

# BIRD SURVEY REPORT IN RESTORASI EKOSISTEM RIAU

**BIRD**  
REPORT



# **Bird Survey Report in Restorasi Ekosistem Riau**

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# FAUNA & FLORA INTERNATIONAL



**F**auna & Flora International (FFI) is the first international organization which engaged in the field of conservation. Since its establishment in 1903, FFI had contributed to many important conservation areas for biodiversity. In the early year of its establishment, FFI has helped and supported the determination of the various conservation areas in Africa, including Kruger National Park and the Serengeti. Currently, FFI has contributed substantially to the protection of threatened biodiversity and ecosystems in more than 40 countries spread over 5 continents with a total of more than 13.50 million acres of important conservation area, either on land or sea.

FFI with its vision believed that biodiversity could effectively being conserved by having communities living side by side in any protected landscape. To achieve its goal, FFI has implemented various scientific approach as a basis for creating conservation solutions that are sustainable and still take into account of human needs. FFI-IP helps communities to map the indigenous forests and get the its recognition officially to manage the forest in a sustainable way. In addition, FFI participate for guarding the survival of endangered species through sustainable funding mechanisms based on the program of REDD and PES.

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**R**iau Ecosystem Restoration (RER) is a conservation collaboration between the public and private sector for the activity of restoration and conservation in Kampar Peninsula on an ecologically high valued peat swamp forest. Therefore, it is important to conduct survey and study about birds in Peat Swamp Forest of Kampar Peninsula for having the basic information of biodiversity in the region. The objective of bird survey is to identify and describe the latest condition of the habitat, diversity, along with its potentials and its threats. Based on Point Count and VES (Visual Encounter Survey) methods on 31 transects dispersed within 3 concession areas (PT. GCN, PT. SMN, and PT. TBOT), the teams detected 193 species. In addition, some species were found at the outside of the RER concession, which resulted 220 species as the total number that found both inside and outside the area. About 45 species of them is categorized as globally threatened species such as White-winged duck (*Cairina scutulata*) and Milky stork (*Mycteria cinerea*). The highest bird diversity is in PT. TBOT area, followed by PT. GCN, and the lowest diversity is in PT. SMN – this finding correlates with habitat complexity (\*high in TBOT) and availability of food resources. The variation of plant understory layer composition is also assumed to have influence on the diversity of bird that inhabits understory layer which are dominant in RER region, causing certain bird families to be dominant across all RER regions. The existence of peat swamp specialist species such as Hook-billed bulbul (*Setornis criniger*), Grey-breasted babbler (*Malacopteron albogulare*), and Scarlet-breasted flowerpecker (*Prionochilus thoracicus*) signifies the importance of Kampar Peninsula peat swamp forest for bird conservation in Sumatra. In addition, presence of Black partridge and Bonaparte's nightjar in the RER is known to be a new record of distribution in Sumatra region.





# I. PREFACE

## 1.1 Background

Peat swamp forest is a unique and fragile ecosystem which under threat by human disturbances. Sumatra used to have 7,151,887 ha of peat swamp forest, the largest in the Indonesia beside Kalimantan and Papua with. However, due to drainage, illegal logging, habitat changes into agriculture, plantation and also due to forest fire caused loss of 78% of original peatland of Sumatra, (Purba et al., 2014). Riau province has the largest peatland area which had 4,004,434 ha in Sumatra and about 671,125 ha existed in Kampar Peninsula (Tropenbos International Indonesia Program, 2010).

The Kampar Peninsula is part of the largest peatland forest for Riau, plays an important area for biodiversity conservation. This area also an important habitat for sumatran tiger and other endangered species. Birdlife International also identified that, this landscape as one of important bird area (IBA) because this landscape hold significant numbers of a globally threatened species and hold a significant component of the group of species whose distributions are largely or wholly confined to one biome (peat swamp forest). Kampar Peninsula also provide important ecosystem services such as the storage of carbon stocks which potentially ranged from 2.14 to 2.68 billion tonnes, preservation of water resources and flood reducer (Tropenbos International Indonesia Program, 2010).

In an organizational perspective, Riau Ecosystem Restoration (RER) is a non-profit organization formed by APRIL in 2013 with an area of about 150,000 ha. RER has the purpose of restoration and conservation of peat swamp forest ecosystem in the area of Kampar Peninsula as a response to the program from the Ministry of Environment and Forestry-Republic of Indonesia to protect 2.6 million hectares of forest through ecosystem restoration forest system (IUPHHK-RE).

Three of the four concessions under support of the RER in the Kampar Peninsula had obtained a license of IUUPHHK-RE which are PT. Gemilang Cipta Nusantara (20.265 ha), PT. Sinar Mutiara Nusantara (32.830 ha) dan PT. The Best One Unitimber (39.412 ha). RER's restoration and conservation efforts are very important as RER concession occupied about 29% of coverage of the Tasik Besar Serkap-Forest Management Unit. RER had been collaborated with Fauna and Flora International-Indonesia Programme (FFI-IP) for designing the framework, policies and management plans which relate to the Community, Climate and Biodiversity (CCB) assessment in the landscape profile. The management plan resulted from this assessment will restore its ecological for the Kampar Peninsula landscape. This initiative will ensure the ecosystem services from the peat swamp forest to many people, especially the communities that coexist with this landscape (Restorasi Ekosistem Riau, 2015). If successful, the restoration and conservation program can be a model to be replicated in other areas in the broader landscape level (Kristi, 2014).

Biodiversity is part of an important aspect as a constituent biotic component of peat swamp forest ecosystem in Kampar Peninsula. However, the availability and an update of biological diversity data at a study site is very limited or difficult to obtain. Unfortunately, the data is needed as a reference for making a consideration

on the preparation of programs related to the management of restoration and conservation efforts. In order to fulfill those needs several studies of the diversity of fauna and flora in the region is an important part for managing the landscape properly.

The enactment of Kampar Peninsula as one of Important Bird Area (IBA) based on the finding of several endangered bird, like White-winged duck, Storm Stork, Hook-bill Bulbul and others which their distribution were highly dependent on the existence of the peat swamp forests (BirdLife International, 2016). Several bird species can be as indicator species for environmental quality and the landscape management approach. Bird is easily avoided when the environment changes. Bird also occupies various habitat types, even for spesific family , they could occupy specific habitats from cool temperate habitat in the Antarctic to warm climates such as in the desert. Bird could easily being observed and monitored through its existence which easier for monitoring (Birdlife International, 2013).

## **1.2 Objective**

In order to meet the need for basic data which related to diversity of bird in Kampar Peninsula, FFI-IP carried out a dedicated survey to identify and describe the current state of diversity, estimates the number of population, and threats faced.



## II. METHODS

### 2.1 Study Site

The area of Riau Ecosystem Restoration (RER) consists of PT. GCN, PT. SMN and PT. TBOT in the stretch of the Kampar Peninsula which its topography ranges from 2-16 m. This area classified as a wet tropical climate with relative humidity ranging from 81-84 % with an annual average of around 82 %. Annual rainfall ranges between 1.949-2.951mm/year. Monthly average for air temperature ranged from 26.1-27.5 oC with annual average 26.7oC (PT. GCN, 2012).

In general, there are three main type of ecosystems in Kampar Peninsula which are mangrove forest, peat swamp forest and riparian forest. For RER area, main ecosystem can be classified based on the type of vegetation: (1) mix peat swamp forests with uneven canopy heights (mixed peat swamp forest), (2) peat swamp forests with relatively flat-high tree canopy and has a uniform diameter trees (tall pole forest), (3) peat swamp forests with low canopy (low pole forest), and (4) riparian forest. Riparian forests in the RER are along the three rivers that flow in the area of the Turip River, and Serkap River which flow into PT. TBOT, Serkap River in PT. SMN and Sangar River inside PT. GCN. During the highest tide, wide puddle of these rivers may reach 1-1.5 km. The peat depth on RER reaches 15 m with the level of acidity (pH) ranged from 3.1 to 3.9 (Tropenbos International Indonesia Program, 2010; PT. GCN, 2012).

Peat swamp forest ecosystem in Kampar Peninsula is an important habitat for endangered fauna and flora. Several endangered flora species had a high economic value such as ramin (*Gonystilus* sp.), other dipterocarp species (*Shorea* spp.), durian (*Durio* sp.), kempas (*Kompassia malaccensis*) and punak (*Tetramerista glabra*). Couple critically endangered and threatened mammals such as sumatran tiger (*Panthera tigris sumatrae*), pangolin (*Manis javanica*), and sun bear (*Ursus malayanus*). Some species of hornbills and raptors such as hawks and falcons, and also some reptiles like false gharial (*Tomistoma schlegelii*) and box turtle (*Batagur borneoensis*) (Tropenbos International Indonesia Program, 2010).

#### a. Survey in PT. Gemilang Cipta Nusantara (GCN)

In PT. Gemilang Cipta Nusantara (GCN), eight transects were conducted within concession area and one additional transect in Tasik Besar Serkap Forest Management Unit which is located at the outside of PT. GCN. Survey was conducted from May to June 2015 with approximately effective time of data collection are 18 days. In the concession area lies Sangar River with 5-7 m width which is the only major river that flows from the northeast to the southwest. In general, PT. GCN represent a secondary peat swamp forest which dominated by mengkuang (*Pandanus* sp.) and meranti (*Shorea* sp.).

