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Introduction

Peat swamp forest is one of the unique ecosystems in Southeast Asia, distributing mainly in Sumatra, Borneo and New Guinea (Whitemore 1984). While the floral composition of peat swamp forest has been relatively well studied (Anderson 1961; Bruenig 1990; Posa \textit{et al.} 2011), the faunal composition has not much studied yet (Whitemore 1984; Gaither Jr. 1994).

Because of the low nutrient content of the peat soil and the low primary productivity, the diversity and abundance of animals in peat swamp forest was considered low (Janzen 1974; Whitten \textit{et al.} 2000; Posa \textit{et al.} 2011). However, recent studies showed certain species in peat swamp area were rather abundant. Johnson \textit{et al.} (2005) and Quinten \textit{et al.} (2011) indicated that the densities of orangutan and other several species of primate in some peat swamp forests in Borneo and Sumatra were higher than those in adjacent lowland dipterocarp forests. Gaither Jr. (1994) also detected that some understory bird species were more abundant in peat swamp forest of Borneo, although the diversity and total abundance were generally lower.

While the species diversity is low, peat swamp forests have been refuges for various endangered species from lowland forests, which are under greater pressures from logging, hunting and development (Yule 2010). However, the peat swamp forest is now exploited by migrants and concession holders, and converted into large-scale oil palm and acacia plantations (Uryu \textit{et al.} 2008; Corlett 2009). Some native animals of peat swamp forest may be able to survive in such new habitats (Meijaard \textit{et al.} 2010), but serious impact on biodiversity may happen as reported in lowland forests in the region (Davies \textit{et al.} 2001; Chung \textit{et al.} 2000; Tsukamoto and Sabang 2005; Fitzherbert \textit{et al.} 2006).

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Giam Siak Kecil and Bukit Batu are unique areas in Riau, Sumatra, Indonesia, which has been declared as a “Biosphere Reserve” by UNESCO in 2009. This Giam Siak Kecil-Bukit Batu Biosphere Reserve (GSK-BB) has an area of 1,787 km² and embraces different land use types on the vast tropical landscape which is dominated by peat land. The reserve is divided into three zones, i.e. Core Area, Buffer Zone and Transition Area (Figure 1). The major part of Core Area is two wildlife reserves that are managed by the Indonesian Forest Department, namely Giam Siak Kecil Wildlife Reserve and Bukit Batu Wildlife Reserve. The other part of the Core Area is protected area (“Kawasan Lindung”) of surrounding industrial tree plantation (“Hutan Tanaman Industri” or “HTI”). The Buffer Zone is mostly managed by four industrial tree plantations under Sinar Mas Forestry. Acacia mangium and Eucalyptus pellita are planted in the Giam Siak Kecil area and Acacia crassicarpa are planted in the Bukit Batu area to supply timber for pulp and paper production by Asia Pulp and Paper. The outmost Transition Area is mostly owned and managed by smallholders as small-scale plantations of oil palm and rubber and for other agricultural purposes.

In this study, we aim to assess and evaluate the status of the species composition of mammals and birds in the different land use types on the peat land in Bukit Batu area of GSK-BB. Mammals and birds are faunal groups commonly used as “flag species” for forest management and conservation (Jonsson and Villard 2009; Roberge and Angelstam 2009).

Study area

Bukit Batu area is north-eastern part of GSK-BB. This area is located by the Strait of Malacca, in Bengkalis Regency of Riau Province, Indonesia (Figure 2). The area is about 800 km². The climate of the area belongs to the Zone D (Oldeman et al. in Whitten et al. 2000), which has three to four consecutive wet months and two to six consecutive dry months. The average annual rainfall in Bukit Batu is about 2000 mm (the average during the last 5 years was 2018.2 mm); the minimum air temperature ranges 23-24 ºC and the maximum level ranges 31-33 ºC, while the air humidity is always beyond 80% (PT. BBHA 2011, unpublished data).

The major land use types in this area during the study period (2010-2011) are (1) natural peat swamp forest in Core Area, comprising Bukit Batu Wildlife Reserve and the protected areas within surrounding industrial tree plantations (HTI), (2) planted acacia forest in two industrial tree plantations in Buffer Zone, namely PT. Bukit Batu Hutani Alam (BBHA) and PT. Sakato Pratama Makmur (SPM), and (3) agriculture area in Transition Zone. The natural peat swamp forests in Core Area are in both unlogged and logged conditions, but partly include sparse bush or grassland and rubber stands planted along lower stream of the Bukit Batu River. The Bukit Batu Wildlife Reserve was gazetted in 1986.
(SK.MENHUT No. 173 / KPTS-II / 1986) and in 1999 (SK.MENHUT BUN No. 482 / KPTS-II / 1999), but the riverside forest along the lower Bukit Batu River was heavily logged illegally from 2000 to 2009. The tree spices planted in Buffer Zone is mostly *Acacia crassicarpa*, which is suitable species for swampy soil. There is a network of canals in this plantation that was constructed for water management and water ways. PT. BBHA and PT. SPM manage a total concession area of 460 km² and 322 km², respectively. The acacia trees are planted in as large as 264 km² (57.3%) and 224 km² (69.5%), while protected area (“Kawasan Lindung”) is established in 104 km² (22.6%) and 34 km² (10.7%) in the areas of PT. SPM and PT. BBHA, respectively. The acacia trees are harvested in five years, and nearly 50 km² of planted acacia forest is harvested every year in each plantation. The Buffer Zone was formerly used for selective logging until 1998 and then converted to the industrial tree plantations since 1999. Land use types in Transition Area are smallholder oil palm plantation, rubber garden and rubber jungle, home garden, paddy field, secondary forest dominated by *Macaranga* spp., and degraded bush. Most of the residents are Malay and Javanese who inhabit in this area by the 18th century at the latest. Northern part of the Transition Area has been burned out repeatedly, and most of the areas are still abandoned as degraded bush.
Figure 1. Remaining natural forests in Sumatra and location of Giam Siak Kecil-Bukit Batu Biosphere Reserve (red square) and Bukit Batu area (black square).

