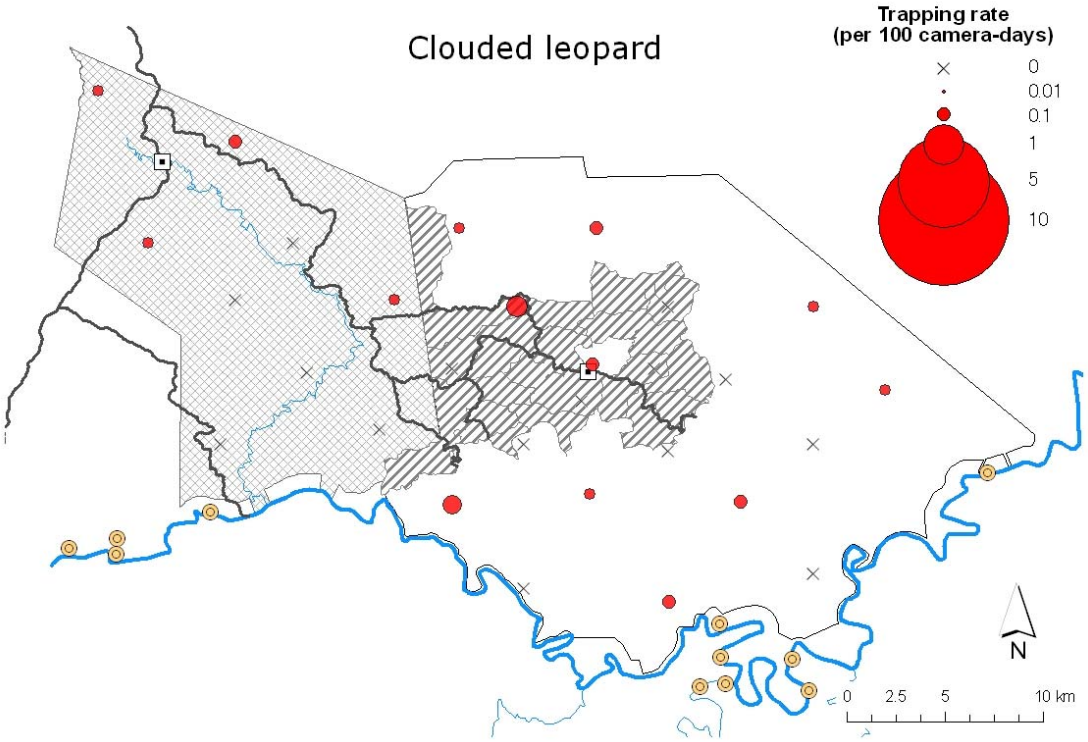


Distribution: Peninsular Malaysia, Sumatra, and Borneo

Some pictures of this species were very difficult to distinguish from Collared Mongoose.

Sunda Clouded Leopard

Neofelis diardi



Red list status: Vulnerable

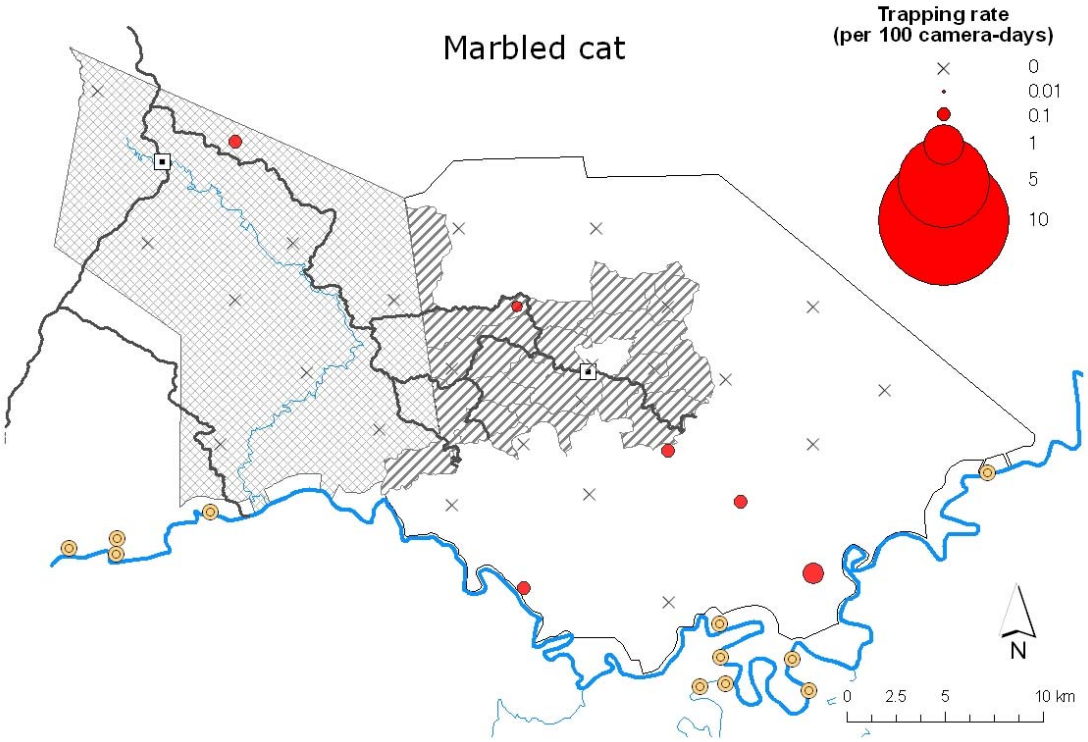
SG: Harimau

Distribution: Sumatra and Borneo

This species is the most frequently photographed felid in Deramakot and Tangkulap