Five of the nine transect is relatively close to the Sangar River which about 4 km apart signed as RK\_GC03, RK\_GC04, RK\_GC07 and GC\_04. The condition of the forest floor is largely inundated to a depth at least 30-40 cm in transects RK\_GC03 and GC\_04, while other transect remained dry.

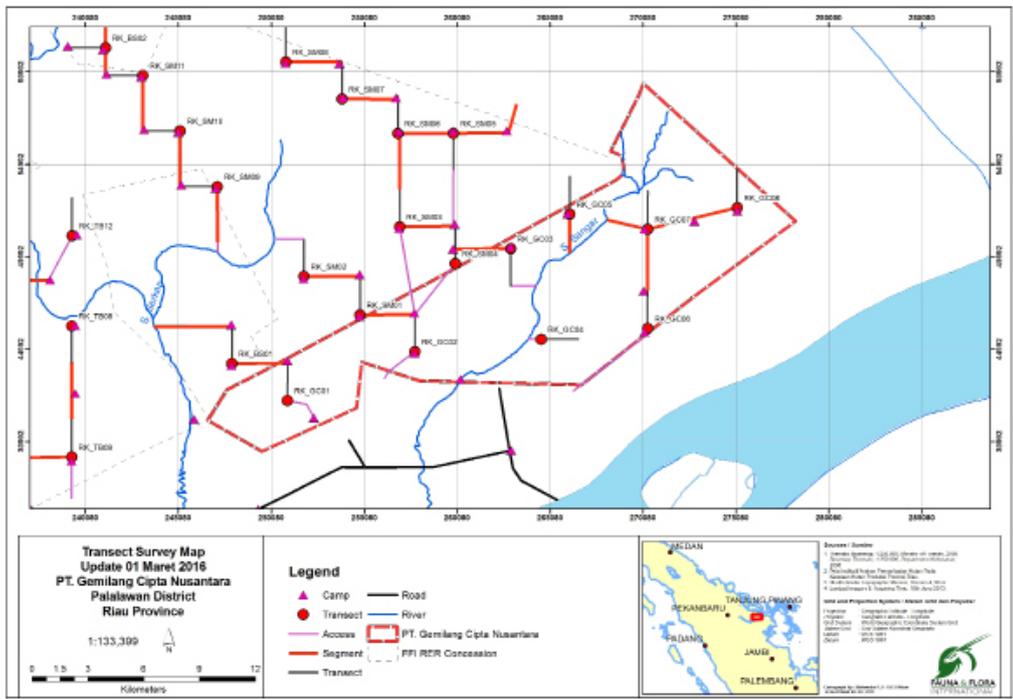


Figure 1. Distribution of nine transects in PT. GCN. RK\_BS01 transects are outside the concession area.

In the transect with the relatively high light intensity or low canopy cover due to the openings, mostly found pandan in the form of live shrubs or trees. Pandan dominance conditions and shrubs was found in transect RK\_GC02, RK\_GC04, RK\_GC06, RK\_GC07 and RK\_GC08. In opening area, we found several *Nepenthes* sp.

In transect of RK\_GC01 and RK\_BS01, have relatively different vegetation conditions with other transects with pandan dominance compared to other transects. Transect of RK\_GC06 located in the periphery of the southern part of the concession area. The forest area in transects connected to acacia plantation paralleled with a 5 m width canal as the demarcation. In RK\_GC06 transect also found a wide access track (approx. 5 m), which might be used for illegal logging.



Figure 2. Pandan dominance on some segments in transects RK\_GC06, RK\_GC07 and RK\_GC08.

## b. Survey in PT. Sinar Mutiara Nusantara (SMN)

The survey was conducted on ten transects in the concession area and one transect (RK\_BS02) located outside the concession area about 1 km to the south of Tasik Besar Lake. The survey was conducted during August-October 2015 by the effective time for 26 days (Figure 3).

In general, the location of data collection was a secondary peat swamp ecosystem. The habitat is a terrestrial patches with dry conditions. Although in some locations of sampling, a water source such as a stream; inundation due to fallen trees; puddle; water in tree holes and water from pitcher (*Nepenthes* sp.) can be found in RK\_SM04. The dominant tree vegetation that can be found throughout the concession such as meranti (*Shorea teysmanniana*), punak (*Tetramerista glabra*), and bintangur (*Calophyllum ferrugineum*) with shrubs such as *Pandanus* sp.

The dominant vegetation of *Pandanus* sp. in PT. SMN can be found in transects of RK\_SM04, RK\_SM06, RK\_SM07. Transect of RK\_SM05 was dominated with rasau (*Pandanus helicopus*) while others like in

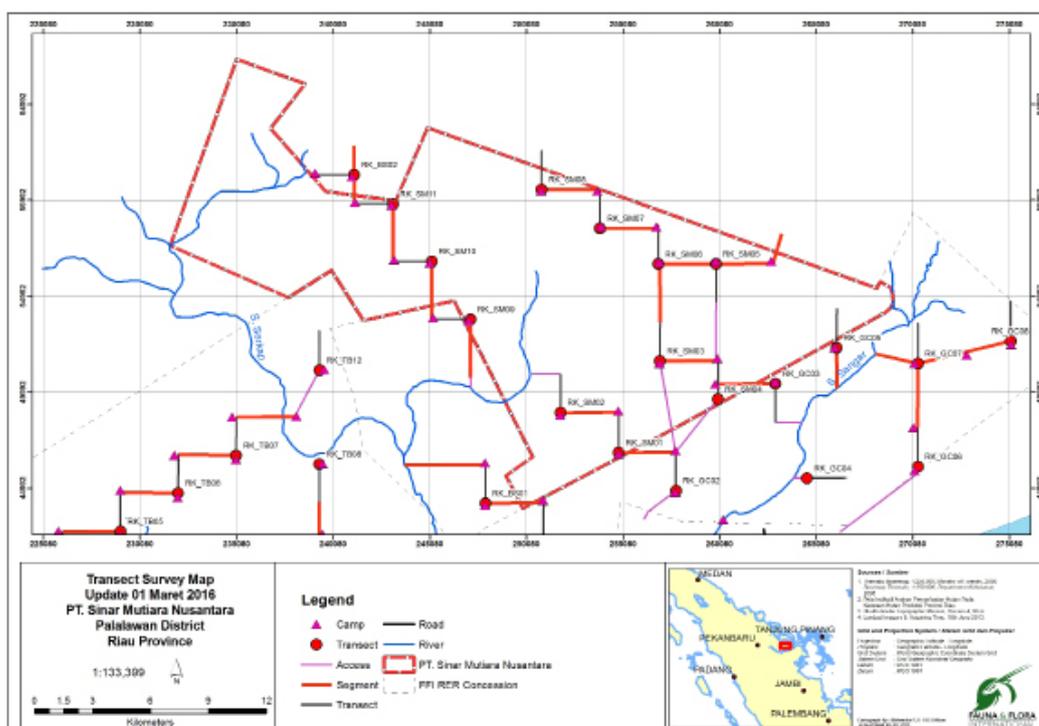


Figure 3. Distribution of transects in the area of PT. SMN. RK\_BS02 transect was outside the concession boundaries of PT.SMN and approaching Tasik Besar Serkap.



Figure 4. Condition of a transect with several small stands of trees with its diameters between 5 to 10 cm.

RK\_SM11 and RK\_BS02 had vegetation ranging from shrubs, pandan, linau and salak trees. *Nepenthes* sp. also found in significant amounts in almost all transects.

### c. Survey in PT. The Best One Unitimber (TBOT)

The survey was conducted on 12 transects during November to December 2015 with effective survey time by 30 days in mostly rainy season conditions. Most transects in the concession are moist peat swamp forest with inundation depth of about 15-50 cm in most of transects, except for transects of RK\_TB08, RK\_TB09, RK\_TB10, RK\_TB11 dan RK\_TB12.

Transects at RK\_TB01, RK\_TB08, RK\_TB09, RK\_TB11 tend to have a lot of stands of large trees from meranti, punak, suntai and kelat with a diameter of more than 30 cm when compared with other transects. Mengkuang (*Pandanus* sp.) in the form of the tree was rarely found in each transect except in transect of RK\_TB11, but in the form shrubs which dominated the whole of the beginning of 100-300 m transects of RK\_TB05, RK\_TB06, RK\_TB10, RK\_TB11, dan RK\_TB12. *Nepenthes* sp. was rarely being found in this area.

