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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 *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 *et al.* 2000; Posa *et al.* 2011). However, recent studies showed certain species in peat swamp area were rather abundant. Johnson *et al.* (2005) and Quinten *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 *et al.* 2008; Corlett 2009). Some native animals of peat swamp forest may be able to survive in such new habitats (Meijaard *et al.* 2010), but serious impact on biodiversity may happen as reported in lowland forests in the region (Davies *et al.* 2001; Chung *et al.* 2000; Tsukamoto and Sabang 2005; Fitzherbert *et al.*

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2008).

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 crassiparpa* 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 °C and the maximum level ranges 31-33 °C, 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 species 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.

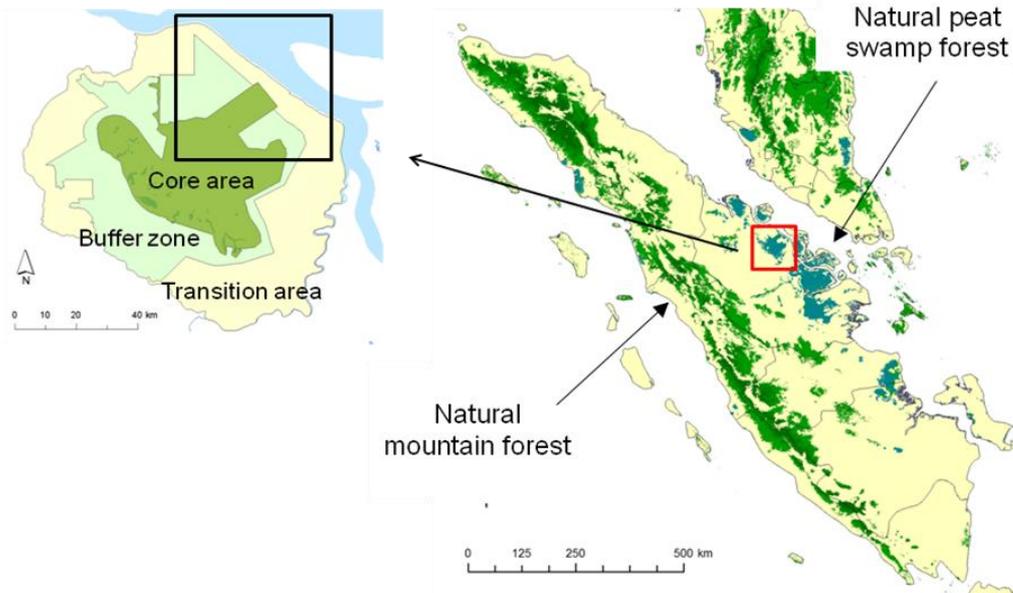


Figure 1. Remaining natural forests in Sumatra and location of Giam Siak Kecil-Bukit Batu Biosphere Reserve (red square) and Bukit Batu area (black square).