Figure 2. Bukit Batu area. Red lines indicate the border of the two industrial tree plantations (HTI), whereas green line indicates the border of the Core Area. Areas surrounded by yellow lines are protected area ("Kawasan Lindung") of the HTI. There are several villages (red circle) along the coast.
Figure 3. Major vegetation types in study area. (From top left) Primary (A) and logged (B) natural forest in the Wildlife Reserve, protected area (C) and planted acacia forest (D) in industrial tree plantation (HTI), resident areas of Desa Sukajadi (E) and Desa Temiang (F).
Methods

Mammal surveys

1. Camera trapping for large mammals
Inventory of middle and large-sized terrestrial mammals was conducted using camera-trap. We chose four plots in the natural peat swamp forest in Bukit Batu Wildlife Reserve, three plots in protected areas within the industrial tree plantation, and three plots in the planted acacia forest (Figure 4). In each plot, we selected five random points inside 500m radius circle and set automatic digital cameras with infrared sensor (Bushnell Trophy Cam, Model 119435) at each point. A camera was set on a tree, 50-100 cm above the ground. The field-of-view of a camera was 2-7 m². The batteries and memory cards were changed every 3-5 months. The recorded animals were identified based on Payne et al. (2005), Duckworth et al. (2009), Sunquist and Sunquist (2002), and Wilson and Mittermeier (2009). The cameras were set from November 2010 to October 2011. The total working camera-days were 671-1316 camera-days in each plot.

2. Live trapping and mist-netting for small mammals
Non-volant small mammals such as rats, squirrels, and treeshrews have been surveyed using live traps in protected areas in the industrial tree plantations in April 2011. Volant mammals, particularly bats were trapped using mist nets in the protected area and the Wildlife Reserve in April and October 2011 (Figure 5). The live trap was a wire cage measuring 25 cm x 10 cm x 10 cm, with a baited hook connected to the door. We used fried coconut smeared with peanut butter as bait to attract animals. We

Figure 4. Study site of mammal camera trapping. Yellow dots indicate plots in which five camera points were set randomly.
established two line-transects and placed 25 baited traps on each transect with interval of 10-15 m. Traps were checked every day in the morning and the baits were replaced when necessary. Each transect was surveyed for eight consecutive nights. The mist-net we used was 12 m long, 2.6 m high and has mesh sizes of 34 and 36 mm. It was supported with 4 shelves and operated at ground level (Figure 6). Four mist-nets were set up at two points in protected area for eight nights and four mist-nets were set up at one point in the Wildlife Reserves for one night. The mist-nets were checked in the morning (at about 6:30 am) and in the evening (between 7:00 to 10:00 pm).

Trapped animals were taken to the camp for detailed examination. Each individual was given identification number, weighed, and measured. The measurements taken for ground and arboreal small mammals were head and body length, ear length, tail length, and hind foot. For bats, we measure the forearm length and tibia length. Immediately after the identification and measurement, most individuals were brought back to the respective capture site and released. Several individuals were taken to Cibinong and processed as scientific museum specimens. These specimens were kept in 8% formaldehyde, but the livers were taken out and preserved separately in 96% ethanol (pro-analysis) for further genetic studies. All voucher specimens are now deposited at the Division of Zoology, Research Center for Biology, Indonesian Institute of Sciences at Cibinong.

Figure 5. Study site of live trapping (blue triangle) and mist-netting (red star).
3. Observation and Interview

Most mammal species of tropical forest ecosystems are difficult to observe directly, since they are sparse, relatively not abundant, very elusive and nocturnal. We therefore combined our trapping effort with indirect observation based on footprint, marking, feces, and other signs, and interview with local people of Desa Temiang.

**Bird Surveys**

1. **Point-counting**

Direct observation of bird using point-count method was conducted along twelve transects. There were three transects in the Wildlife Reserve, planted acacia forest, rubber jungle and residential area respectively (Figure 7). Four points were set at interval of 250 m along each transect and every bird species that was seen or heard within 25 m radius for 20 minutes were record. At each point, survey was done in the morning (6:00-10:00) and in the evening (14:00-18:00). The survey was conducted in March, May, and October 2011.

**Figure 6.** A series of five mist-nets set in the protected area of HTI.
**Figure 7.** Study site for bird survey by point counting. Green hexagons indicate transects with four observation points.

2. **Mist-netting**

Mist-nets were also used to record understory bird communities. We set up 14 mist-nets in the protected area of HTI in April 2011 and 20 mist-nets in the Wildlife Reserves in October 2011. The mist-nets were operated for three days in each observation site. The mist-nets were checked every hour from about 5:30 to 17:00. Caught birds were identified, measured, photographed, ringed and released. For future identification purpose, we attached metal ring with identification number on it (Figure 8).

**Figure 8.** Metal ring with specific code was attached on bird tarsus

**Nomenclature**

**Mammals**

Identification and taxonomical order followed Francis (2008), Rowe (1996), and Payne *et al.* (2005)

**Birds**


**Results and Discussion**

**Mammals**

In total, 19 species of middle and large-sized mammals were detected using camera trapping, and five species (mostly primates) were observed directly and eight species were caught by live trapping and mist-netting. In addition, even though we could not find direct clue of the presence in this study, the inhabitation of Sumatran Tiger (*Panthera tigris sumatrae*) in this area was no doubt as locals and plantation workers informed. Among the detected species, Hairy-nosed Otter (*Lutra sumatrana*) is a new distribution record of the species.

There were several middle mammal species whose inhabitances are not confirmed; Western Tarsier (*Tarsius bancanus*), White-thighed Surili (*Presbytis siamensis*), Siamang (*Symphalangus syndactylus*) and Fishing Cat (*Prionailurus viverrinus*). Further study is necessary on these species. Comparing with camera-trapping, the efforts made for live trapping (400 trap nights) and mist-netting (68 mist-net days) were insufficient; therefore more small mammal species are expected to be discovered if we continue the survey.

Giesen and Balen (1991) conducted biodiversity survey in Giam Siak Kecil Wildlife Reserve of GSK-BB where mineral soil is more dominant. In comparison with their findings, we did not detect Sambar Deer (*Rusa unicolor*), Asian Elephant (*Elephas maximus*), and Tapir (*Tapirus indicus*) in this study area. It is also notable that we did not detect other common species in Sumatra such as Barking Deer (*Muntiacus* sp.) and Porcupine (*Hystrix brachyura* and *Trichys fasciculata*). Peat swamp forest is considered to be not good habitat for these species.

In this study, species composition in planted acacia forest was quite different from that in natural peat swamp forest, despite the fact that they stood side by side. Among the 19 species we detected by camera-trapping, 13 species were detected only in natural forest (Wildlife Reserve and protected area), while species detected only in acacia forest is only Common Palm Civet (*Paradoxurus hermaphroditus*). The species that were detected only in natural forests include many endangered and elusive species such as Sun Bear (*Helarctos malayanus*), Clouded Leopard (*Neofelis diardi*) and
Marbled Cat (*Pardofelis marmorata*), indicating the irreplaceable value of the remaining natural forest.

**Birds**

A total of 172 species of birds was recorded from 204 mist-net days, 3,720 minutes of point count survey, camera-trapping and other observations. It covers 43.3% of 397 resident bird species recorded in Sumatra (MacKinnon and Phillipps 1993).