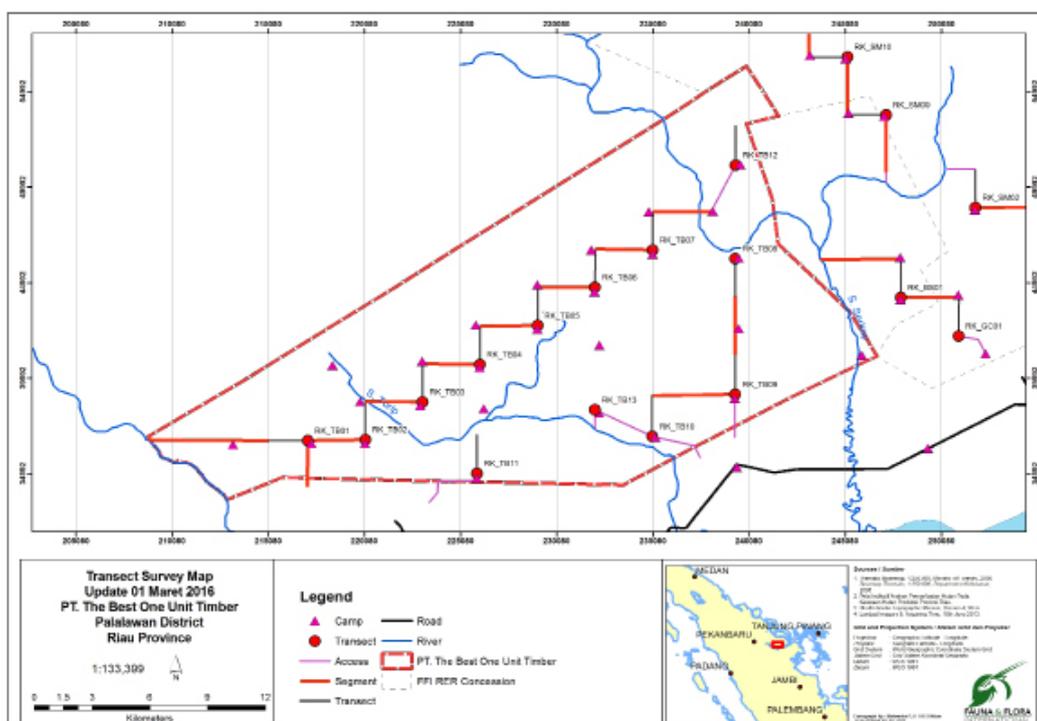


Figure 5. Distribution of transects in the area of PT. TBOT.

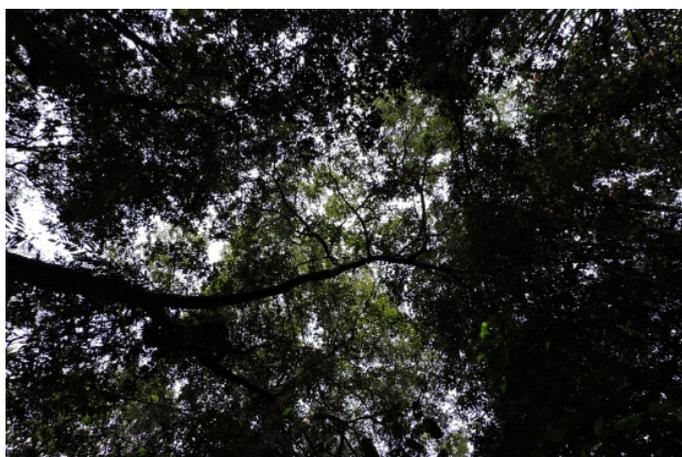


Figure 6. Domination of large trees such as punak, suntai, kelat and meranti are relatively prevalent in some transects in the area of PT. TBOT form a dense canopy cover.

## 2.2 Data Sampling

### a. General Research Design

Data collection for fauna and flora refers to the line transect or point count method. A total of 32 transects with 2 km length was chosen by stratified random sampling. The number of transects in each concession was amended by the proportion of its range and orientation representing the four cardinal directions. Nine transect were in PT. GCN, 11 transects were in PT. SMN and 12 transects were in PT. TBOT.

### b. Bird Data Collection

Survey on bird combines three techniques, e.g. point count, VES, and Sound Call Back (SCB). FFI uses the MacKinnon list technique, a common technique for bird survey worldwide. Observation on birds is carried out during 3 working days in 6 point stations set up in every 200 m interval along the transect line, with a diameter of 50 meter observation. A 20 minutes observation carried out in every point, with a specific time frame for the morning started from 5:30 a.m. to 10:00 and 15:30 to 18:30 in the afternoon. The data collection will record species name, number of individuals, distance to the observer, included the behavior during onservation. Micro habitat data were recorded at each point count which cover the percentage of tree height, percentage of forest floor (ground cover), the plant dominance (such as lianas, macaranga, shrubs, palms, gingers, bamboo, grass , etc. ). The distance with water source, slope, number of dead trees, as well as the thickness of moss and leaf litter also recorded in each transect for data analysis.

VES is used to record additional species (cold search). The data recorded includes the species of bird found inside and outside the transect. The recording was made outside the time of observation with a point count method, such as the way into the transect or while in the camp. This method does not count the number of individuals found that were not included in the calculation of the density and diversity , but is used to determine the number of species richness of bird qualitatively (Manley et al., 2006).

Sound Call Back method, performed around a 19:30 until 21:30 around the camp up to 200 meters from the camp. The method of using a voice recorder and a sound for nocturnal bird . This method is effective for calling bird which might active at night (nocturnal) and making a territorial reaction of bird as a concerned while applying the method (MacKinnon et al, 2010).

We use the “Birds in Sumatra , Java , Bali and Kalimantan “ book for bird identification (MacKinnon et al., 2010) then for the English and scientific names follow the List of Burung Indonesia No. 2 (Sukmantoro et al., 2007). For bird protection status, we follow the IUCN Redlist of endangered species (2011), CITES (2011), and Government Regulation of the Republic of Indonesia ( Law No. 5 of 1990 and Government Regulation No. 7 of 1999 ). Bird ecological properties such as migration , endemic and restricted distribution being used to determine the conservation value of bird. The category for feeding guild (food palatibility pattern of bird) will refer to the Handbook of the Birds of the World works of Andrew Elliott, Jordi Sargatal Vicens, and J. Del Hoyo based on the link <http://www.hbw.com/>.

## 2.3 Data Analysis

The data being used for Shannon - Wiener diversity as well as for other analysis in this report will use the findings from transects only.

### a. Bird Diversity

Bird diversity in each transect was measured using the Shannon - Wiener diversity index ( $H'$ ) and Pielou evenness index ( $J$ ), which is calculated by using the formula:

$$H' = - \sum p_i \ln p_i$$

- $H'$  = diversity index Shannon- Wiener  
 $p_i$  =  $n_i/N$   
 $n_i$  = number of individuals of species-i  
 $N$  = the total number of individuals

Shannon - Wiener diversity index calculates the relative abundance and species richness. The index value will increase along with the addition of species richness and species evenness (Brower et al., 1998).

For comparing the diversity index from two different habitats, then the Hutchenson's t-test will be performed (Magurran, 2014). The tests were conducted using the statistical software PAST 3.07. The value of t and p(same) will be obtained from this test, if the value of p(same) is smaller than 0.05, then index the diversity stated significantly different, and vice versa (Hammer, 2015). The Hutchenson's t-test formulated as follows:

$$t = \frac{H'_1 - H'_2}{\sqrt{\text{var}(H'_1) + \text{var}(H'_2)}}$$

- $\text{Var}(H')$  = Variance of Shannon - Wiener diversity index  
 $S$  = Total number of species

$H'$  variance will be calculated using this formula:

$$\text{var}(H') = \frac{\sum p_i (\ln p_i)^2 - (\sum p_i \ln p_i)^2}{-N} + \frac{S - 1}{2N^2}$$

### b. Pielou Evenness Index

To measure the level of species evenness, Pielou Evenness Index will be used by this formula:

$$J' = \frac{H'}{\ln S}$$

- $E$  = Pielou Evenness Index  
 $H'$  = Shannon diversity index  
 $S$  = Number of total species

$E$  value ranges from 0 to 1. The closer the value of  $E$  to 1 means that a community has a number of individuals per species that is relatively the same.

To measure the level of species dominance, Simpson's dominance index ( $D$ ) will be used. If a habitat dominated by certain species, then the index value will be 1 or close to 1. Conversely, the habitat is not dominated by particular species if the index value 0 or close to 0 (Boyce, 2015). The Simpson's dominance index formula as follows.

$$D = \frac{\sum n_i^2}{N} \quad \text{atau} \quad D = \frac{\sum (n_i[n_i - 1])}{N[N - 1]}$$

- $D$  = Simpson's dominance index  
 $n_i$  = number of individuals of species-i

### c. Rarefaction and extrapolated species richness

This method will be used to see a trend of increasing number of species to the number of sampling units. For this study, the trend will overview on the number of days of transect observations using EstimateS 9.0

(Colwell, 2013). The results of this analysis is species accumulation curve per sampling unit. The more oblique form of the curve on the left and tend to not showing the flat shape of the curve on the right, will indicate that the findings are still potential for the study area. It is most likely a record of increasing number of species if the number of sampling units added (Magurran, 2014).

#### **d. Distance Sampling**

Distance sampling is a method for the calculation of population density by using radial distance of birds individu. The radial distance collected from a distance estimate of individual birds to the middle point of observation, while the survey effort is determined from the number of observations in the morning and the afternoon. The analysis is done by Distance software 6.0 (Bibby et al., 1998).

#### **e. Statistical Analysis**

*Cluster analysis.* This analysis was conducted to see the similarities of bird community within surveyed transects. Transect with similar bird communities will tend to be clustered in one group. On the other hand, transect that has different herpetofaunal communities will be separated into another group. The cluster analysis was conducted using PAST 3.07 (Hammer, 2015).

Sorensen's similarity index will be used to create a similarity community tree (dendrogram) using relative abundance data, the index value ranging from 0 to 1. The closer to 1, means the two communities have a high similarity in species composition.

*Two-way ANOVA.* This statistical tests are used to discover significant differences between the parameters of the habitat structure in the concession areas. Two-way ANOVA assumes data is normally distributed, thus normality test conducted to test normality of data (Hammer, 2015). Two-way ANOVA and normality test (Shapiro-Wilk) was conducted using PAST 3.07.