Marbled Cat

Pardofelis marmorata

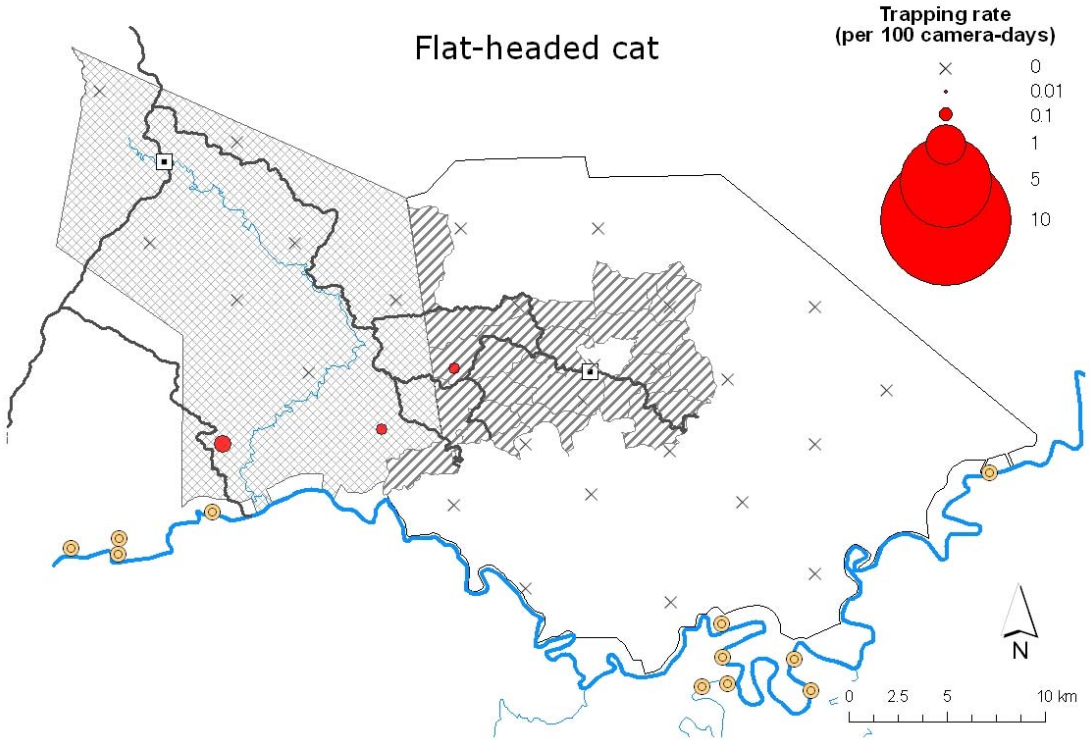


Red list status: Vulnerable

Distribution: Himalayas, Myanmar, Thailand, southern China, Lao, Vietnam, Cambodia, Peninsular Malaysia, Sumatra and, Borneo