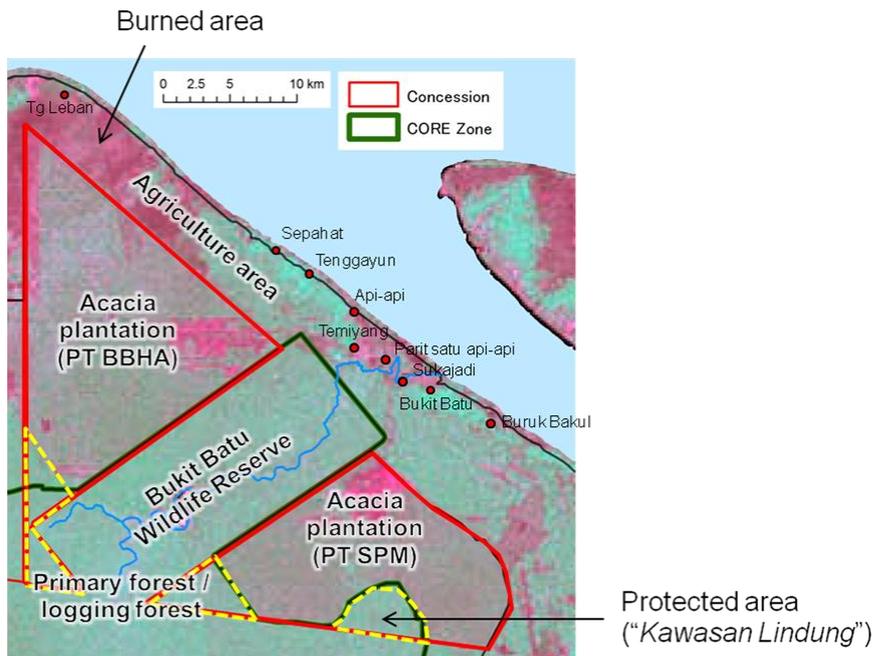


Figure 2. Bukit Batu area. Red lines indicate the border of the two industrial tree plantations (HTI), whereas green line indicates the border of the Core Area. Areas surrounded by yellow lines are protected area (“*Kawasan Lindung*”) of the HTI. There are several villages (red circle) along the coast.



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.

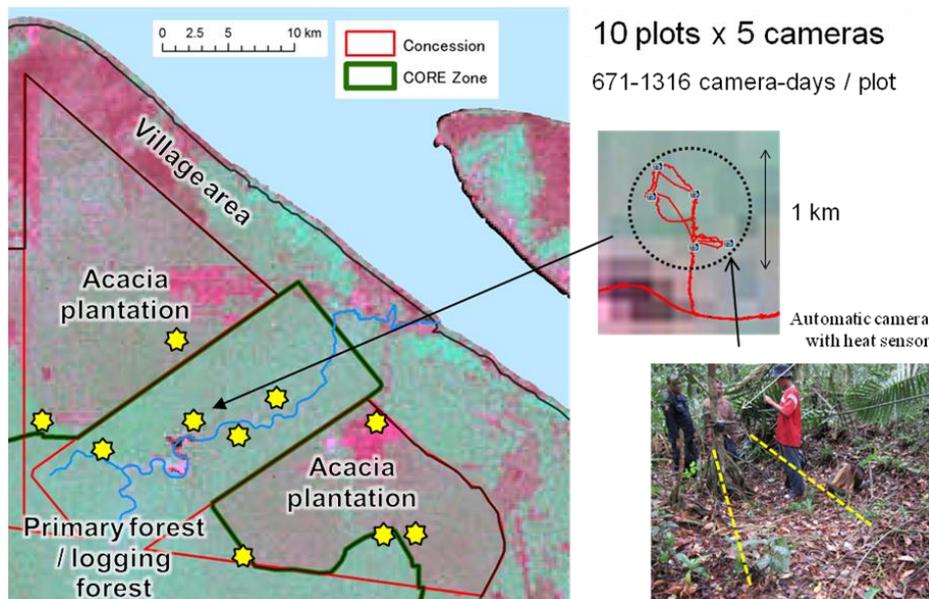


Figure 4. Study site of mammal camera trapping. Yellow dots indicate plots in which five camera points were set randomly.

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

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.

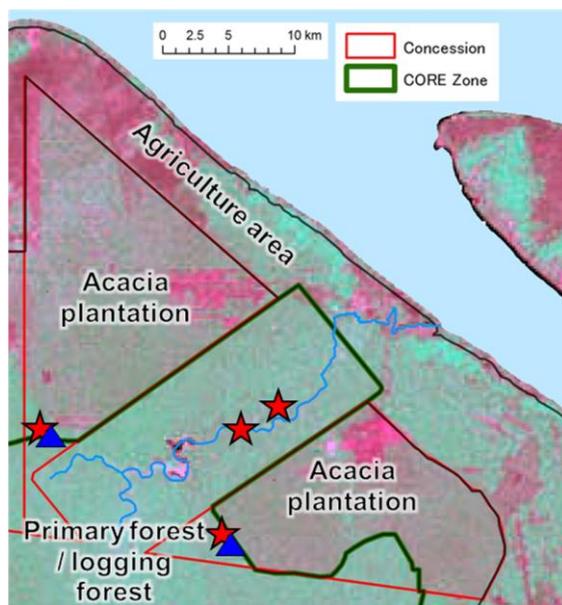


Figure 5. Study site of live trapping (blue triangle) and mist-netting (red star).



Figure 6. A series of five mist-nets set in the protected area of HTI.

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.