## III. RESULTS AND DISCUSSIONS

### 3.1 RESULT

#### a. Habitat structure

Based on microhabitat data that has been collected on each observation points, data with normal distribution ( $p$ -normal > 0.05) was achieved. In that case, two way ANOVA test can be performed and habitat structure condition on each concession areas and the significant difference of habitat structure parameters between concession areas can be described as seen in Table 1.

Table 1. Comparison of habitat structure parameters between concession areas

Parameters	GCN (mean)	SMN (mean)	TBOT (mean)	F	df	p
Tallest tree (m)	28,852	30,136	33,333	4,445	2	0,021
Ground cover (%)	65,463	79,545	73,444	5,432	2	0,010
Plant height 0-1,5 m (%)	60,093	66,894	57,069	1,121	2	0,340
Plant height 1,5-5 m (%)	57,037	70,53	55,514	4,924	2	0,014
Plant height 5-15 m (%)	38,333	35,227	55,986	8,909	2	0,001
Plant height >15 m (%)	21,574	14,773	39,764	7,318	2	0,003
Bole climb (%)	12,407	8,152	19,597	4,965	2	0,014
Liana (%)	5,056	4,758	10,986	4,092	2	0,027
Macaranga (%)	0,278	1,409	2,083	1,249	2	0,302
Rattan (%)	2,963	1,909	5,931	1,097	2	0,347
Fern (%)	10,278	13,864	14,611	0,329	2	0,723
Small palm (%)	30,556	20,53	11,847	1,766	2	0,189
Distance from water resource	2,704	2,803	2,222	2,665	2	0,087
Logs (jml individu)	7,037	3,379	5,111	4,269	2	0,024
Snags (jml individu)	3,074	1,773	1,417	2,604	2	0,091
Zingiberaceae (%)	0,463	0	0,222	1,277	2	0,294
Grass (%)	0	3,864	11,069	3,873	2	0,032
Moss (cm)	0,946	1,459	1,389	4,65	2	0,018
Litter (cm)	1,537	1,871	2,41	8,691	2	0,001

#### b. Bird diversity in RER region

Based on the observation with point count and VES methods, there found 193 bird species that belong to 53 family (Appendix 1) with total individual number 9,507 (using point count method). From the total number of

species that was found, 13 are migrant bird species and 180 are resident bird species. Besides utilizing point count and VES methods, some additional bird species were found by using camera trap inside the RER region and free observation outside the RER region, so the total bird species reaches 220 (Appendix 2).

Based on the IUCN red list, 36 species (18.65%) are classified as near threatened (NT), 7 (3.63%) are vulnerable (VU), and 3 bird species (1.55%) are classified as endangered (EN) (Table 2), including Storm stork (*Ciconia stormi*) which was only recorded by camera trap.

Table 2. Threatened bird species that are found in RER region

Local Name	Scientific Name	IUCN	CITES	GOI	End.
Great hornbill	<i>Buceros bicornis</i>	NT	I	✓	-
Wrinkled Hornbill	<i>Aceros corrugatus</i>	NT	II	✓	-
Black Hornbill	<i>Anthracoceros malayanus</i>	NT	II	✓	-
Rhinoceros Hornbill	<i>Buceros rhinoceros</i>	NT	II	✓	-
Long-tailed Parakeet	<i>Psittacula longicauda</i>	NT	II	-	-
Blue-rumped Parrot	<i>Psittinus cyanurus</i>	NT	II	-	-
Mangrove Pitta	<i>Pitta megarhyncha</i>	NT	-	✓	-
Red-naped Trogon	<i>Harpactes kasumba</i>	NT	-	✓	-
Diard's Trogon	<i>Harpactes diardii</i>	NT	-	✓	-
Scarlet-rumped Trogon	<i>Harpactes duvaucelii</i>	NT	-	✓	-
Wallace's Hawk-Eagle	<i>Spizaetus nanus</i>	VU	II	✓	-
Bonaparte's Nightjar	<i>Caprimulgus concretus</i>	VU	-	-	-
Short-toed Coucal	<i>Centropus rectunguis</i>	VU	-	-	-
Lesser Adjutant	<i>Leptoptilos javanicus</i>	VU	-	✓	-
Crestless Fireback	<i>Lophura erythrophthalma</i>	VU	-	-	-
Black Partridge	<i>Melanoperdix nigra</i>	VU	-	-	-
Hook-billed Bulbul	<i>Setornis criniger</i>	VU	-	-	-
White-winged Duck	<i>Cairina scutulata</i>	EN	I	✓	-
Milky Stork	<i>Mycteria cinerea</i>	EN	I	✓	-

The number of species that was found was quite varied. Babblers and cuckoos families had the highest number by 16 species. Bulbuls, woodpeckers, and sunbirds share the proportion of 11 species (Figure 7). The summary (Table 3) only covers bird species that were found in survey area (RER) and number of bird on the inside and outside of survey area (Kampar Peninsula).

The result analysis of rarefaction shows that GCN and TBOT areas are generally have high species richness than SMN (Figure 8). Increasing of curve on every region indicates a potential of additional new species on all survey areas. However, the rate of additional new species was already decreasing which indicates that most of bird species in the area has been detected. Rarefaction on TBOT shows a graph that is closer to asymptotic compared to the other two regions, so there is only a small part of species that has not yet been detected. Each region shows an addition of 7, 9, and 11 bird species for TBOT, SMN, and GCN in order to achieve an asymptotic curve (indicated with dotted line).

Based on diversity and evenness indexes (Figure 9). There is a significant diversity difference of bird between GCN region (4.144) and SMN (3.877) ( $t = 9.43$ ;  $p\text{-same} < 0.05$ ), and TBOT (4.135) and SMN (3.877) ( $t = 10.69$ ;  $p\text{-same} < 0.05$ ). But the bird diversity is not significantly different between GCN and TBOT regions ( $t = 0.36$ ;  $p\text{-same} > 0.05$ ). Shannon evenness index shows a high individual number evenness in GCN region (0.5345) and lowest in SMN region (0.4511).

Table 3. Summary of bird number of species that were found in the RER concession area and Kampar Peninsula.

No	Description	RER Concession						AN	KP
		GCN		SMN		TBOT			
		PC	PC+VES	PC	PC+VES	PC	PC+VES		
1	Total of Species	118	132	107	134	121	143	193	220
2	Total of individu	2.135	-	3.082	-	4.291	-	9.508	-
3	Endemism								
	• Sumatra	0	0	0	0	0	0	0	0
	• Indonesia	0	0	0	0	0	0	0	1
4	Number of Migran Species	1	1	5	6	7	12	12	14
5	Coservation Status (IUCN ver 3.1)								
	• Near threatened (NT)	29	30	27	28	28	31	36	39
	• Vulnerable (VU)	2	3	3	7	2	4	7	7
	• Endangered (EN)	1	0	0	1	0	0	2	3
7	Trade status assesment (CITES)								
	• Appendix I	2	2	1	2	1	1	3	3
	• Appendix II	16	14	17	16	15	20	25	31
8	Protection status of RI								
	• Protected	28	24	27	28	24	38	46	55
	• Not Protected	90	83	94	90	107	99	147	165

PC= Poin Count; VES = Visual Encounter Survey; AN= Jumlah Akumulatif (RER); KP= Kampar Peninsula