There was a significant difference of bird species composition between the natural peat swamp forest (Wildlife Reserve and protected area) and the artificially-modified vegetations (planted acacia forest, rubber jungle and resident area). The distinctive species groups in natural forest were Trogons (*Harpactes* spp.), Leafbirds (*Chloropsis* spp.), some Bulbuls (*Setornis criniger, Trcholestes criniger, Ixos malaccensis*), many kinds of Babblers (*Pellorneum capistratum, Trichastoma* spp., *Malacocincla* spp., *Malacopteron* spp., *Stachyris* spp.), and Flycatchers (*Rhinomyias umbratilis, Philentoma pyrhopoeta*). Natural peat swamp forest was also home to some winter migrant visitor as *Ficedula zanthopygia, Pericrocotus divaricatus* and *Phylloscopus borealis*. By contrast, the bird fauna in planted acacia forest, rubber jungle and village were more characterized by some open land Bulbuls (*Pycnonotus aurigaster and Pycnonotus goiavier*), Prinias (*Prinia* spp.), and Munias (*Lonchura* spp.). In addition, winter migrant visitor, *Pernis ptilorhynchus* was present mainly in resident area, where it was seen in sheer numbers (more than 100 individuals per day) in March and October. This species is known to pass Rupat Island, north of Bukit Batu area, during their migration (Sukmantoro 2006), and it appeared that Bukit Batu was also situated in their migration route. Some Kingfishers (*Alcedo meninting, Pelargopsis capensis* and *Halcyon smyrnensis*) seem to be more associated with acacia forests and village areas, where they could hunt small fish and other aquatic animals in canals and ponds. The species that were common in all land-use types were Blue-eared Barbet (*Megalaima australis*), Cream-vented Bulbul (*Pycnonotus simplex*), and Red-eyed Bulbul (*Pycnonotus sinica*).

Compared to the species list in Giam Siak Kecil Wildlife Reserve by Giesen and Balen (1991), 91 species out of the 172 species detected in this study were not recorded by them; these species were
mostly forest species such as Hornbills, Trogons, Babblers, and Bulbuls. On the contrary, 42 species out of 121 species they detected were not observed in our study site; they were mostly raptors, water birds and open-habitat species. We did not encounter water birds as Milky Stork, Storm’s Stork and Lesser Adjutants; possibly because we focused more on the terrestrial habitat, where such species were less likely to be spotted. However, the possibility of the effect of habitat degradation during the last two decades in this area on these endangered species should also be considered. Continuous survey in the Giam Siak Kecil and Bukit Batu area will help to clarify this point.

Danielsen and Heegaard (1995) recorded 192 bird species in primary and disturbed forest on mineral soil in Bukit Tigapuluh area, in the southern part of Riau. Comparing with their result, it seems that some common or not uncommon species out of the 192 species they detected were absent in our study area. The possible reasons of the lack of the species could be (1) the limited effort of our field survey, (2) differences of observers, (3) habitat degradation, and (4) ecological and environmental factors of peat swamp ecosystem. The third and fourth points suggest the importance to understand biodiversity in peat land ecosystems and its response to human disturbance.

**Conclusion**

Although Bukit Batu area seems to lack some part of common species, we conclude that the natural forest in the Core Area is the home of many forest-dependent mammal and bird species, some of which are at a risk of population decline. Considering that the land uses in surrounding landscape are changing rapidly, there is an urgent need to conserve the forest in the Core Area and to study further about the function and resilience of peat swamp forest ecosystem.

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List of recorded mammals and birds

Mammals

Observed mammal species are listed below with scientific name, English name, distribution, endangered status on IUCN Red List 2011 (IUCN 2011) and some comments on the status of the species in the study area. Detailed presence / absence data is shown in Appendix 1. The species ID in the following section is identical to the ID in Appendix 1.

Family ERINACEIDAE

1. *Echinosorex gymnura*
   Moonrat
   Distribution: Burma, Peninsular Thailand and Malaysia, Sumatra, and Borneo
   Endangered status: Least concern
   Recorded by camera-trap only in natural forest (the protected area and the Wildlife Reserve).

2. *Crocidura monticola*
   Sunda Shrew
   Distribution: Indonesia, and Malaysia
   Endangered status: Least concern
   Taken by live trap in natural forest (the protected area).
Family TUPAIIDAE

3. *Tupaia glis*
   - Common Tree shrew
   - Distribution: Indonesia, Malaysia, and Thailand
   - Endangered status: Least concern
   Taken by live-trap in natural forest (the protected area).

Family PTERROPODIDAE

4. *Cynopterus brachyotis*
   - Short-nosed Fruit bat
   - Distribution: China, India, Laos, Myanmar, Sri Lanka, Thailand, Viet Nam, Malaysia, Singapore, Sumatera, and Sulawesi
   - Endangered status: Least concern
   Taken by mist-net in natural forest (the protected area and the Wildlife Reserve).
5. *Balionycteris maculata*
   Spotted-winged Fruit bat
   Distribution: Indonesia, Malaysia, and Thailand
   Endangered status: Least concern
   Taken by mist-net in natural forest (the protected area and the Wildlife Reserve).

6. *Manis javanica*
   Sunda Pangolin
   Distribution: Myanmar, Thailand, Laos, Vietnam, Cambodia, Peninsular Malaysia, Sumatra, Java and Borneo
   Endangered status: Endangered
   Recorded by camera-trap only in natural forest (the protected area and the Wildlife Reserve).

**Family MANIDAE**
Family LORISIDAE

7. *Nycticebus coucang*
   Slow Loris
   Distribution: Peninsular Malaysia and Sumatra
   Endangered status: Vulnerable

This species is arboreal. One accidental photo was taken and also directly observed in natural forest (the protected area).

*Tarsius bancanus*?
   Western Tarsier
   Distribution: South Sumatra and Borneo
   Endangered status: Vulnerable

One of the authors (YSF) heard a sound like this species in natural forest (the protected area). The local also informed their inhabitance in natural forest. Further study is necessary to confirm their inhabitance. According to IUCN (2011), the species is only known in Southeastern Sumatra and Bangka Island.

Family CERCOPITHECIDAЕ
8. *Presbytis femoralis percura*
   
   **Banded Langur / Banded Surili**
   
   Distribution: Endemic to Riau (between the Rokan and Siak River)
   
   Endangered status: Near threatened
   
   This species are arboreal. Three accidental photos were taken only at one camera setting-point in the protected area. One of the authors (AM) saw this species a few times in village area (Along the course Bukit Batu River, from the village to the border of BBWR and in rubber jungle in Temiang and Bukit Batu).
   
   Because their distribution range is very small and GSK-BB Biosphere Reserve is the main natural forest in it, this Biosphere Reserve is very valuable to population viability of this species.

![Banded Langur](image)

9. *Presbytis siamensis*?
   