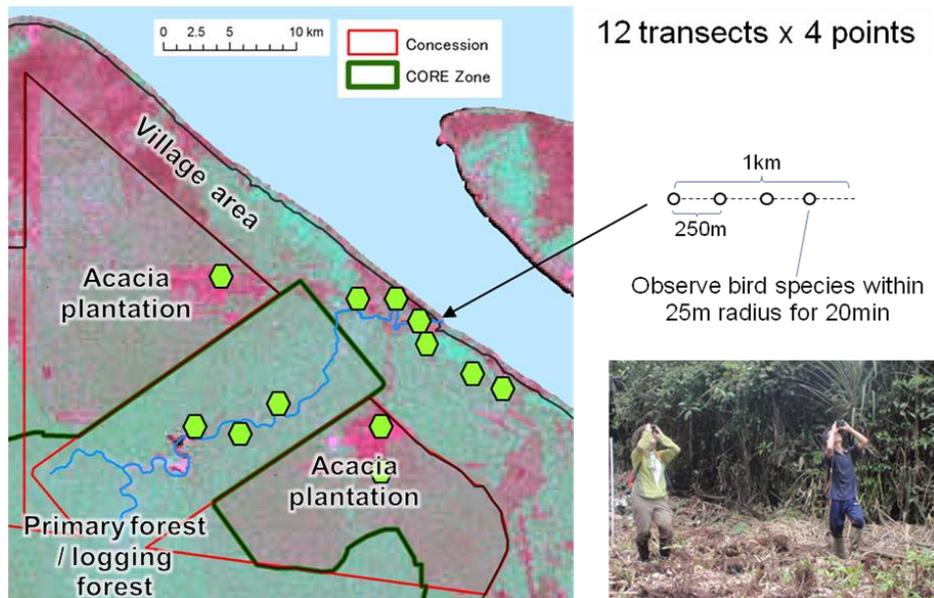


Figure 7. Study site for bird survey by point counting. Green hexagons indicate transects with four observation points.

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)

and Payne *et al.* (2000). Scientific names and English names followed the nomenclature of IUCN Red List 2011 (IUCN 2011) and Wilson & Reeder (2005).

Birds

The taxonomical order followed MacKinnon and Phillipps (1993). Scientific and English names followed the nomenclature of Sibley & Monroe (1990), Indonesian names followed MacKinnon (1991) and MacKinnon *et al.* (2010). Some of the Indonesian names that were not in these books followed Avibase website (<http://avibase.bsc-eoc.org/>) organized by Bird Life International.

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 inhabitations 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).

Among the 172 species, three species have been listed as “vulnerable species” in IUCN Red List (IUCN 2011), namely Black Partridge (*Melanoperdix niger*), Crestless Fireback (*Lophura erythrophthalma*), and Hook-billed Bulbul (*Setornis criniger*). Other 32 species were listed as “Near-threatened species” (Long-tailed Parakeet, Blue-rumped Parrot, Black-bellied Malkoha, Red-naped Trogon, Diard's Trogon, Scarlet-rumped Trogon, Wrinkled Hornbill, Asian Black Hornbill, Rhinoceros Hornbill, Great Hornbill, Helmeted Hornbill, Red-crowned Barbet, Red-throated Barbet, Buff-necked Woodpecker, Black-and-yellow Broadbill, Fiery Minivet, Green Iora, Lesser Green Leafbird, Puff-backed Bulbul, Streaked Bulbul, White-chested Babbler, Short-tailed Babbler, Sooty-capped Babbler, Rufous-crowned Babbler, Grey-breasted Babbler, Chestnut-rumped Babbler, Black-throated Babbler, Fluffy-backed Tit-Babbler, Rufous-tailed Shama, Grey-chested Jungle Flycatcher, Japanese Paradise Flycatcher, Scarlet-breasted Flowerpecker).

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 pyrhoptera*). 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 Rupert 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 brunneus*).

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).



Family SORICIDAE

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 Treeshrew

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).



Family MANIDAE

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 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 inhabitation in natural forest. Further study is necessary to confirm their inhabitation. According to IUCN (2011), the species is only known in Southeastern Sumatra and Bangka Island.

Family CERCOPITHECIDAE

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.