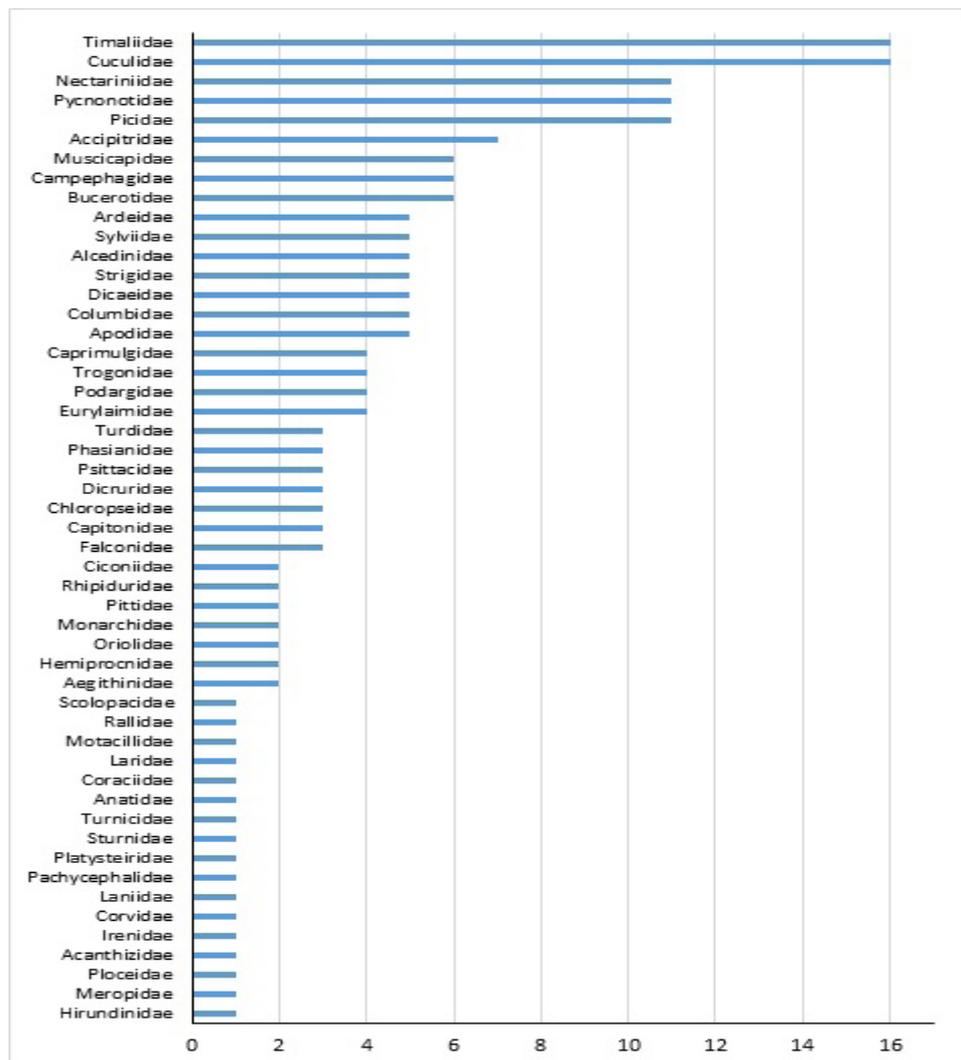


Figure 7. The number of species that represent each bird family

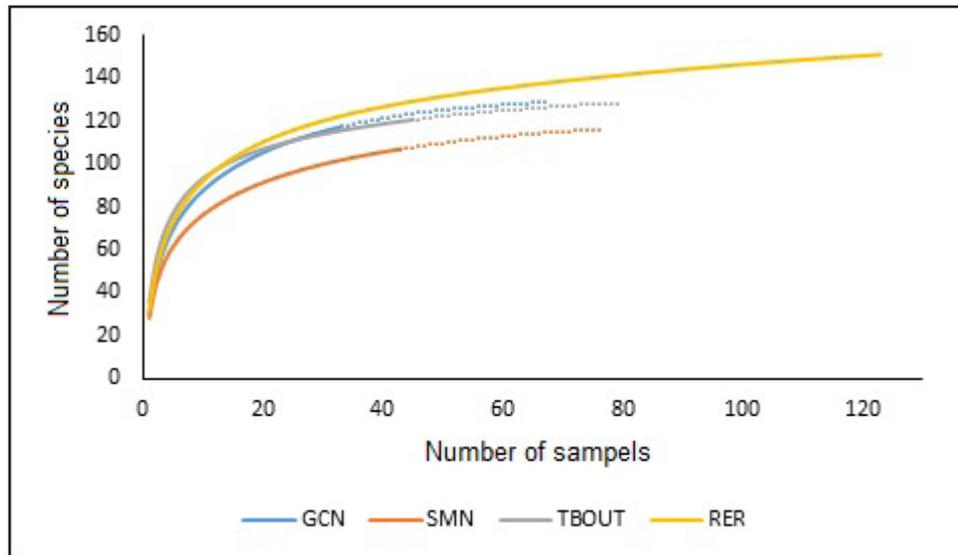


Figure 8. Rarefaction curves for the RER area and each concession areas

The composition of bird species with a relative high abundance on each concession regions is quite different between one and another. Species with the relatively high abundance is shown on the following table.

Table 4. Five species with the highest abundance in each concession.

Local Name	Scientific Name	Relative Abundance
<b>PT. GCN</b>		
Cream-vented Bulbul	<i>Pycnonotus simplex</i>	0,058
Blue-eared Barbet	<i>Megalaima australis</i>	0,055
Striped Tit-Babbler	<i>Macronous ptilosus</i>	0,050
Blue-crowned Hanging Parrot	<i>Loriculus galgulus</i>	0,031
Chestnut-winged Babbler	<i>Stachyris erythroptera</i>	0,03
<b>PT. SMN</b>		
Cream-vented Bulbul	<i>Pycnonotus simplex</i>	0,098
Striped Tit-Babbler	<i>Macronous ptilosus</i>	0,057
Blue-crowned Hanging Parrot	<i>Psittacula longicauda</i>	0,057
Short-tailed Babbler	<i>Malacocincla malaccense</i>	0,039
Takur tonggeret	<i>Megalaima australis</i>	0,034
<b>PT. TBOT</b>		
Cream-vented Bulbul	<i>Pycnonotus simplex</i>	0,077
Green lora	<i>Aegithina viridissima</i>	0,045
Chestnut-rumped Babbler	<i>Stachyris maculata</i>	0,042
Short-tailed Babbler	<i>Malacocincla malaccense</i>	0,031
Red-crowned Barbet	<i>Megalaima rafflesii</i>	0,027

### Bird Species Composition and Similarity

Based on the bird species composition, PT. SMN and PT. TBOT regions have higher bird species composition similarities, while PT. GCN region has bird composition that is quite different compared to the other two regions (Figure 10 and Table 5).

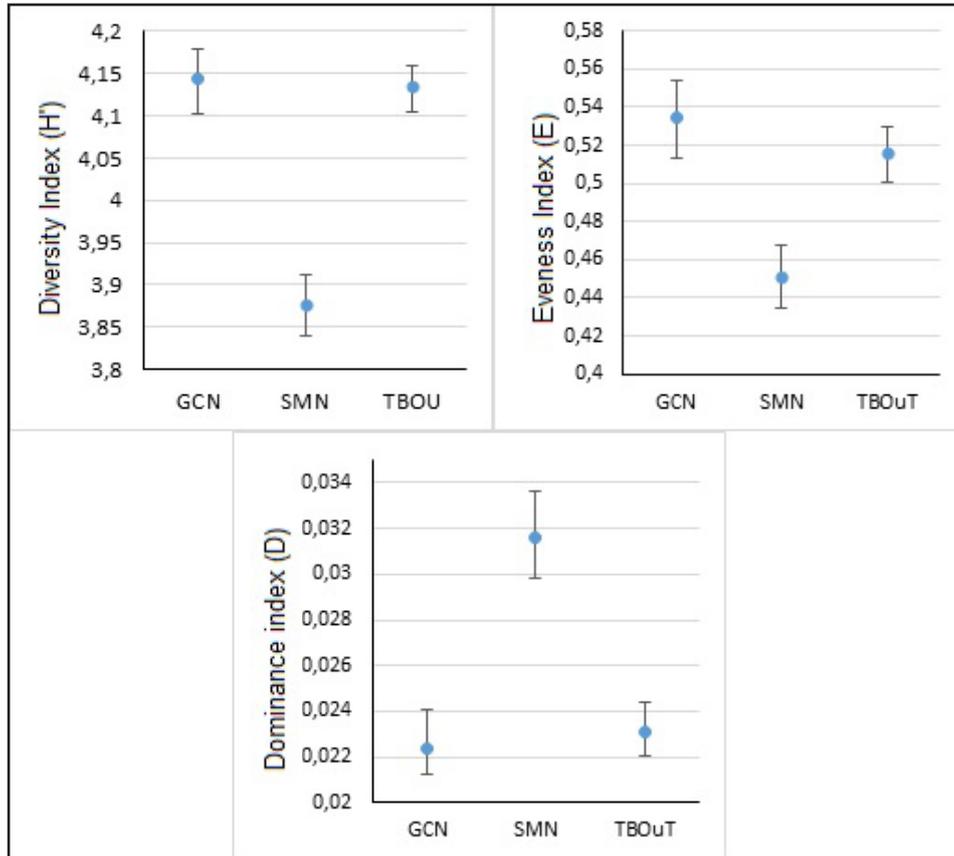


Figure 9. The diversity, evenness, and dominance index between concession area

Table 5. Calculation result of Sorensen index between concession areas

	GCN	SMN	TBOT
GCN	1	0,77	0,77
SMN		1	0,86
TBOT			1

There are 17 species which only detected in PT. GCN region, they are Common iora (*Aegithina tipia*), House swift (*Apus nipalensis*), Rusty-breasted cuckoo (*Cacomantis sepulcralis*), Large-tail nightjar (*Caprimulgus macrurus*), Ochraceous bulbul (*Criniger ochraceous*), Yellow-bellied bulbul (*Criniger phaeocephalus*), Malaysian blue flycatcher (*Cyornis turcosus*), Asian palm swift (*Cypsiurus balasiensis*), Brown-backed flowerpecker (*Dicaeum everetti*), Black drongo (*Dicrurus macrocercus*), Orange-breasted trogon (*Harpactes oreskios*), Buff-vented bulbul (*Iole olivacea*), Rufous woodpecker (*Micropternus brachyurus*), Yellow-bellied prinia (*Prinia flaviventris*), Yellow-vented bulbul (*Pycnonotus goiavier*), Silver-rumped spinetail (*Rhaphidura leucopygialis*), and Grey-headed babbler (*Stachyris poliocephala*).

98 species can be found on both regions of PT. SMN and PT. TBOT. Four species are specifically for SMN region, which are Oriental magpie-robin (*Copsychus saularis*), Pied triller (*Lalage nigra*), Spectacled bulbul (*Pycnonotus erythroptalmos*), and Pied fantail (*Rhipidura javanica*). Thirteen other bird species can only be found in PT TBOT such as Plain sunbirds (*Anthreptes simplex*), White-rumped shama (*Copsychus malabaricus*), Sumatra stripe babbler (*Coracina striata*), Green imperial pigeon (*Ducula aenea*), Common cuckoo (*Cuculus canorus*), Indian cuckoo (*Cuculus micropterus*), Banded broadbill (*Eurylaimus javanicus*), Spotted kestrel (*Falco moluccensis*), Red-naped trogon (*Harpactes kasumba*), Copper-throated Sunbird (*Leptocoma calcostetha*), Mangrove pitta (*Pitta megarhyncha*), and Jambu fruit dove (*Ptilinopus jambu*).