   **White-thighed Surili**
   
   Distribution: Peninsular Malaysia, and Sumatra
   
   Endangered status: Near threatened
   
   One of the authors (YSF) observed a monkey like this species and took a picture in a rubber forest in village area. However, that individuals might be a *Presbytis femoralis percura*. Anothor author (AM) never observed this species during his study in this area for a several years. Further study is necessary to confirm the presence of this spices in this area. According to IUCN (2011), the know distribution range of this spices in Sumatra is east of the Siak river and does not include this area.

![White-thighed Surili](image)

9. *Trachypithecus cristatus*
Silvery lutung
Distribution: Peninsular Malaysia, Sumatra, and Borneo
Endangered status: Near threatened
Directly observed in natural forest (the protected area) and a rubber forest in village area. One of the author (AM) also saw a dead one hit by a car on Bukit Batu road.

10. *Macaca fascicularis*
Long-tailed Macaque / Crab-eating Macaque
Distribution: Laos, Myanmar, Thailand, Cambodia, Viet Nam, Peninsular Malaysia, Singapore, Sumatera, Java, Nusa Tenggara, Borneo, and Philippine
Endangered status: Least concern
Directly observed in natural forest (the protected areas) and in a rubber forest in village area.

11. *Macaca nemestrina*
Southern Pig-tailed Macaque
Distribution: Peninsular Malaysia, Sumatra and Borneo
Endangered status: Vulnerable
Recorded by camera-trap in all three habitats. Directly observed also in the protected area and village area.

12. *Hylobates agilis*
Agile Gibbon
Distribution: Peninsular Malaysia, and Sumatra
Endangered status: Endangered
Directly observed in natural forest (the protected area of Humus).

_Symphalangus syndactylus_
Siamang
Distribution: Peninsular Malaysia, and Sumatra
Endangered status: Endangered
An assistant of one of the authors (YSF) observed a monkey like this species in natural forest (the protected area of Makmur). However, another author (AM) never observed this species during his study in this area for several years even though he studied mostly in village area. Further study is necessary to confirm the presence of this species in this area.

**Family MANIDAE**

13. _Ratufa affinis_
Pale Giant Squirrel
Distribution: Peninsular Malaysia, Sumatra, and Borneo
Endangered status: Near threatened
Direct observation in natural forest (the protected area).

14. _Petinomys setosus_
Termminck’s Flying Squirrel
Distribution: Peninsular Malaysia, Sumatra, and Borneo
Endangered status: Vulnerable
Taken by mist-net accidentally in early morning in natural forest (the protected area).

**Family MURIDAE**
15. *Sundamys sp.*

*Sundamys*

Taken by live-trap in natural forest (the protected area).

This species is difficult to identify.

16. *Maxomys whiteheadi*

*Whitehead’s Spiny Rat*

Distribution: Peninsular Malaysia, Sumatra, and Borneo

Endangered status: Vulnerable

Taken by live-trap in natural forest (the protected area).

17. *Maxomys sp.*

*Spiny Rat*

An individual was taken by live-trap in natural forest (the protected area). This individual is still in analysis to identification.
Family URSIDAE

18. *Helarctos malayanus*
   
   Sun Bear
   
   Distribution: Myanmar, Thailand, Cambodia, Laos, Vietnam, Yunnan, Peninsular Malaysia, Sumatra and Borneo
   
   Endangered status: Vulnerable

Recorded by camera trap mostly in natural forest (the protected area and the Wildlife Reserve). Footprints and ex-bedding site (a big hole of tree with footprints and urine) were also observed in natural forest (the protected area).

Family MUSTELIDAE

19. *Mustela flavigula*
   
   Yellow Throated Marten
   
   Distribution: China, Korea, Nepal, India, Myanmar, Thailand, Cambodia, Laos, Vietnam, Peninsular Malaysia, Sumatra, Java and Borneo
   
   Endangered status: Least concern

Recorded by camera-trap only in natural forest (the protected area and the Wildlife Reserve). Directly
observed in rubber jungle and smallholder’s oil palm plantation.

20. *Lutra sumatrana*
    Hairy-nosed Otter
    Distribution: Myanmar, Cambodia, Vietnam, Peninsular Thailand and Malaysia, South Sumatra, Borneo
    Endangered status: Endangered
    New distribution record
One of the authors (AM) observed a dead individual on Bukit Batu road. Because this species is an endangered species and very little is known about the ecology, further study is necessary.

Family VIVERRIDAE

21. *Viverra tangalunga*
    Malay Civet
    Distribution: Peninsular Malaysia, Sumatra, Java, Borneo, Philippine and Sulawesi.
    Endangered status: Least concern
Recorded by camera-trap in all three habitats.
22. *Arctogalidia trivirgata*
   Small-toothed Palm Civet
   Distribution: Myanmar, Thailand, Cambodia, Laos, Vietnam, Yunnan, Peninsular Malaysia, Sumatra and Borneo
   Endangered status: Least concern
   Only two records in the Wildlife Reserve. Some photos were difficult to distinguish with *Paradoxurus hermaphroditus*.

23. *Paradoxurus hermaphroditus*
   Common Palm Civet
   Distribution: India, Bangladesh, China, Myanmar, Thailand, Cambodia, Laos, Vietnam, Yunnan, Peninsular Malaysia, Sumatra, Borneo, Java and Philippines
   Endangered status: Least concern
   Only 3 photos were taken in Acacia forest. Some photos were difficult to distinguish with *Arctogalidia trivirgata*. 
24. *Arctictis binturong*

Binturong

Distribution: India, Bhutan, China, Myanmar, Thailand, Cambodia, Laos, Vietnam, Yunnan, Peninsular Malaysia, Sumatra, Borneo, West Java and Palawan

Endangered status: Vulnerable

Only one photo in natural forest (the protected area).

25. *Hemigalus derbianus*

Banded Palm Civet

Distribution: Peninsular Malaysia, Sumatra and Borneo

Endangered status: Vulnerable

Recorded by camera-trap only in natural forest (the protected area and the Wildlife Reserve).
26. *Prionodon linsang*
   Banded Linsang
   Distribution: Malay Peninsula, Sumatra, Borneo and patchily in Java
   Endangered status: Least concern
   Recorded by camera-trap only in natural forest (the protected area and the Wildlife Reserve).

27. *Herpestes brachyurus*
   Short-tailed Mongoose
   Distribution: Malay Peninsula, Sumatra, Borneo and Palawan
   Endangered status: Least concern
   Recorded by camera-trap only in natural forest (the protected area).