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*. Another 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 species in this area. According to IUCN (2011), the known distribution range of this species in Sumatra is east of the Siak river and does not include this area.



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, Sumatra, 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 a 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*

Terminck'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 zangalunga*

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 derbyanus*

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 “*Nangoi*”. 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 “*Nangoi*” 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 $\frac{3}{4}$ 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.



Wild pigs which look like *Sus scrofa*



Wild pig which looks like *Sus barbatus*

Family TRAGULIDAE

33. *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 Bambang kuning Least Concern

5. *Ixobrychus cinnamomeus*
Cinnamon Bittern Bambang 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 HEMIPROCNIIDAE)
/ 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 diardii*
Diard's Trogon Luntur diard Near Threatened

41. *Harpactes duvaucelii*
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 apiLeast Concern



45. *Ceyx rufidorsa*
Rufous-backed Kingfisher Udang apiLeast 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 KingfisherCekakak 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



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

88. *Pycnonotus melanicterus*
Black-crested Bulbul Cucak kuning Least Concern

89. *Pycnonotus aurigaster*
Sooty-headed Bulbul Cucak Kutilang Least Concern

90. *Pycnonotus eutilotus*
Puff-backed Bulbul Cucak rumbai-tungging Near Threatened



91. *Pycnonotus goiavier*
Yellow-vented Bulbul Merbah cerukcuk Least Concern

92. *Pycnonotus plumosus*
Olive-winged Bulbul Merbah belukar Least Concern

93. *Pycnonotus simplex*
Cream-vented Bulbul Merbah corok-corok Least Concern



94. *Pycnonotus brunneus*
Red-eyed Bulbul Merbah mata-merah Least Concern



95. *Pycnonotus erythrothalmos*

Spectacled Bulbul

Merbah kaca mata

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



**BABLERS (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 Cinenen kelabu Least Concern

127. *Orthotomus sericeus*

Rufous-tailed Tailorbird Cinenen 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 bubuk 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 Kipas an 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 leucorhynchus*

White-breasted Woodswallow Kekep babi Least Concern

**SHRIKES (FAMILY LANIIDAE)
/ BENTET**

144. *Lanius tigrinus*

Tiger Shrike Bentet loreng Least Concern



STARLINGS (FAMILY STURNIDAE)

/ JALAK

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

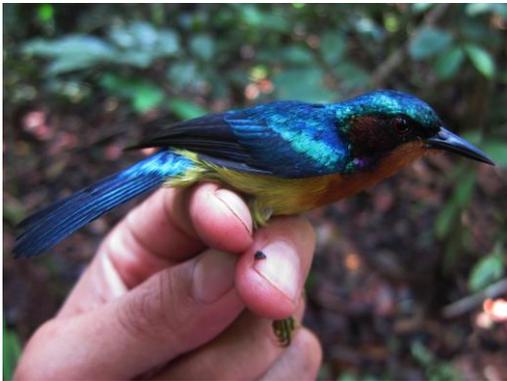
Burung-madu polos Least Concern



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 DICAETIDAE)
/ BURUNG CABAI**

160. *Prionochilus thoracicus*

Scarlet-breasted Flowerpecker

Pentis kumbang

Near Threatened



161. *Prionochilus maculatus*

Yellow-breasted Flowerpecker

Pentis rajaLeast 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

Appendix1. Mammal species occurrence at each land use.