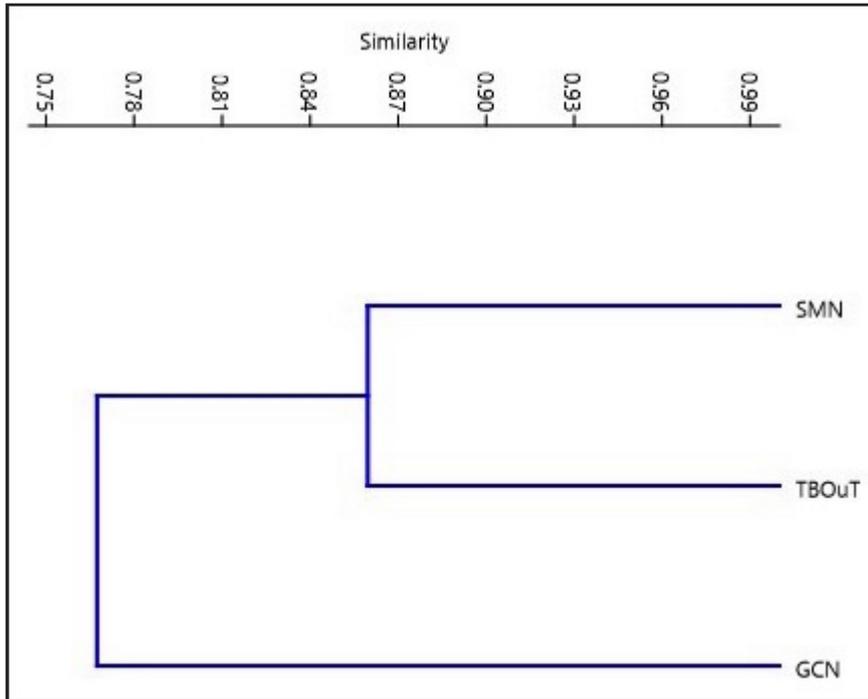


Figure 10. Dendrogram of species composition similarity between concession area by using the Sorensen's similarity index

### Bird Density

Analysis result using Distance obtained bird density as presented in Figure 11. Bird density in the whole region of RER is estimated to be 2,571.6 ind/km<sup>2</sup> (CI= 95%, 2,335.5-2,831.5). Bird density between concession areas do not show a significant difference, but there is a tendency that bird population in TBOuT region has the highest density with 2,888.7 ind/km<sup>2</sup> (CI= 95%, 2,511.4-3,322.8). The bird density in GCN region is as much as 2,487.8 ind/km<sup>2</sup> (CI= 95%, 2,001.5-3,092.3) while the lowest bird density is in SMN region with 2,338 ind/km<sup>2</sup> (CI= 95%, 2,049.9-2,666.9).

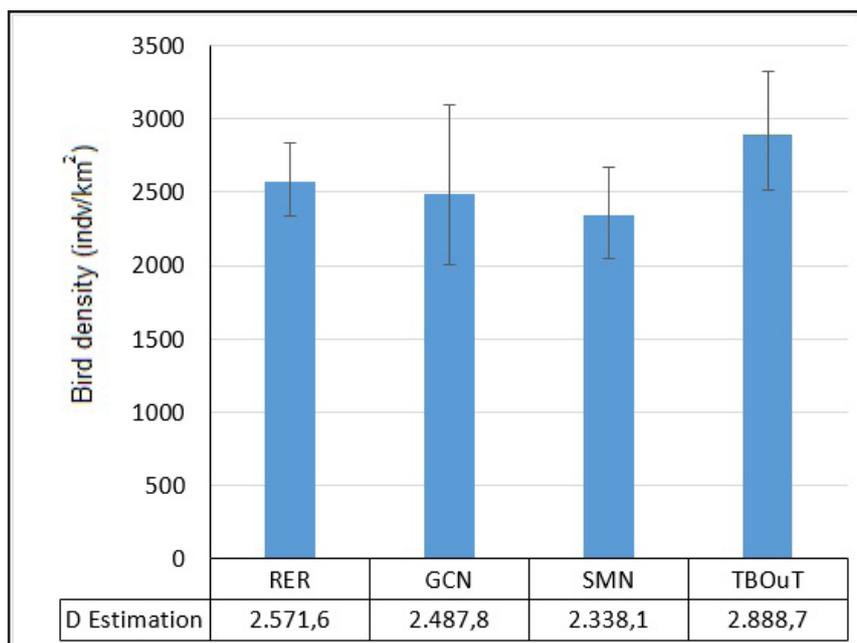


Figure 11. Density estimation of birds in the entire RER area and each concession areas.

## Feeding Guilds

There are nine types of feeding guild that was identified with point count and VES methods in the whole survey area. The types of the most dominating feeding guild are insectivore, frugivore, and insectivore-frugivore (Figure 12), while the feeding guild with the lowest proportion is herbivore-insectivore that is presented by one species; White-winged duck (*Cairina scutulata*).

Based on point count data, the bird abundance was achieved based on the feeding guild in the whole survey area (Figure 13). It can be observed that insectivores kept on being the dominant feeding guild, followed by

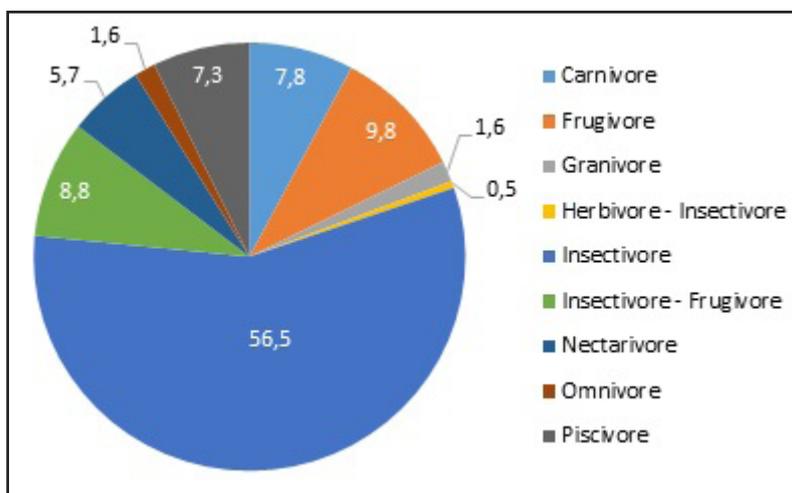


Figure 12. Proportion of number of species based on feeding guilds in the RER area

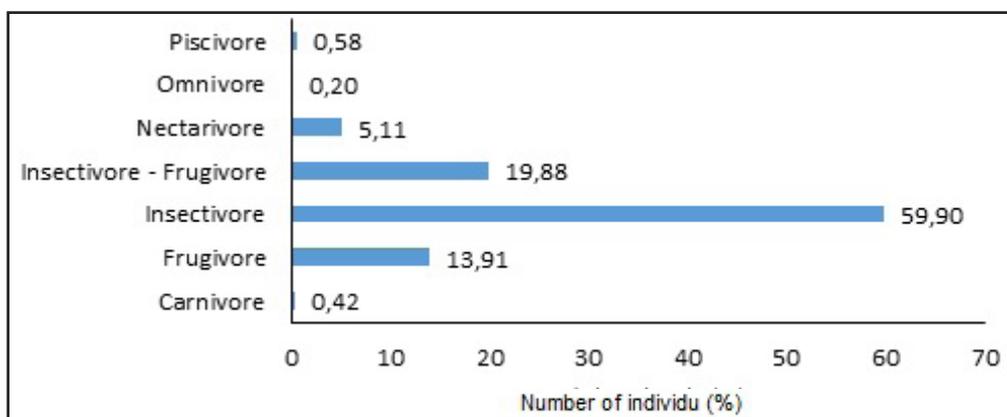


Figure 13. The abundance of birds based on feeding guild

insectivore-frugivore and frugivore. The omnivores have the lowest abundance.

### c. Bird diversity in PT. Gemilang Cipta Nusantara (GCN).

Based on observation result with point count and VES methods, 132 species of bird was found and belong to 36 families with total individual number 2,135 (by using point count method). From the total of species number, one species is a migrant bird, and 131 are resident bird species.

Some bird species that have been sighted are globally threatened species based on IUCN red list and CITES, and protected species in regards to Indonesian government regulation (Table 6). 30 species are categorized as Near Threatened (NT), 3 species categorized as Vulnerable (VU), and one species is categorized as Endangered (EN) (Appendix 1).

Table 6. Some threatened bird species that were found in PT. GCN region.

Local Name	Scientific Name	IUCN	CITES	GOI	Endemic
Great hornbill	<i>Buceros bicornis</i>	NT	I	✓	-
Wallace's hawk-eagle	<i>Spizaetus nanus</i>	VU	II	✓	-
Bonaparte's nightjar	<i>Caprimulgus concretus</i>	VU	-	-	-
Hook-billed bulbul	<i>Setornis criniger</i>	VU	-	-	-
White-winged duck	<i>Cairina scutulata</i>	EN	I	✓	-

The bird diversity and evenness index in PT. GCN region are shown in Figure 14. Transects with highest diversity and evenness indexes are RK\_GC04, RK\_GC03, and RK\_GC05. Each transects are not significantly different with each other, because the value of t test to the value of H' shows that  $p > 0.05$ . Meanwhile, the lowest diversity index is in RK\_GC06, RK\_GC08, and RK\_GC07 transects. The H' value between those transects are not significantly different ( $p > 0.05$ ) but if compared with RK\_GC04, RK\_GC03, and RK\_GC05 transects, there is a significant difference ( $p < 0.05$ ). Based on the dominance index (Figure 15), transects RK\_GC08 and RK\_GC06 have the highest D values, while RK\_GC04 has the lowest dominance index.