Family FELIDAE

28. *Neofelis diardi*
   Sunda Clouded Leopard
   Distribution: Sumatra and Borneo
   Endangered status: Vulnerable
   Recorded only one photo by camera-trap in the Wildlife Reserves.
29. *Panthera tigris sumatrae*
   Sumatran Tiger
   Distribution: Sumatra
   Endangered status: Critically endanger
   Sumatran Tiger were seen by laborers when they harvested the acacia trees (one individual in the night and 2 cubs in afternoon) when one of the authors (YSF) stayed in the area. However, because they were not detected by camera-trap in spite of our huge study effort (10,988 camera-days in total), the population density is considered very low.

30. *Pardofelis marmorata*
   Marbled Cat
   Distribution: Nepal, India, China, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malay Peninsula, Sumatra and Borneo
   Endangered status: Vulnerable
   Recorded by camera-trap only in natural forest (the protected area and the Wildlife Reserve).

31. *Prionailurus bengalensis*
   Leopard Cat
   Distribution: Nepal, India, China, Korea, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malay Peninsula, Sumatra, Borneo, Java and Philippines
   Endangered status: Least concern
Recorded by camera-trap in all three habitats. A dead individual was observed on Bukit Batu road.

**Prionailurus viverrinus**

- Fishing Cat
- Distribution: Nepal, India, Myanmar, Thailand, Laos, Cambodia, Vietnam and Java
- Endangered status: Endangered

The presence of fishing cat in Sumatra is questionable (Duckworth *et al.*, 2009) and no photo of fishing cat was taken by camera-trap. However, feces of wild cat with fish scales were founded along a canal, suggesting the presence of this species. Further research is necessary.

**Family SUIDAE**

32. *Sus scrofa* & *Sus barbatus oi*

- Wild Boar & Bearded Pig
- Distribution: Europe, mainland Asia, Sumatra and Java (*S. scrofa*), Malay Peninsula and Sumatra (*S. barbatus oi*)
- Endangered status: Least concern (*S. scrofa*) & vulnerable (*S. barbatus oi*)

Wild Pig was the most frequently photographed animal in this study area. It was fairly common in all types of land use surveyed in this study. However, in some pictures, it was difficult to identify the species. There were individuals in the pictures that could be readily identified either as the common Wild Boar *Sus scrofa* or the rarer Bearded Pig *Sus barbatus oi*. Other individuals showed similarities
with both. We suspect, they were probably the hybrid between both species. However, there is so far no report about natural hybridization between them in the wild, although it did happen in captivity.

Local people distinguished two types of Wild Pig, namely “Celeng” and “Nangor”. The “Celeng” which is rather smaller and has greyish hide with black fur, could be found everywhere in the area, particularly in gardens and agricultural sites. The “Nangor” which is slightly bigger and has lighter hide with brownish fur, is more likely to be encountered in forested sites. The former and the latter are believed to correspond Sus barbatus and Sus scrofa, respectively.

In addition, local people also mentioned about “Babi Bakau” which literally means “Mangrove Pig”. According to their description, it looked very much like the “common wild pig” or S. scrofa, but much smaller in size. Some said the adult “Babi Bakau” is only about ¾ the size of adult S. scrofa. If the description of the locals was correct, then there might be a ‘variant’ of S. scrofa that is specially adapted to mangrove habitat. Being smaller (and lighter) could be more advantageous in such muddy habitat full of entangling roots. However, this information deserves further verifications.
31. *Tragulus kanchil*

   Lesser Mouse-deer

   Distribution: Myanmar, Thailand, Laos, Cambodia, Vietnam, Malay Peninsula, Sumatra and Borneo

   Endangered status: Least concern

Two species of mouse-deer (*T. kanchil* and *T. napu*) distribute in Sumatra, but only *T. kanchil* was recorded by camera-trap only in natural forest (the protected area and the Wildlife Reserve). Their footprints were also detected in natural forest (the protected area).
**Birds**

Observed bird species are listed below with scientific name, English name, Indonesian name, and endangered status on IUCN Red List 2011 (IUCN 2011). Detailed presence / absence data is shown in Appendix 2. The species ID in the following section is identical to the ID in Appendix 2.

**HERONS (FAMILY ARDEIDAE)**

/ CANGAK

1. *Ardea sumatrana*  
   Great-billed Heron  
   Cangak laut  
   Least Concern

2. *Ardea purpurea*  
   Purple Heron  
   Cangak merah  
   Least Concern

3. *Butorides striata*  
   Striated Heron  
   Kokokan laut  
   Least Concern

4. *Ixobrychus sinensis*  
   Yellow Bittern  
   Bambangan kuning  
   Least Concern

5. *Ixobrychus cinnamomeus*  
   Cinnamon Bittern  
   Bambangan merah  
   Least Concern

**HAWKS AND EAGLES (FAMILY ACCIPITRIDAE)**

/ ELANG

6. *Pandion haliaetus*  
   Osprey  
   Elang tiram  
   Least Concern

7. *Pernis ptilorhynchus*  
   Oriental Honey-Buzzard  
   Sikep-madu asia  
   Least Concern
8. *Elanus caeruleus*
Black-winged Kite Elang tikus Least Concern

9. *Spilornis cheela*
Crested Serpent Eagle Elang-ular bido Least Concern

10. *Accipiter soloensis*
Chinese Goshawk Elang-alap cina Least Concern

FALCONS (FAMILY FALCONIDAE)
/ ALAP-ALAP

11. *Microhierax fringillarius*
Black-thighed Falconet Alap-alap capung Least Concern

PHEASANTS (FAMILY PHASIANIDAE)
/ PUYUH, SEMPIDAN, KUAU, MERAK
12. *Melanoperdix niger*
Black Partridge Puyuh hitam  Vulnerable

13. *Lophura erythrophthalma*
Crestless Fireback Sempidan merah  Vulnerable

14. *Gallus gallus*
Red Junglefowl Ayam-hutan merah  Least Concern

15. *Turnix suscitator*
Barred Buttonquail Gemak loreng  Least Concern
RAILS (FAMILY RALLIDAE)  
/ AYAM-AYAMAN

16. *Amaurornis phoenicurus*  
White-breasted Waterhen  Kareo padi  Least Concern

PAINTED SNIPES (FAMILY ROSTRATULIDAE)  
/ BERKIK-KEMBANG

17. *Rostratula benghalensis*  
Greater Painted Snipe  Berkik-kembang besar  Least Concern

SANDPIPERS (FAMILY SCOLOPACIDAE)  
/ TRINIL-TRINILAN

18. *Tringa hypoleucos*  
Common Sandpiper  Trinil pantai  Least Concern

19. *Gallinago stenura*  
Pintail Snipe  Berkik ekor-lidi  Least Concern

PIGEONS AND DOVES (FAMILY COLUMBIDAE)  
/ MERPATI-MERPATIAN

20. *Treron curvirostra*  
Thick-billed Green Pigeon  Delimukan puyuh  Least Concern
21. *Treron vernans*  
Pink-necked Green Pigeon  
Punai gading  
Least Concern