Flat-Headed Cat

Prionailurus planiceps



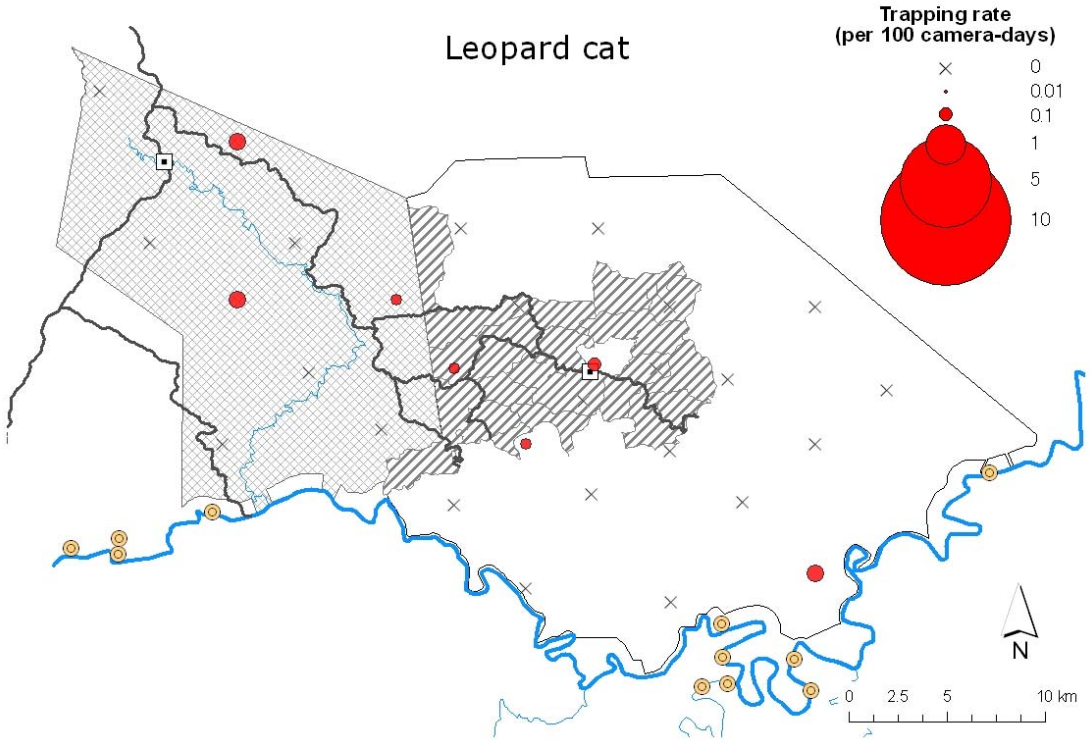
Red list status: Endangered

SG: Kucing hutan

Distribution: Peninsular Malaysia, Sumatra, and Borneo

Leopard Cat

Prionailurus bengalensis



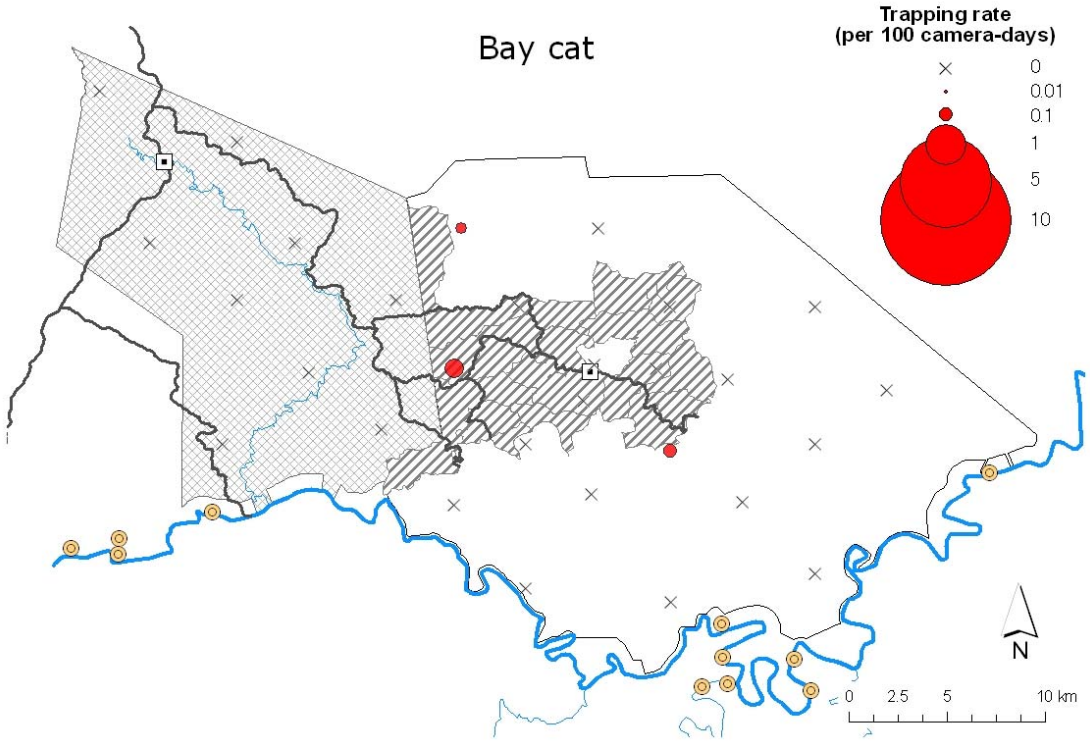
SG: Tusing gauton

Distribution: Northern India, Myanmar, Laos, Cambodia, Vietnam, China, Korea, Taiwan, Peninsular Malaysia, Sumatra, Borneo, Java, Bali, and Palawan

This species is frequently observed along the logging roads, but was not frequently captured by our cameras inside forest.