		Bukit Batu Wildlife Reserve	HTI*4 Protected area				HTI*4 Acacia			Village area
Methods		Camera trapping Mist-netting Local information	Camera trapping Live trapping Mist-netting Direct observation Local information	Direct observation						
Efforts	Camera-days	3978	3335				3675			
	Trap-nights		400							
	Mist-net-nights	4	64							
ID	Scientific Name	Common name								
1	<i>Echinosorex gymnura</i>	Moonrat		1	1					
2	<i>Crocidura monticola</i>	Sunda shrew			1					
3	<i>Tupaia glis</i>	Common treeshrew			1					
4	<i>Cynopterus brachyotis</i>	Lesser dog-faced fruit bat		1		1				
5	<i>Balionycteris maculate</i>	Spotted-winged fruit bat		1		1				
6	<i>Manis javanica</i>	Pangolin		1	1					
7	<i>Nycticebus coucang</i>	Slow loris			1					
8	<i>Presbytis femoralis percura</i>	Banded langur			1					
9	<i>Trachypithecus cristatus</i>	Silvery lutung				1				
10	<i>Macaca fascicularis</i>	Crab-eating macaque				1				
11	<i>Macaca nemestrina</i>	Southern pig-tailed macaque		1	1	1	1	1		
12	<i>Hylobates agilis</i>	Agile gibbon				1				
13	<i>Ratufa affinis</i>	Pale giant squirrel				1				
14	<i>Petinomys setosus</i>	Temminck's flying squirrel			1					
15	<i>Sundamys</i> sp.	Sundamys			1					
16	<i>Maxomys whiteheadi</i>	Whitehead's maxomys			1					
17	<i>Maxomys</i> sp.	Spiny rat			1					
18	<i>Helarctos malayanus</i>	Sun bear		1	1	1 ^{*1}	1			
19	<i>Mustela flavigula</i>	Yellow throated marten		1	1					
20	<i>Lutra sumatrana</i>	Hairy-nosed otter						1		
21	<i>Viverra zangalunga</i>	Malay civet		1	1					
22	<i>Arctogalidia trivirgata</i>	Small-toothed palm civet		1						
23	<i>Paradoxurus hermaphroditus</i>	Common palm civet				1				
24	<i>Arctictis binturong</i>	Binturong			1					
25	<i>Hemigalus derbyanus</i>	Banded palm civet		1	1					
26	<i>Prionodon linsang</i>	Banded linsang		1	1					
27	<i>Herpestes brachyurus</i>	Short-tailed Mongoose			1					
28	<i>Neofelis diardi</i>	Sunda clouded leopard		1						
29	<i>Panthera tigris sumatrae</i>	Sumatran tiger						1		
30	<i>Pardofelis marmorata</i>	Marbled cat		1	1					
31	<i>Prionailurus bengalensis</i>	Leopard cat		1	1					

32	<i>Sus scrofa</i> / <i>Sus barbatus oi</i> * ²	Wild boar / Bearded pig	1	1		1	1
33	<i>Tragulus kanchil</i>	Lesser mousedeer	1	1	1 ^{*3}		

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

Appendix2. Bird species occurrence at each land use.

		Bukit Batu Wildlife Reserve		HTI* ¹ Protected area	HTI* ¹ Acacia	Village	Rubber Jungle	Other observation* ²
Methods		Point count	Mist net	Mist net	Point count	Point count	Point count	
Efforts		840 min	120 mistnet days	84 mistnet days	960 min	960 min	960 min	
Species number		61 sp	38 sp	30 sp	19 sp	49 sp	37 sp	
ID	Scientific Name							
1	<i>Ardea sumatrana</i>							1
2	<i>Ardea purpurea</i>							1
3	<i>Butorides striata</i>				1			
4	<i>Ixobrychus sinensis</i>							1
5	<i>Ixobrychus cinnamomeus</i>							1
6	<i>Pandion haliaetus</i>					1		
7	<i>Pernis ptilorhynchus</i>					1		
8	<i>Elanus caeruleus</i>							1
9	<i>Spilornis cheela</i>	1			1		1	
10	<i>Accipiter soloensis</i>							1
11	<i>Microhierax fringillarius</i>	1						
12	<i>Melanoperdix niger</i>							1
13	<i>Lophura erythrophthalma</i>							1
14	<i>Gallus gallus</i>							1
15	<i>Turnix suscitator</i>					1		
16	<i>Amauormis phoenicurus</i>				1	1		
17	<i>Rostratula benghalensis</i>							1
18	<i>Tringa hypoleucos</i>							1
19	<i>Gallinago stenura</i>							1
20	<i>Treron curvirostra</i>						1	
21	<i>Treron vernans</i>					1		
22	<i>Ducula aenea</i>							1
23	<i>Streptopelia chinensis</i>					1		
24	<i>Geopelia striata</i>					1		
25	<i>Psittacula longicauda</i>					1	1	
26	<i>Psittinus cyanurus</i>							1
27	<i>Loriculus galgulus</i>	1				1		
28	<i>Cacomantis merulinus</i>					1	1	
29	<i>Surniculus lugubris</i>	1						
30	<i>Phaenicophaeus diardi</i>							1
31	<i>Phaenicophaeus chlorophaeus</i>	1						1
32	<i>Centropus sinensis</i>	1			1	1	1	
33	<i>Centropus bengalensis</i>					1	1	
34	<i>Otus lempiji</i>							1
35	<i>Caprimulgus macrurus</i>							1