22. *Ducula aenea*  
Green Imperial Pigeon  
Pergam hijau  
Least Concern

23. *Streptopelia chinensis*  
Spotted Dove  
Tekukur biasa  
Least Concern

24. *Geopelia striata*  
Zebra Dove  
Perkutut jawa  
Least Concern

PARROTS (FAMILY PSITTACIDAE)  
/ BURUNG PARUH BENGKOK

25. *Psittacula longicauda*  
Long-tailed Parakeet  
Betet ekor-panjang  
Near Threatened

26. *Psittinus cyanurus*  
Blue-rumped Parrot  
Nuri tanau  
Near Threatened

27. *Loriculus galgulus*  
Blue-crowned Hanging Parrot  
Serindit melayu  
Least Concern

CUCKOOS (FAMILY CUCULIDAE)  
/ KANGKOK
28. *Cacomantis merulinus*  
   Plaintive Cuckoo Wiwik kelabu Least Concern

29. *Surniculus lugubris*  
   Drongo Cuckoo Kedasi hitam Least Concern

30. *Phaenicophaeus diardi*  
   Black-bellied Malkoha Kadalan beruang Near Threatened

31. *Phaenicophaeus chlorophaeus*  
   Raffles's Malkoha Kadalan selaya Least Concern

32. *Centropus sinensis*  
   Greater Coucal Bubut besar Least Concern

33. *Centropus bengalensis*  
   Lesser Coucal Bubut alang-alang Least Concern

**OWLS (FAMILY STRIGIFORMES) / BURUNG HANTU**

34. *Otus lempiji*  
   Collared Scops-owl Celepuk reban Least Concern

**NIGHTJARS (FAMILY CAPRIMULGIDAE) / CABAK**

35. *Caprimulgus macrurus*  
   Large-tailed Nightjar Cabak maling Least Concern

36. *Caprimulgus affinis*  
   Savanna Nightjar Cabak kota Least Concern

**SWIFTS (FAMILY APODIDAE) / WALET**
37. *Collocalia fuciphagus*  
Edible-nest Swiftlet  
Walet sarang-putih  
Least Concern

**TREESWIFTS (FAMILY HEMIPROCNIDAE)  
/ TEPEKONG**

38. *Hemiprocne comata*  
Whiskered Treeswift  
Tepekong rangkang  
Least Concern

**TROGONS (FAMILY TROGONIDAE)  
/ LUNTUR**

39. *Harpactes kasumba*  
Red-naped Trogon  
Luntur kasumba  
Near Threatened

40. *Harpactes diardi*  
Diard's Trogon  
Luntur diard  
Near Threatened

41. *Harpactes duculae*  
Scarlet-rumped Trogon  
Luntur putri  
Near Threatened

**KINGFISHERS (FAMILY ALCEDINIDAE)  
/ RAJA-UDANG**

42. *Alcedo atthis*  
Common Kingfisher  
Raja-udang erasia  
Least Concern
43. *Alcedo meninting*
   Blue-eared Kingfisher  Raja-udang meninting  Least Concern

44. *Ceyx erithaca*
   Black-backed Kingfisher  Udang api  Least Concern

45. *Ceyx rufidorsa*
   Rufous-backed Kingfisher  Udang api  Least Concern

46. *Pelargopsis capensis*
   Stork-billed Kingfisher  Pekaka emas  Least Concern

47. *Halcyon coromanda*
   Ruddy Kingfisher  Cekakak merah  Least Concern
48. *Halcyon smyrnensis*
   White-throated Kingfisher Cekakak belukar  Least Concern

**BEE-EATERS (FAMILY MEROPIDAE)**
/ KIRIK-KIRIK

49. *Merops philippinus*
   Blue-tailed Bee-eater   Kirik-kirik laut  Least Concern

50. *Merops viridis*
   Blue-throated Bee-eater  Kirik-kirik biru  Least Concern

**HORNBILLS (FAMILY BUCEROTIDAE)**
/ ENGGANG

51. *Aceros corrugatus*
   Wrinkled Hornbill  Julang jambul hitam  Near Threatened
52. *Aceros undulatus*
   Wreathed Hornbill    Julang emas    Least Concern

53. *Anthracoceros malayanus*
   Asian Black Hornbill  Kangkareng hitam    Near Threatened

54. *Anthracoceros albirostris*
   Oriental Pied Hornbill  Kangkareng perut-putih    Least Concern

55. *Buceros rhinoceros*
   Rhinoceros Hornbill  Enggang cula    Near Threatened

56. *Buceros bicornis*
   Great Hornbill  Enggang papan    Near Threatened

57. *Buceros vigil*
   Helmeted Hornbill  Rangkong gading    Near Threatened

BARBETS (FAMILY CAPITONIDAE)
/TAKUR

58. *Megalaima rafflesii*
   Red-crowned Barbet  Takur tutut    Near Threatened

59. *Megalaima mystacophanos*
   Red-throated Barbet  Takur warna-warni    Near Threatened

60. *Megalaima australis*
   Blue-eared Barbet  Takur tenggeret    Least Concern

61. *Caloramphus fuliginosus*
   Brown Barbet  Takur ampis    Least Concern
WOODPECKERS (FAMILY PICIDAE) / PELATUK

62. *Sasia abnormis*
    Rufous Piculet  Tukik tikus  Least Concern

63. *Celeus brachyurus*
    Rufous Woodpecker  Pelatuk kijang  Least Concern

64. *Picus vittatus*
    Laced Woodpecker  Pelatuk hijau  Least Concern
65. *Picus puniceus*
   Crimson-winged Woodpecker  Pelatuk sayap-merah Least Concern

66. *Picus miniaceus*
   Banded Woodpecker  Pelatu mearh

67. *Meiglyptes tristis*
   Buff-rumped Woodpecker Caladi batu  Least Concern

68. *Meiglyptes tukki*
   Buff-necked Woodpecker Caladi badok  Near Threatened

69. *Dryocopus javensis*
   White-bellied Woodpecker  Pelatuk ayam  Least Concern

70. *Blythipicus rubiginosus*
   Maroon Woodpecker  Pelatuk pangkas  Least Concern

71. *Reinwardtipicus validus*
   Orange-backed Woodpecker  Pelatuk kundang  Least Concern
BROADBILLS (FAMILY EURYLAIMIDAE)
/ MADI

72. *Eurylaimus ochromalus*
Black-and-yellow Broadbill Sempur-hujan darat Near Threatened