Bay Cat

Pardofelis badia



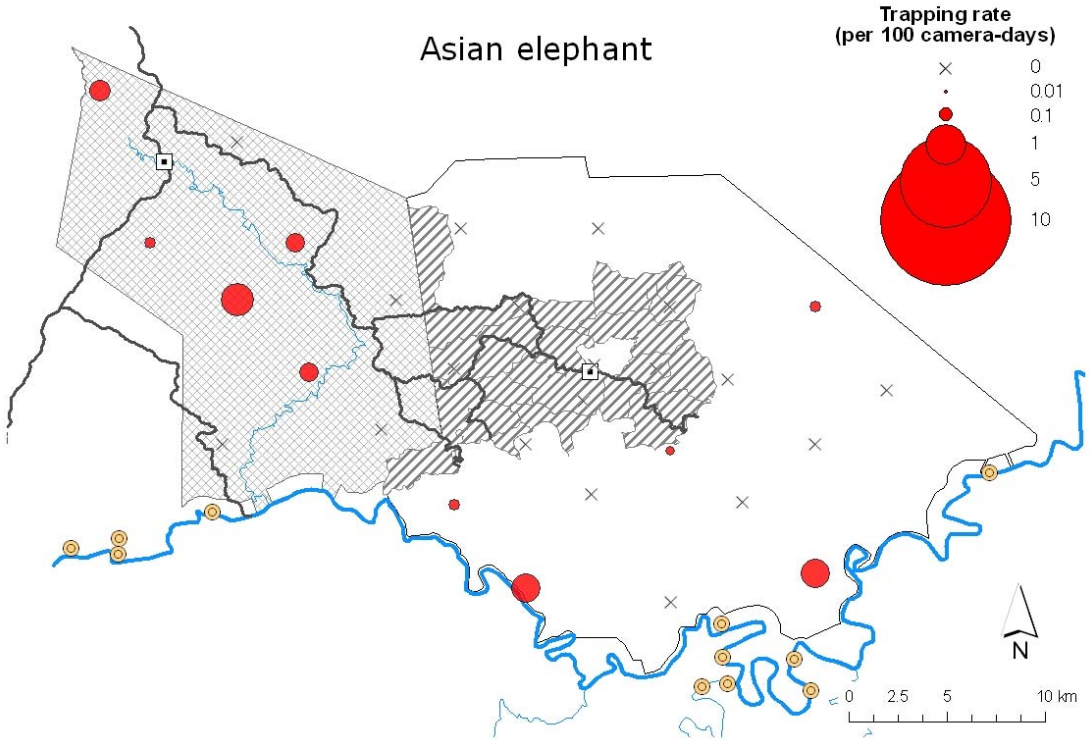
Red list status: Endangered

Distribution: Endemic to Borneo

One of the rarest mammals in Borneo

Asian Elephant

Elephas maximus



Red list status: Endangered

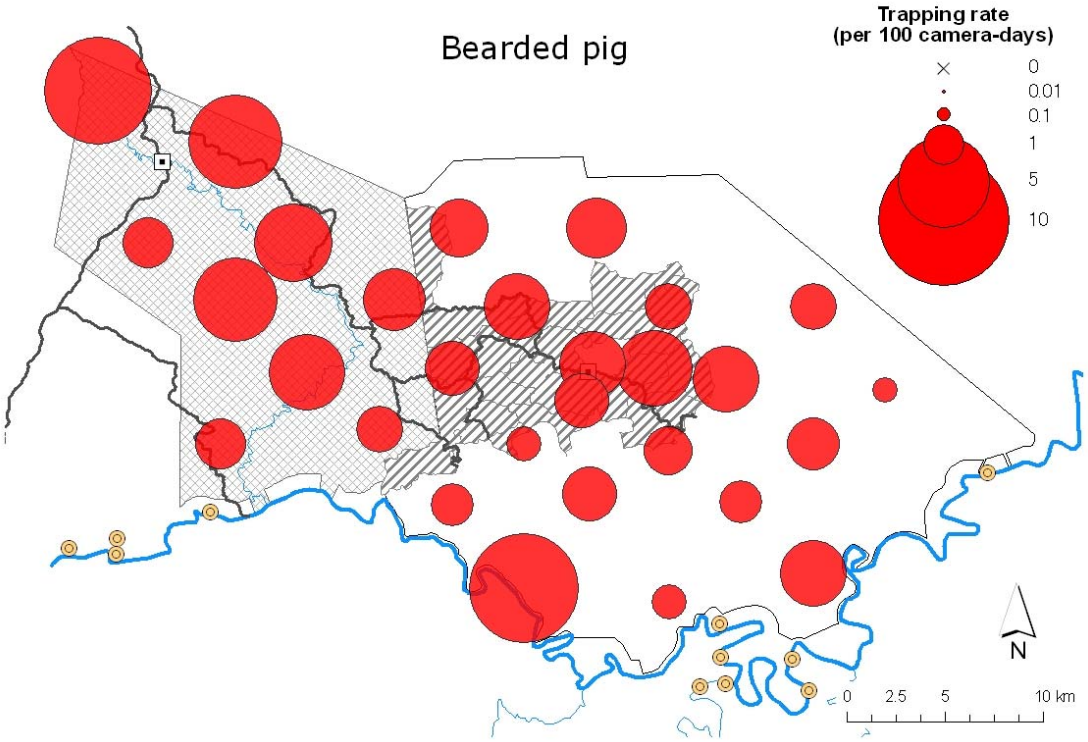
SG: Maman / Nenek

Distribution: India, Sri Lanka, Myanmar, Thailand, Lao, Southern China, Vietnam, Cambodia, Peninsular Malaysia, Sumatra. and Borneo

Many cameras were destroyed by elephants.

Bearded Pig

Sus barbatus



Red list status: Vulnerable

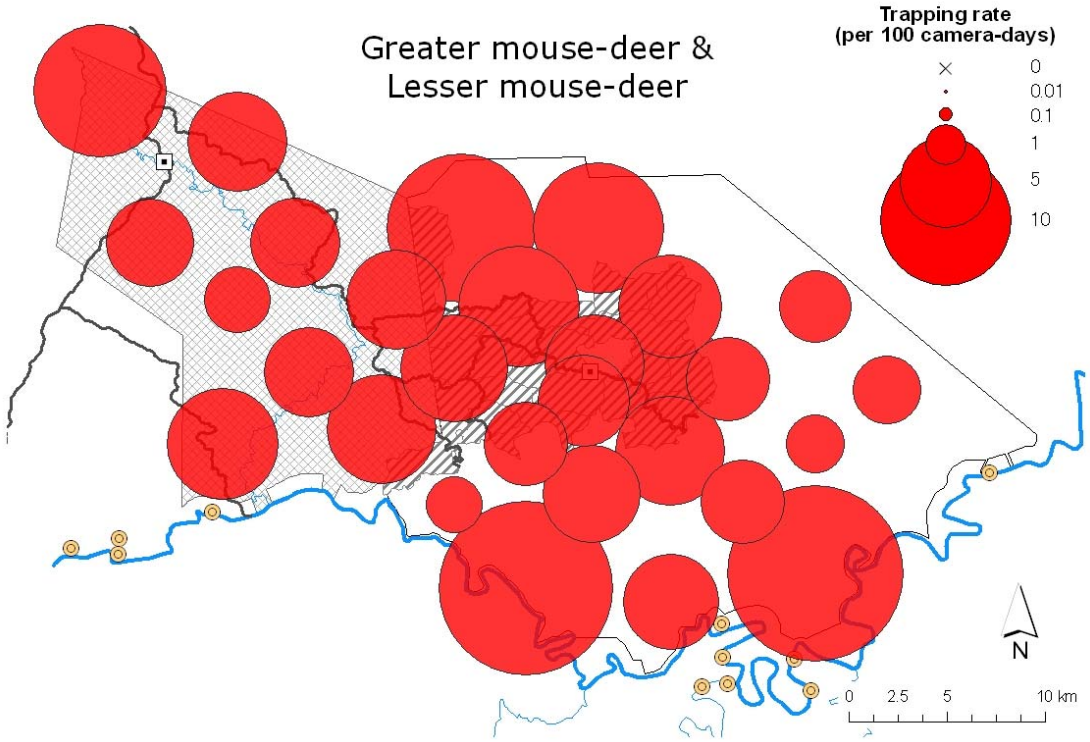
SG: Bakas

Distribution: Peninsular Malaysia, Sumatra, and Borneo

During mast fruiting season such as in 2007 and 2010, their density increased obviously and large herds including more than 20 piglets were observed.