36	<i>Caprimulgus affinis</i>								1
37	<i>Collocalia fuciphagus</i>								1
38	<i>Hemiprocne comata</i>	1						1	1
39	<i>Harpactes kasumba</i>	1							
40	<i>Harpactes diardii</i>	1							
41	<i>Harpactes duvaucelii</i>		1		1				
42	<i>Alcedo atthis</i>								1
43	<i>Alcedo meninting</i>				1		1		
44	<i>Ceyx erithaceus</i>		1						
45	<i>Ceyx rufidorsa</i>		1		1				1
46	<i>Pelargopsis capensis</i>								1
47	<i>Halcyon coromanda</i>							1	
48	<i>Halcyon smyrnensis</i>				1		1	1	
49	<i>Merops philippinus</i>								1
50	<i>Merops viridis</i>				1		1		
51	<i>Aceros corrugatus</i>								1
52	<i>Aceros undulatus</i>						1		
53	<i>Anthracoceros malayanus</i>	1					1	1	
54	<i>Anthracoceros albirostris</i>								1
55	<i>Buceros rhinoceros</i>	1					1		
56	<i>Buceros bicornis</i>								1
57	<i>Buceros vigil</i>				1				
58	<i>Megalaima rafflesii</i>	1							
59	<i>Megalaima mystacophanos</i>							1	
60	<i>Megalaima australis</i>	1						1	
61	<i>Caloramphus fuliginosus</i>		1						
62	<i>Sasia abnormis</i>	1	1						
63	<i>Celeus brachyurus</i>						1		
64	<i>Picus vittatus</i>						1		
65	<i>Picus puniceus</i>								1
66	<i>Picus miniaceus</i>						1	1	
67	<i>Meiglyptes tristis</i>								1
68	<i>Meiglyptes tukki</i>		1		1				
69	<i>Dryocopus javensis</i>								1
70	<i>Blythipicus rubiginosus</i>	1							
71	<i>Reinwardtipicus validus</i>								1
72	<i>Eurylaimus ochromalus</i>	1							1
73	<i>Hirundo rustica</i>								1
74	<i>Hirundo tahitica</i>								1
75	<i>Hirundo striolata</i>								1
76	<i>Delichon dasypus</i>								1
77	<i>Hemipus hirundinaceus</i>							1	
78	<i>Coracina fimbriata</i>								1
79	<i>Lalage nigra</i>						1		
80	<i>Pericrocotus divaricatus</i>							1	
81	<i>Pericrocotus igneus</i>	1						1	
82	<i>Aegithina viridissima</i>	1			1		1		
83	<i>Aegithina tiphia</i>	1					1	1	