SWALLOWS (FAMILY HIRUNDINIDAE)
/LAYANG-LAYANG

73. *Hirundo rustica*
Barn Swallow Layang-layang api Least Concern

74. *Hirundo tahitica*
Pacific Swallow Layang-layang batu Least Concern

75. *Hirundo striolata*
Striated Swallow Layang-layang loreng

76. *Delichon dasypus*
Asian House Martin Layang-layang rumah Least Concern

CUCKOO-SHRIKES (FAMILY CAMPEPHAGIDAE)
/BENTET-KEDASI

77. *Hemipus hirundinaceus*
Black-winged Flycatcher-shrike Jingjing batu Least Concern

78. *Coracina fimbriata*
Lesser Cuckoo-shrike Kepudang-sungu kecil Least Concern

79. *Lalage nigra*
Pied Triller Kapasan kemiri Least Concern

80. *Pericrocotus divaricatus*
Ashy Minivet Sepah padang Least Concern

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81. *Pericrocotus igneus*  
Fiery Minivet Sepah tulin Near Threatened

**LEAFBIRDS (FAMILY CHLOROPSEIDAE) / CICA-DAUN**

82. *Aegithina viridissima*  
Green Iora Cipoh jantung Near Threatened

83. *Aegithina tiphia*  
Common Iora Cipoh kacat Least Concern

84. *Chloropsis cyanopogon*  
Lesser Green Leafbird Cica-daun kecil Near Threatened

85. *Chloropsis sonnerati*  
Greater Green Leafbird Cica-daun besar Least Concern

86. *Chloropsis cochinchinensis*  
Blue-winged Leafbird Cica-daun sayap-biru Least Concern

**BULBULS (FAMILY PYCNONOTIDAE) / CUCAK-CUCAKAN**

87. *Pycnonotus atriceps*  
Black-headed Bulbul Cucak kuricang Least Concern
<table>
<thead>
<tr>
<th>Number</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>88.</td>
<td><em>Pycnonotus melanicterus</em></td>
<td>Black-crested Bulbul</td>
<td>Cucak kuning</td>
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<tr>
<td>89.</td>
<td><em>Pycnonotus aurigaster</em></td>
<td>Sooty-headed Bulbul</td>
<td>Cucak Kutilang</td>
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<tr>
<td>90.</td>
<td><em>Pycnonotus eutilotus</em></td>
<td>Puff-backed Bulbul</td>
<td>Cucak rumbai-tungging</td>
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<tr>
<td>91.</td>
<td><em>Pycnonotus goiavier</em></td>
<td>Yellow-vented Bulbul</td>
<td>Merbah cerukcuk</td>
</tr>
<tr>
<td>92.</td>
<td><em>Pycnonotus plumosus</em></td>
<td>Olive-winged Bulbul</td>
<td>Merbah belukar</td>
</tr>
<tr>
<td>93.</td>
<td><em>Pycnonotus simplex</em></td>
<td>Cream-vented Bulbul</td>
<td>Merbah corok-corok</td>
</tr>
<tr>
<td>94.</td>
<td><em>Pycnonotus brunneus</em></td>
<td>Red-eyed Bulbul</td>
<td>Merbah mata-merah</td>
</tr>
</tbody>
</table>
95. *Pycnonotus erythropthalmos*
Spectacled Bulbul  Merbah kacamata  Least Concern

96. *Setornis criniger*
Hook-billed Bulbul  Empuloh paruh-kait  Vulnerable

97. *Tricholestes criniger*
Hairy-backed Bulbul  Brinji rambut-tunggir  Least Concern
98. *Ixos malaccensis*
   Streaked Bulbul  Brinji bergaris  Near Threatened

**DRONGOS (FAMILY DICRURIDAE)**
/ SRIGUNTING

99. *Dicrurus annectans*
   Crow-billed Drongo  Srigunting gagak  Least Concern

100. *Dicrurus remifer*
    Lesser Racket-tailed Drongo  Srigunting bukit  Least Concern

101. *Dicrurus paradiseus*
    Greater Racket-tailed Drongo  Srigunting batu  Least Concern

**ORIOLES (FAMILY ORIOLIDAE)**
/ KEPUDANG

102. *Oriolus chinensis*
    Black-naped Oriole  Kepudang kuduk-hitam  Least Concern

103. *Irena puella*
    Asian Fairy-bluebird  Kecembang gadung  Least Concern

**CROWS (FAMILY CORVIDAE)**
/ GAGAK-GAGAKAN
104. *Corvus enca*
Slender-billed Crow       Gagak hutan       Least Concern

BABBLERS (FAMILY TIMALIIDAE)  
/ BURUNG PENGOCEH

105. *Pellorneum capistratum*
Black-capped Babbler       Pelanduk topi-hitam Least Concern

106. *Trichastoma rostratum*
White-chested Babbler       Pelanduk merah       Near Threatened
107. *Trichastoma bicolor*
Ferruginous Babbler    Pelanduk merah    Least Concern

108. *Malacocincla malaccensis*
Short-tailed Babbler    Pelanduk dada-putih    Near Threatened

109. *Malacocincla abbotti*
Abbott's Babbler    Pelanduk asia    Least Concern

110. *Malacopteron magnirostre*
Moustached Babbler    Asi kumis    Least Concern

111. *Malacopteron affine*
Sooty-capped Babbler    Asi topi-jelaga    Near Threatened
112. *Malacopteron cinereum*
Scaly-crowned Babbler  Asi topi-sisik  Least Concern

113. *Malacopteron magnum*
Rufous-crowned Babbler  Asi besar  Near Threatened

114. *Malacopteron albogulare*
Grey-breasted Babbler  Asi dada-kelabu  Near Threatened
115. *Stachyris maculata*
Chestnut-rumped Babbler Tepus tunggir-merah Near Threatened

116. *Stachyris nigricollis*
Black-throated Babbler Tepus kaban Near Threatened

117. *Stachyris erythroptera*
Chestnut-winged Babbler Tepus merbah-sampah Least Concern
118. *Macronous gularis*
Striped Tit-Babbler  Ciung-air coreng  Least Concern

119. *Macronus ptilosus*
Fluffy-backed Tit-Babbler Ciung-air pongpong  Near Threatened

THRUSHES (FAMILY TURDIDAE) / BURUNG CACING

120. *Copsychus saularis*
Magpie Robin  Kucica kampung  Least Concern

121. *Copsychus malabaricus*
White-rumped Shama  Kucica hutan  Least Concern

122. *Trichixos pyrropygus*
Rufous-tailed Shama  Kucica ekor-kuning  Near Threatened
123. *Turdus obscurus*
   Eyebrowed Thrush       Anis kuning       Least Concern

**OLD WORLD WARBLERS (FAMILY SYLVIIDAE)**
/ BURUNG PENGICAU /

124. *Gerygone sulphurea*
   Golden-bellied Gerygone Remetuk laut       Least Concern