Lesser Mousedeer & Greater Mousedeer

Tragulus javanicus & *Tragulus napu*



SG: Lesser: Palanuk, Greater: Palanuk watang

Distribution:

Lesser: Thailand, Laos, Cambodia, Vietnam, Peninsular Malaysia, Sumatra, and Borneo

Greater: Peninsular Myanmar, Thailand and Malaysia, Sumatra, and Borneo

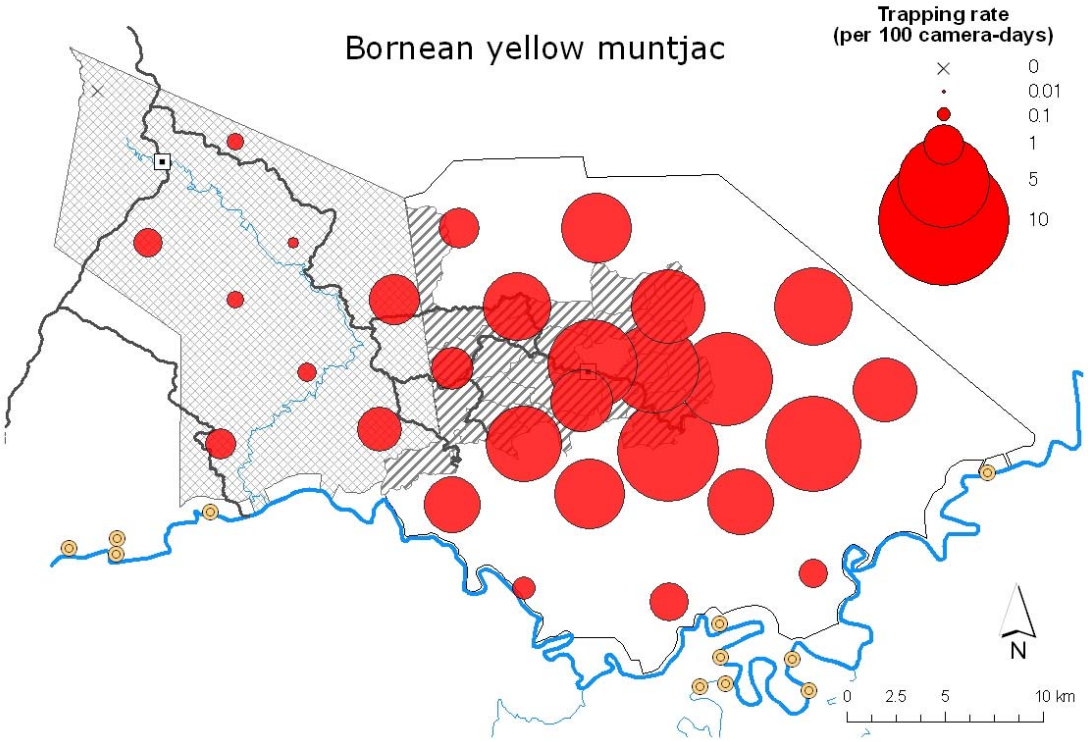
Some pictures of these two species were very difficult to distinguish.

Lesser Mousedeer

Greater Mousedeer

Bornean Yellow Muntjac

Muntiacus atherodes



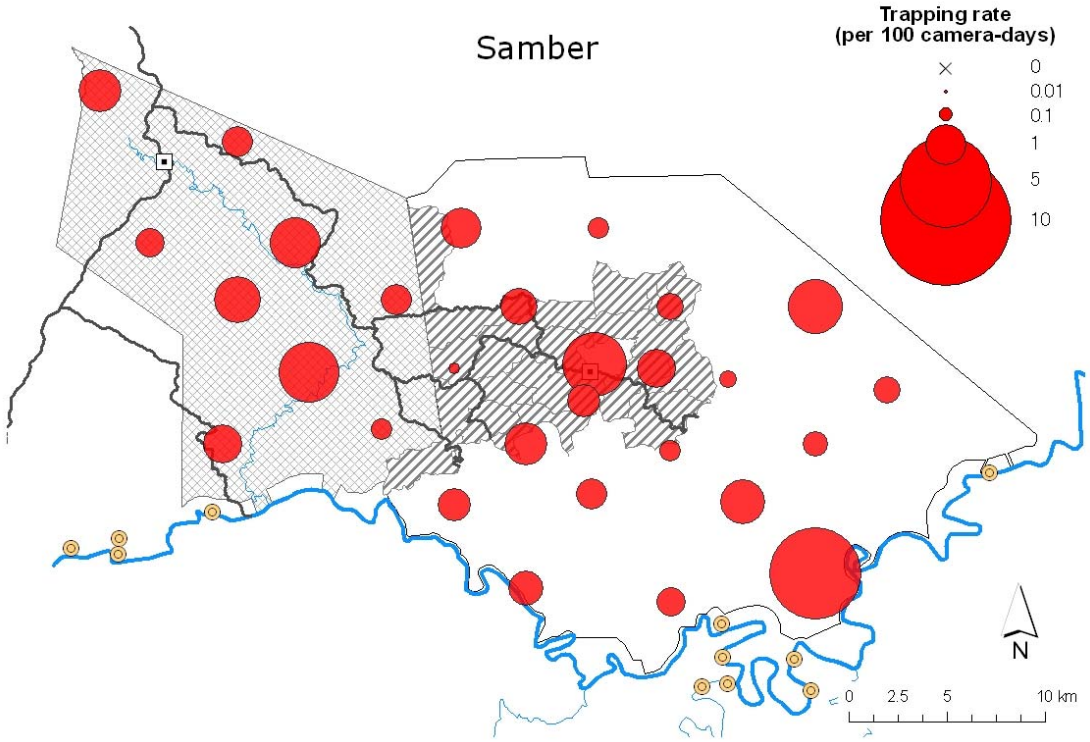
SG: Parukak

Distribution: Endemic to Borneo

The skin colors vary from yellow to brown. Some people reported inhabitance of Bornean Red Muntjac (*Muntiacus muntjac*) in Deramakot. However, we could not get any obvious picture of that species which is characterized by the two-spikes-antlers.