Based on the evenness composition (Figure 16), bird in PT. GCN region can be classified into 5 groups. Group 1 is transects RK\_GC03, RK\_GC04, RK\_GC01, RK\_GC02, and RK-BS01. Group 2 is RK\_GC08, group 3 is RK\_GC05, group 4 is RK\_GC07, and group 5 is RK\_GC06. Group 5 and 6 have the most different bird composition compared to other groups, with evenness level that only reaches 64%.

The bird of PT. GCN composed as insectivores as much as 58% (77 species), and followed by frugivore as much as 13 % (17 species), and frugivore-insectivore as much as 12% (16 species). Herbivore-insectivore bird and omnivore bird are groups with the smallest proportion, which is only 1 % (1 species) (Figure 17).

**d. Bird diversity in PT. Sinar Mutiara Nusantara (SMN).**

As much as 134 bird species were found in PT. SMN region based on the investigation with point count and VES methods. The bird belongs to 41 families and number of individuals obtained from point count method is 3,082 individuals. 6 species are migrant bird and 128 species are residents.

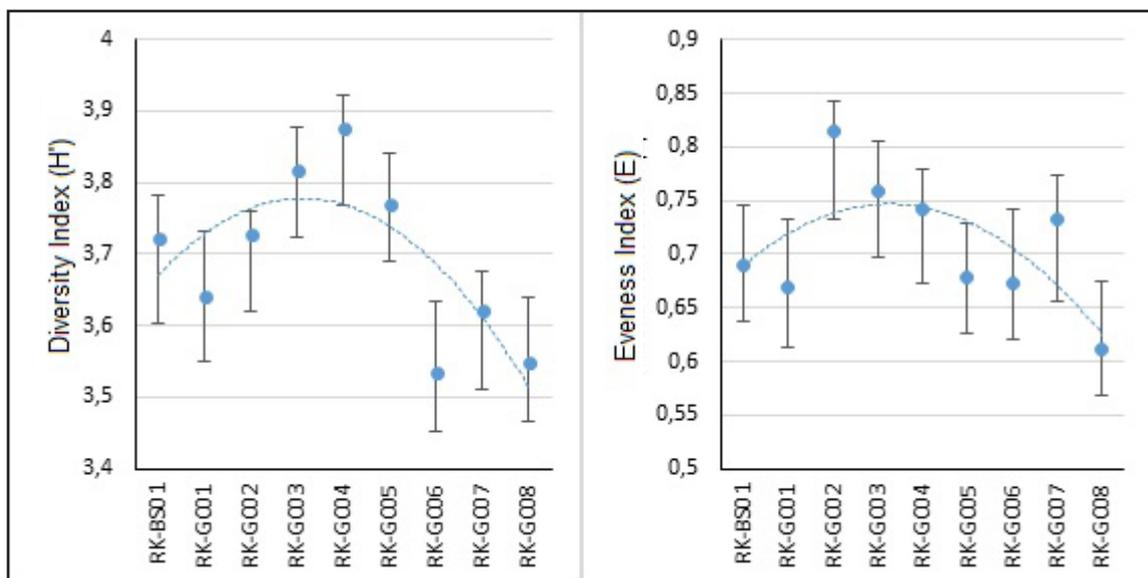


Figure 14. Diversity and evenness index between transects in PT. GCN region

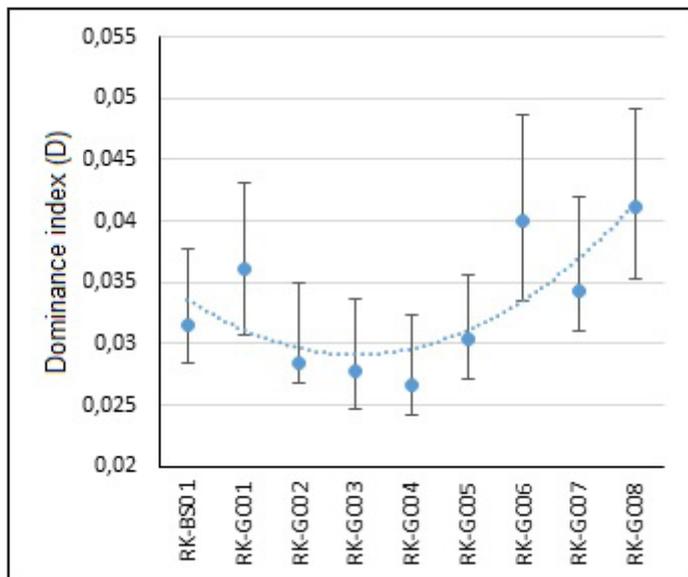


Figure 15 Dominance index between transect in the PT. GCN region

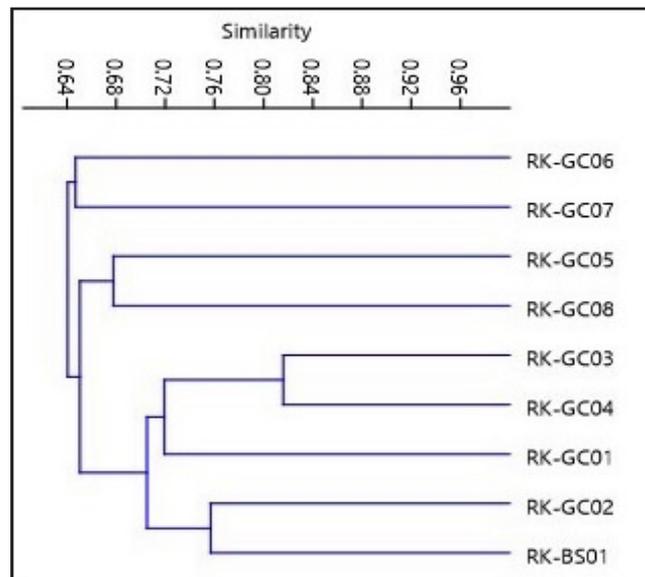


Figure 16 Dendrogram of species composition similarity between transect in the PT. GCN region

Some bird species that has been found are globally threatened species based on IUCN and CITES, and protected species based on Indonesian government regulation (Table 7). 28 species are categorized as Near Threatened (NT), 7 species categorized as Vulnerable (VU), and one species is categorized as Endangered (EN) (attachment 1).

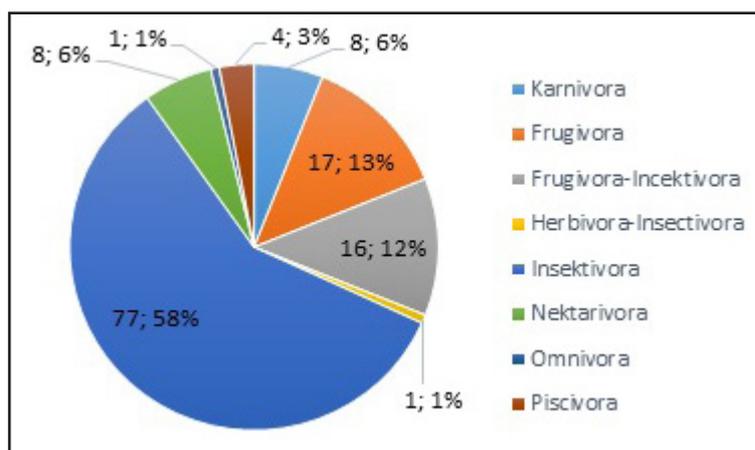


Figure 17 Proportion of number of species based on feeding guild in the PT. GCN region

Table 7. Some threatened bird species that were found in PT. SMN region

Local Name	Scientific Name	IUCN	CITES	GOI	End.
Great Hornbill	<i>Buceros bicornis</i>	NT	I	✓	-
Wallace's Hawk-eagle	<i>Spizaetus nanus</i>	VU	II	✓	-
Short-toed Coucal	<i>Centropus rectunguis</i>	VU	-	-	-
Bonaparte's Nightjar	<i>Caprimulgus concretus</i>	VU	-	-	-
Lesser Adjutant	<i>Leptoptilos javanicus</i>	VU	-	✓	-
Crestless Fireback	<i>Lophura erythrophthalma</i>	VU	-	-	-
Black Partridge	<i>Melanoperdix nigra</i>	VU	-	-	-
Hook-billed Bulbul	<i>Setornis criniger</i>	VU	-	-	-
Milky Stork	<i>Mycteria cinerea</i>	EN	I	✓	-