125. *Phylloscopus borealis*
   Arctic Warbler Cikrak kutub       Least Concern

126. *Orthotomus ruficeps*
   Ashy Tailorbird Cinemen kelabu       Least Concern

127. *Orthotomus sericeus*
   Rufous-tailed Tailorbird Cinemen merah       Least Concern
128. *Prinia flaviventris*
   Yellow-bellied Prinia  Perenjak rawa  Least Concern

129. *Prinia familiaris*
   Bar-winged Prinia  Perenjak jawa  Least Concern

OLD WORLD FLYCATCHERS (FAMILY MUSCICAPIDAE)
/ SIKATAN DUNIA LAMA

130. *Rhinomyias umbratilis*
   Grey-chested Jungle Flycatcher  Sikatan-rimba dada-kelabu  Near Threatened

131. *Muscicapa dauurica*
   Asian Brown Flycatcher  Sikatan bubik  Least Concern

132. *Ficedula zanthopygia*
   Yellow-rumped Flycatcher  Sikatan emas  Least Concern
133. **Muscicapella hodgsoni**
   - Pygmy Blue-Flycatcher
   - Sikatan kerdil
   - Least Concern

134. **Rhipidura javanica**
   - Pied Fantail
   - Kipasan belang
   - Least Concern

135. **Hypothymis azurea**
   - Black-naped Monarch
   - Kehicap ranting
   - Least Concern

136. **Philentoma pyrhoptera**
   - Rufous-winged Philentoma
   - Philentoma sayap-merah
   - Least Concern
137. *Terpsiphone atrocaudata*
Japanese Paradise Flycatcher Seriwang jepang Near Threatened

138. *Terpsiphone paradisi*
Asian Paradise Flycatcher Seriwang asia Least Concern

WHISTLERS (FAMILY PACHYCEPHALIDAE)
/ KANCILAN

139. *Pachycephala grisola*
Mangrove Whistler Kancilan bakau Least Concern
PIPITS AND WAGTAILS (FAMILY MOTACILLIDAE)  
/ KICUIT DAN APUNG

140. Motacilla flava  
Yellow Wagtail Kicuit kerbau  Least Concern

141. Dendronanthus indicus  
Forest Wagtail  Kicuit hutan  Least Concern

142. Anthus novaeseelandiae  
Common Pipit  Apung tanah  Least Concern

WOOD-SWALLOWS (FAMILY ARTAMIDAE)  
/ KEKEP

143. Artamus leucorynchus  
White-breasted Woodswallow  Kekep babi  Least Concern

SHRIKES (FAMILY LANIIDAE)  
/ BENTET

144. Lanius tigrinus  
Tiger Shrike  Bentet loreng  Least Concern
145. Aplonis panayensis
   Asian Glossy Starling          Perling kumbang         Least Concern

146. Acridotheres tritis
   Common Myna                   Kerak Ungu

147. Acridotheres javanicus
   Javan Myna                    Kerak Kerbau

148. Gracula religiosa
   Hill Myna                     Tiong emas           Least Concern

SUNBIRDS AND SPIDERHUNTERS (FAMILY NECTARINIIDAE)
   / BURUNG MADU DAN PIJANTUNG

149. Anthreptes simplex
   Plain Sunbird                 Burung-madu polos    Least Concern
150. *Anthreptes malacensis*

Plain-throated Sunbird  Burung-madu kelapa  Least Concern

151. *Anthreptes singalensis*

Ruby-cheeked Sunbird  Burung-madu belukar  Least Concern

152. *Hypogramma hypogrammicum*

Purple-naped Sunbird  Burung-madu rimba  Least Concern

153. *Nectarinia sperata*

Purple-throated Sunbird  Burung-madu pengantin  Least Concern
154. *Nectarinia calcostetha*
   Copper-throated Sunbird  Burung-madu bakau  Least Concern

155. *Nectarinia jugularis*
   Olive-backed Sunbird  Burung-madu sriganti  Least Concern

156. *Aethopyga siparaja*
   Crimson Sunbird  Burung-madu sepah-raja  Least Concern

157. *Arachnothera longirostra*
   Little Spiderhunter  Pijantung kecil  Least Concern

158. *Arachnothera flavigaster*
   Spectacled Spiderhunter  Pijantung tasmak  Least Concern

159. *Arachnothera affinis*
   Gray-breasted Spiderhunter  Pijantung gunung  Least Concern
FLOWERPECKERS (FAMILY DICAEIDAE) / BURUNG CABAI

160. **Prionochilus thoracicus**
Scarlet-breasted Flowerpecker Pentis kumbang Near Threatened

161. **Prionochilus maculatus**
Yellow-breasted Flowerpecker Pentis raja Least Concern

162. **Prionochilus xanthopygius**
Yellow-rumped Flowerpecker Pentis kalimantan Least Concern

163. **Prionochilus percussus**
Crimson-breasted Flowerpecker Pentis pelangi Least Concern
164. *Dicaeum trigonostigma*  
Orange-bellied Flowerpecker  
Cabai bunga-api  
Least Concern

165. *Dicaeum concolor*  
Plain Flowerpecker  
Cabai polos  
Least Concern

166. *Dicaeum cruentatum*  
Scarlet-backed Flowerpecker  
Cabai merah  
Least Concern

**WEAVERS (FAMILY PLOCEIDAE)**  
/ PIPIT, MANYAR DLL.

167. *Passer montanus*  
Eurasian Tree Sparrow  
Burung-gereja erasia  
Least Concern

168. *Ploceus philippinus*  
Baya Weaver  
Manyar tempua  
Least Concern

169. *Lonchura leucogastra*  
White-bellied Munia  
Bondol perut-putih  
Least Concern

170. *Lonchura punctulata*  
Scaly-breasted Munia  
Bondol peking  
Least Concern

171. *Lonchura malacca*  
Black-headed Munia  
Bondol rawa

172. *Lonchura maja*
| White-headed Munia | Bondol haji | Least Concern |
Appendix 1. Mammal species occurrence at each land use.

<table>
<thead>
<tr>
<th>Methods</th>
<th>HTI*4 Protected area</th>
<th>HTI*4 Acacia</th>
<th>Village area</th>
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* HTI*4 = High Temporal Integrity Index
Notes:

Uncertain species: *Tarsius bancanus, Prebytis siamensis, Symphalangus syndactylus* and *Prionailurus viverrinus* were not listed

*1* Found footprints and an ex-bedding site

*2* Both species and their hybrids were detected. Some photos are quite difficult to identify

*3* Found footprints

*4* Industrial tree plantation
Appendix 2. Bird species occurrence at each land use.

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<th>Rubber Jungle</th>
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Notes:
*1 Industrial tree plantation
*2 Observations out from survey effort listed; these includes camera-trapping and accidental encounter