Sambar Deer

Rusa unicolor



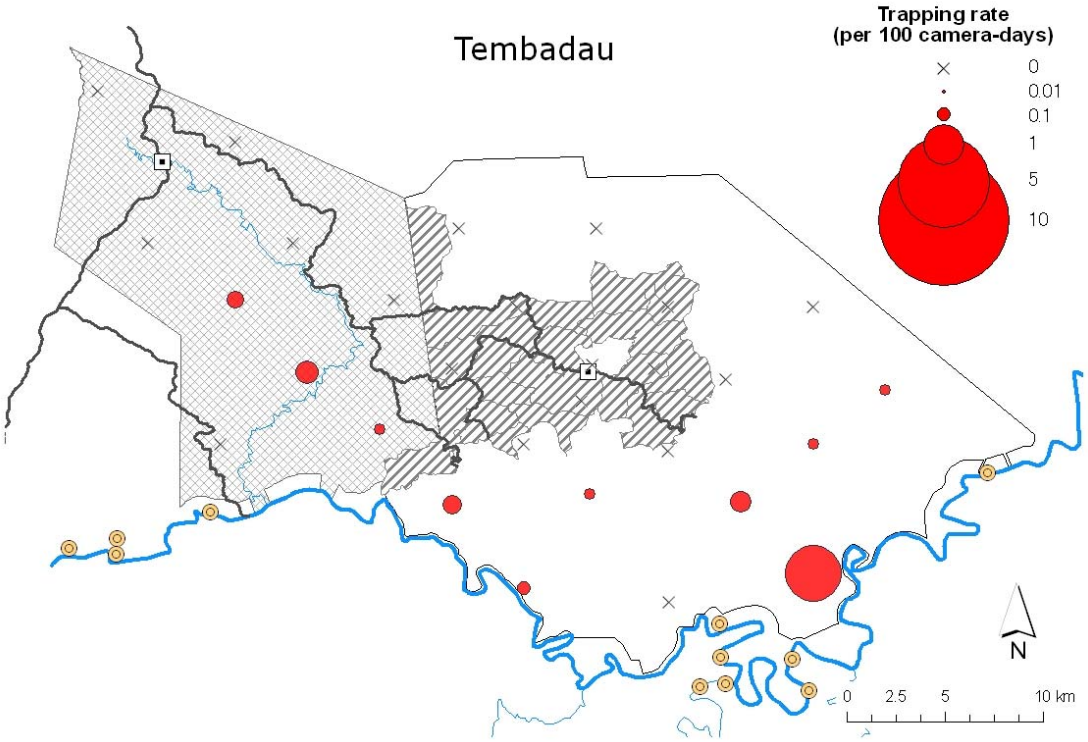
Red list status: Vulnerable

SG: Payaw

Distribution: Sri Lanka, India, southern China, Taiwan, Myanmar, Thailand, Laos, Vietnam, Cambodia, Sumatra, and Borneo

Tembadau / Banteng

Bos javanicus



Red list status: Endangered

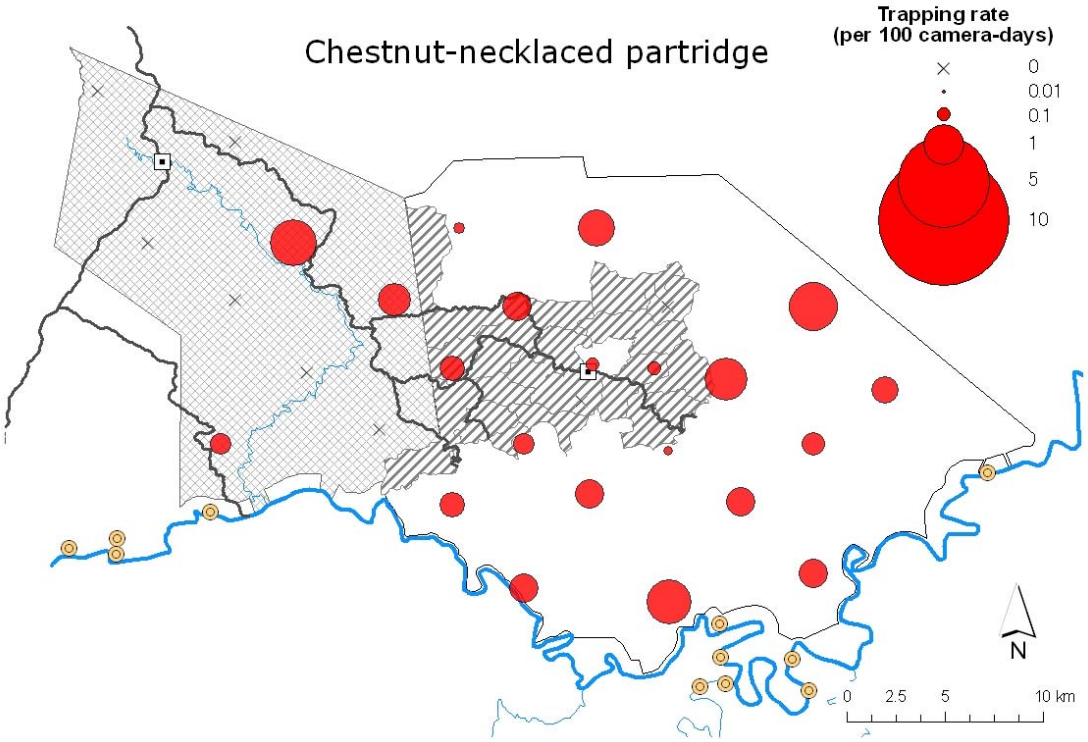
SG: Kalasiw

Distribution: Myanmar, Thailand, Cambodia, Borneo, and Java

Some informants said, domestic cattle (*Bos indicus*) were once bread at a logging camp near Kg Balat. And some of the cattle were escaped into the forest when the camp was closed in 1980's. Some part of wild cows in Deramakot & Tangkulap may be their offspring or hybrid with wild Tembadau.