84	<i>Chloropsis cyanopogon</i>	1						1
85	<i>Chloropsis sonnerati</i>	1						
86	<i>Chloropsis cochinchinensis</i>	1						1
87	<i>Pycnonotus atriceps</i>	1				1		
88	<i>Pycnonotus melanicterus</i>							1
89	<i>Pycnonotus aurigaster</i>	1			1	1		
90	<i>Pycnonotus eutilotus</i>		1					
91	<i>Pycnonotus goiavier</i>				1	1	1	
92	<i>Pycnonotus plumosus</i>	1						
93	<i>Pycnonotus simplex</i>	1	1	1	1		1	
94	<i>Pycnonotus brunneus</i>	1	1		1	1	1	
95	<i>Pycnonotus erythroptalmos</i>	1	1					
96	<i>Setornis criniger</i>		1	1				
97	<i>Tricholestes criniger</i>		1	1				
98	<i>Ixos malaccensis</i>	1						
99	<i>Dicrurus annectans</i>							1
100	<i>Dicrurus remifer</i>					1		
101	<i>Dicrurus paradiseus</i>	1						
102	<i>Oriolus chinensis</i>					1		
103	<i>Irena puella</i>	1						
104	<i>Corvus enca</i>	1			1	1	1	
105	<i>Pellorneum capistratum</i>	1	1					
106	<i>Trichastoma rostratum</i>							1
107	<i>Trichastoma bicolor</i>	1	1	1				
108	<i>Malacocincla malaccensis</i>		1	1				
109	<i>Malacocincla abbotti</i>	1						
110	<i>Malacopteron magnirostre</i>	1						
111	<i>Malacopteron affine</i>	1	1					
112	<i>Malacopteron cinereum</i>		1	1				
113	<i>Malacopteron magnum</i>	1	1	1				
114	<i>Malacopteron albogulare</i>		1	1				
115	<i>Stachyris maculata</i>	1	1	1				
116	<i>Stachyris nigricollis</i>	1	1	1			1	
117	<i>Stachyris erythroptera</i>	1	1	1			1	
118	<i>Macronous gularis</i>	1			1	1	1	
119	<i>Macronous pilosus</i>	1	1	1				1
120	<i>Copsychus saularis</i>					1		
121	<i>Copsychus malabaricus</i>						1	
122	<i>Trichixos pyrropygus</i>	1	1	1				
123	<i>Turdus obscurus</i>							1
124	<i>Gerygone sulphurea</i>							1
125	<i>Phylloscopus borealis</i>	1	1				1	
126	<i>Orthotomus ruficeps</i>	1			1	1		
127	<i>Orthotomus sericeus</i>	1	1	1	1	1	1	
128	<i>Prinia flaviventris</i>				1	1	1	
129	<i>Prinia familiaris</i>					1	1	
130	<i>Rhinomyias umbratilis</i>	1	1	1				
131	<i>Muscicapa dauurica</i>	1					1	

132	<i>Ficedula zanthopygia</i>	1	1					
133	<i>Muscicapella hodgsoni</i>							1
134	<i>Rhipidura javanica</i>							1
135	<i>Hypothymis azurea</i>	1	1	1				1
136	<i>Philentoma pyrhoptera</i>	1	1	1				
137	<i>Terpsiphone atrocaudata</i>							1
138	<i>Terpsiphone paradisi</i>	1	1					
139	<i>Pachycephala grisola</i>			1				1
140	<i>Motacilla flava</i>							1
141	<i>Dendronanthus indicus</i>							1
142	<i>Anthus novaeseelandiae</i>							1
143	<i>Artamus leucorhynchus</i>					1		
144	<i>Lanius tigrinus</i>			1			1	
145	<i>Aplonis panayensis</i>					1		
146	<i>Acridotheres tritis</i>						1	
147	<i>Acridotheres javanicus</i>					1		
148	<i>Gracula religiosa</i>	1				1	1	
149	<i>Anthreptes simplex</i>	1		1				
150	<i>Anthreptes malacensis</i>	1	1		1	1	1	
151	<i>Anthreptes singalensis</i>							1
152	<i>Hypogramma hypogrammicum</i>		1	1				
153	<i>Nectarinia sperata</i>							1
154	<i>Nectarinia calcostetha</i>	1						
155	<i>Nectarinia jugularis</i>					1		
156	<i>Aethopyga siparaja</i>						1	
157	<i>Arachnothera longirostra</i>	1	1	1				
158	<i>Arachnothera flavigaster</i>						1	
159	<i>Arachnothera affinis</i>		1	1				
160	<i>Prionochilus thoracicus</i>	1	1	1				
161	<i>Prionochilus maculatus</i>		1	1				
162	<i>Prionochilus xanthopygius</i>	1						
163	<i>Prionochilus percussus</i>	1	1					
164	<i>Dicaeum trigonostigma</i>							1
165	<i>Dicaeum concolor</i>						1	
166	<i>Dicaeum cruentatum</i>					1	1	
167	<i>Passer montanus</i>					1		
168	<i>Ploceus philippinus</i>					1		
169	<i>Lonchura leucogastra</i>					1		
170	<i>Lonchura punctulata</i>					1		
171	<i>Lonchura malacca</i>							1
172	<i>Lonchura maja</i>					1		

Notes:

*1 Industrial tree plantation

*2 Observations out from survey effort listed; these includes camera-trapping and accidental encounter