Chestnut Necklaced Partridge

Arborophila charltonii graydoni

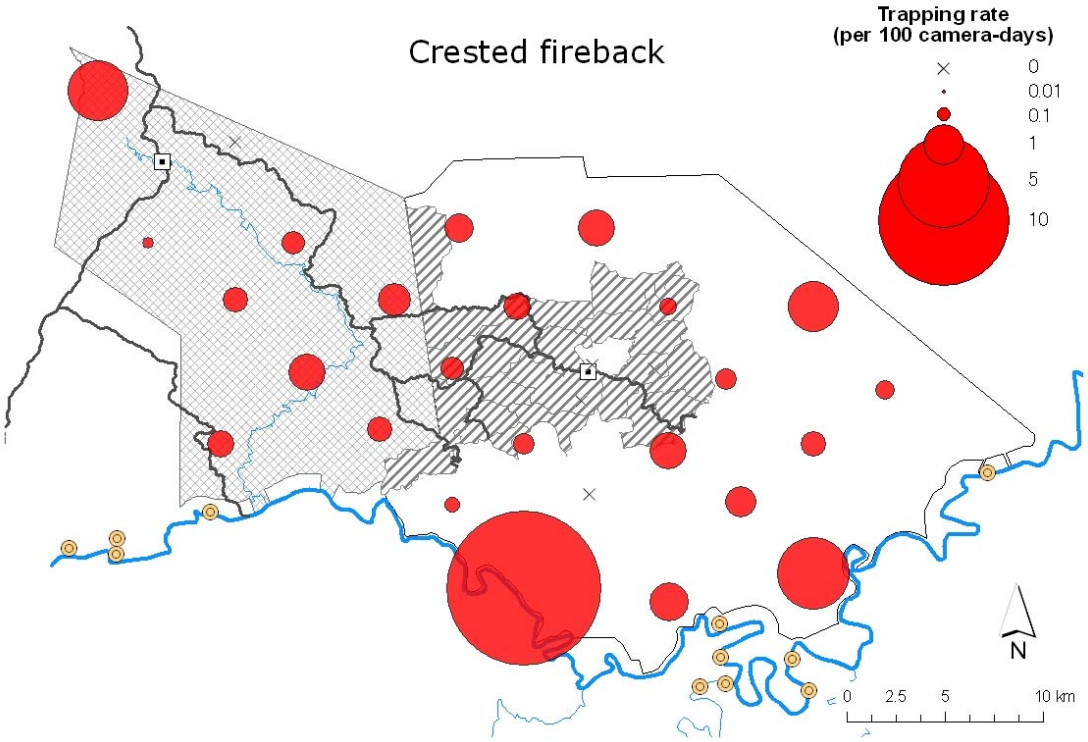


Red list status: Near threated

Distribution: Peninsular Thailand and Malaysia, Sumatra, and Borneo (only in Sabah)

Crested Fireback

Lophura ignita nobilis

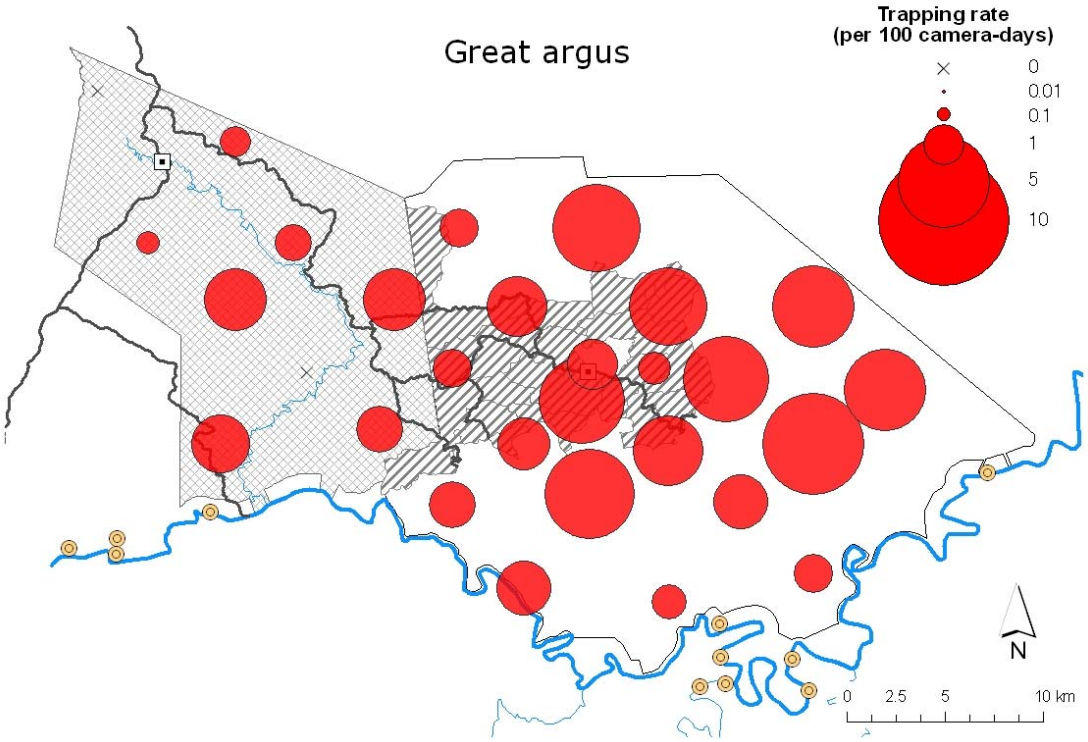


Red list status: Near threatened

Distribution: Peninsular Thailand and Malaysia, Sumatra, and Borneo

Great Argus

Argusianus argus grayi



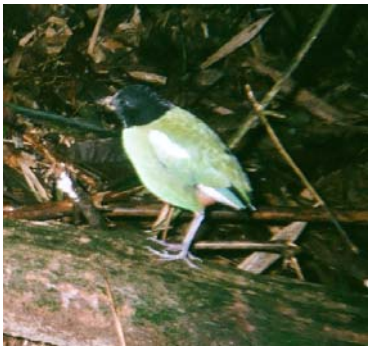
Red list status: Near threatened

SG: Manuk gautun

Distribution: Peninsular Thailand and Malaysia, Sumatra, and Borneo

Other Bird species

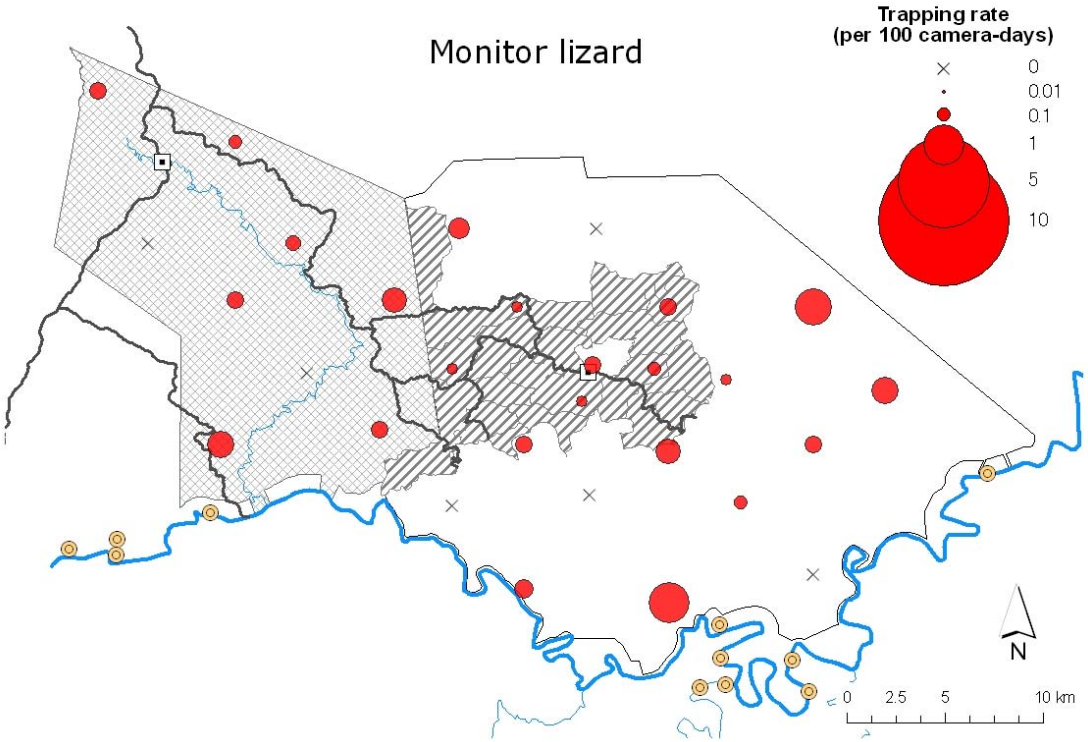
Many other bird species were also photographed. The identified species are Red-breasted Partridge (*Arborophila hyperythra*), Crested Partridge (*Rollulus rouloul*), Crested Wood Partridges (*Rollulus rouloul*), Red-legged Crake (*Rallina fasciata*), Band-bellied Crake (Porzana paykullii), Storm's Stork (*Ciconia stormi*), Yellow Bittern *(Ixobrychus sinensis*), Blyth's Hawk Eagle (*Spizaetus alboniger*), Emerald Dove (*Chalcophaps indica*), Pink-necked Green Pigeon (*Treron vernans*), Rufous-collared Kingfisher (*Actenoides concretus*), White-crowned Hornbill (*Berenicornis comatus*), Blue-headed Pitta (*Pitta baudii*), Black-and-crimson Pitta (*Pitta ussheri*), Giant Pitta (*Pitta granatina*), Hooded Pitta (*Pitta sordida*), Blue-banded Pitta (*Pitta arquata*), Banded Pitta (*Pitta guajana*) Garnet Pitta (*Pitta granatina*), Bornean Ground-cuckoo (*Carpococcyx radiates*), Black-capped Babbler (*Pellorneum capistratum*), White-crowned Shama (*Copsychus stricklandii*), Bornean Ground-babbler (*Ptilocichla leucogrammica*).



Black rough-neck Monitor Lizard

& Common Water Monitor Lizard

Varanus rudicollis & V. salvator



SG: Mandatan

Black rough-neck Monitor Lizard

Common Water Monitor Lizard

Other reptile

Acknowledgments

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Local assistants for the hard filed works: Andy Marcus, Ronnie Marcus, Ronald Samion , Jubilee bin George, Sandra Lakim, Jonik Ajis, Azrie, Ewin and Sidik Ajis (left to right)

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