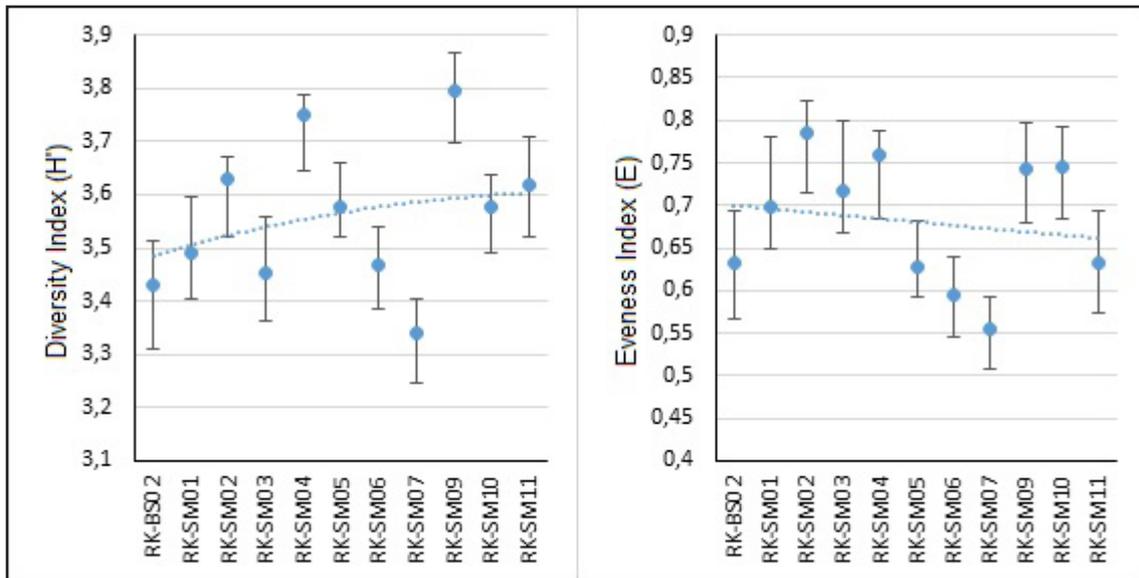


Figure 18. Diversity and evenness index between transects in PT. SMN region

Based on the diversity and evenness indexes (Figure 18), the RK\_SM09 and RK\_SM04 transects have the highest diversity and evenness. The value of  $H'$  between the two transects are not significantly different ( $p > 0.05$ ). Meanwhile, transect RK\_SM07 has the lowest diversity index and is significantly different with RK\_SM09 and RK\_SM04 ( $p < 0.05$ ). Transect RK\_SM07 also has the highest dominance index (Figure 19) which indicates that there is a dominance by one or some species in that transect.

Based on the bird composition similarity (Figure 20), the transect of PT. SMN can be classified into 3 group 1 which consist of RK\_SM11 and RK-BS02 transects. Group 2 with transects RK\_SM09, RK\_SM02, RK\_SM10, RK\_SM01, and RK\_SM03. While group 3 are transects RK\_SM04, RK\_SM05, RK\_SM06, and RK\_SM07. Group 1 has the most varied bird compared to other groups with similarity level of only 67%.

Insectivorous bird is also dominant in PT. SMN with proportion as much as 60% (81 species), this is followed by group of frugivore and group of fruit and insect consumer (frugivore-insectivores) with 10% (13 species) and 9% (12 species) respectively. Group with the least proportion is grain consumer bird (granivores) and omnivores with each proportions as much as 2% (2 species) (Figure 21).

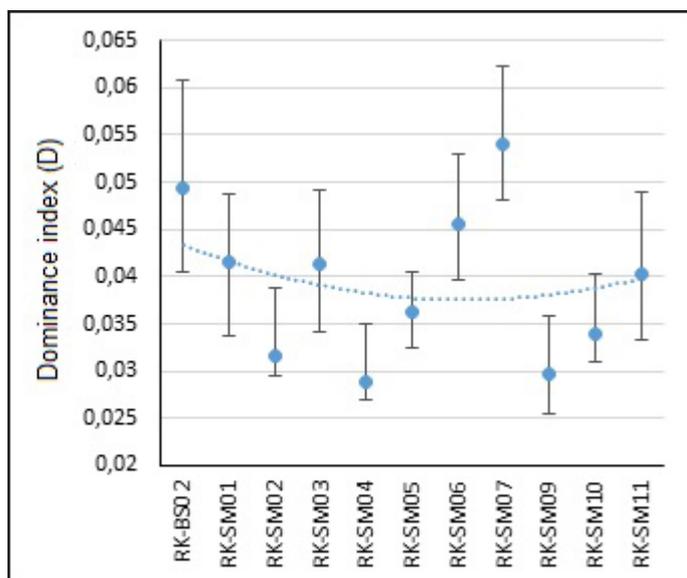


Figure 19. Dominance index between transect in the PT. SMN region

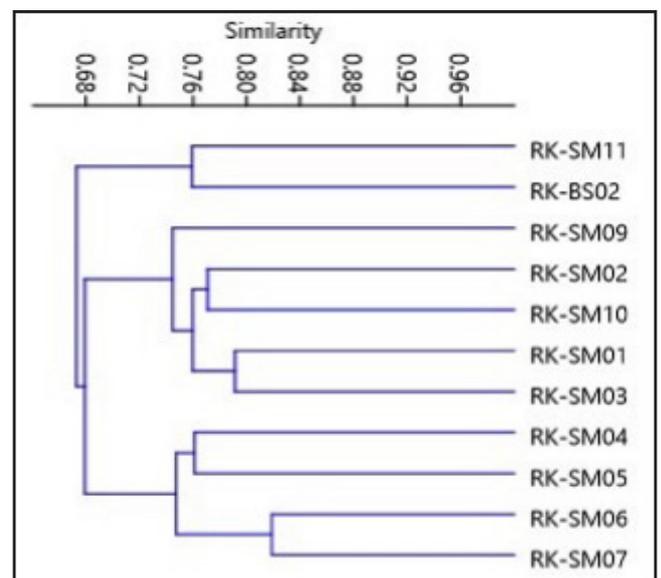


Figure 20. Dendrogram of species composition similarity between transect in the PT. SMN region

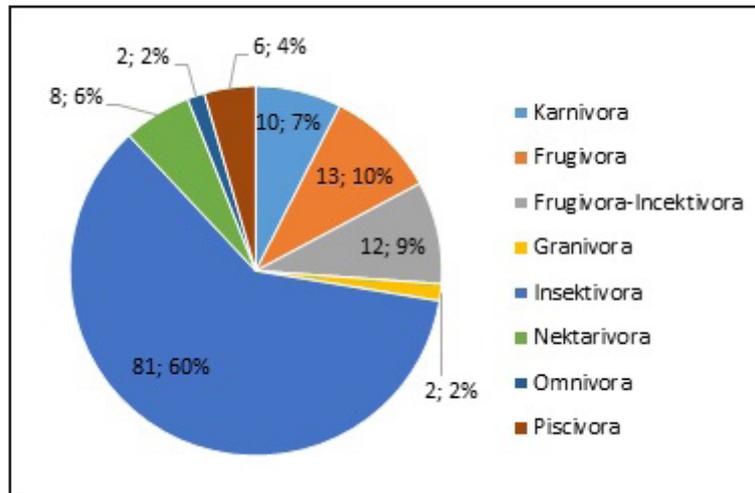


Figure 21. Proportion of number of species based on feeding guild in the PT. SMN region

#### e. Bird diversity in PT. The Best One Unitimber (TBOT).

As much as 143 bird species are found in PT. TBOT region (by point count and VES methods). The bird belongs to 45 families with recorded number of individuals as much as 4,291 individuals through point count method. 12 species are migrant bird and the other 121 species are residents.

Some found bird are globally threatened species based on IUCN and CITES, and species that are protected by Indonesian government regulation (Table 8). 31 species are categorized as Near Threatened (NT) and 4 species are categorized as Vulnerable (VU) (attachment 1).

Diversity and evenness indexes in PT. TBOT are shown in Figure 22. The highest diversity of bird is recorded on transects RK\_TB07, RK\_TB05, RK\_TB01, and RK\_TB02. The t test to the H' value on every transect shows diversity index that are not significantly different ( $p > 0.05$ ). The lowest bird diversity is on transects RK\_TB09 and RK\_TB06. Both transects have H' values that are not significantly different between one and another ( $p > 0.05$ ), but they are significantly different with transects RK\_TB07, RK\_TB05, RK\_TB01, and RK\_TB02 ( $p < 0.05$ ).

The bird species composition in PT. TBOT region is generally shows classification into three groups. Group 1 is bird in transects RK\_TB04, RK\_TB06, RK\_TB05, RK\_TB07, RK\_TB02, RK\_TB03, and RK\_TB01. Group 2 is transects RK\_TB08, RK\_TB12, RK\_TB10, and RK\_TB011. Group 3 is transect RK\_TB09. Group 1 has the most different bird composition compared to group 2 and 3 with evenness level of 62%.

Based on its feeding guild, insectivores have the largest proportion in PT. TBOT region with 60% (85 species). This is followed by frugivore and frugivore-insectivores as much as 10% (14 species) and 8% (12 species). The smallest proportion is on omnivores and granivores with 2% (2 species) (Figure 25).

Table 8. Some threatened bird species that were found in PT. TBOT region

Local Name	Scientific Name	IUCN	CITES	GOI	End.
Great Hornbill	<i>Buceros bicornis</i>	NT	I	✓	-
Short-toed Coucal	<i>Centropus rectunguis</i>	VU	-	-	-
Crestless Fireback	<i>Lophura erythrophthalma</i>	VU	-	-	-
Black Partridge	<i>Melanoperdix nigra</i>	VU	-	-	-
Hook-billed Bulbul	<i>Setornis criniger</i>	VU	-	-	-

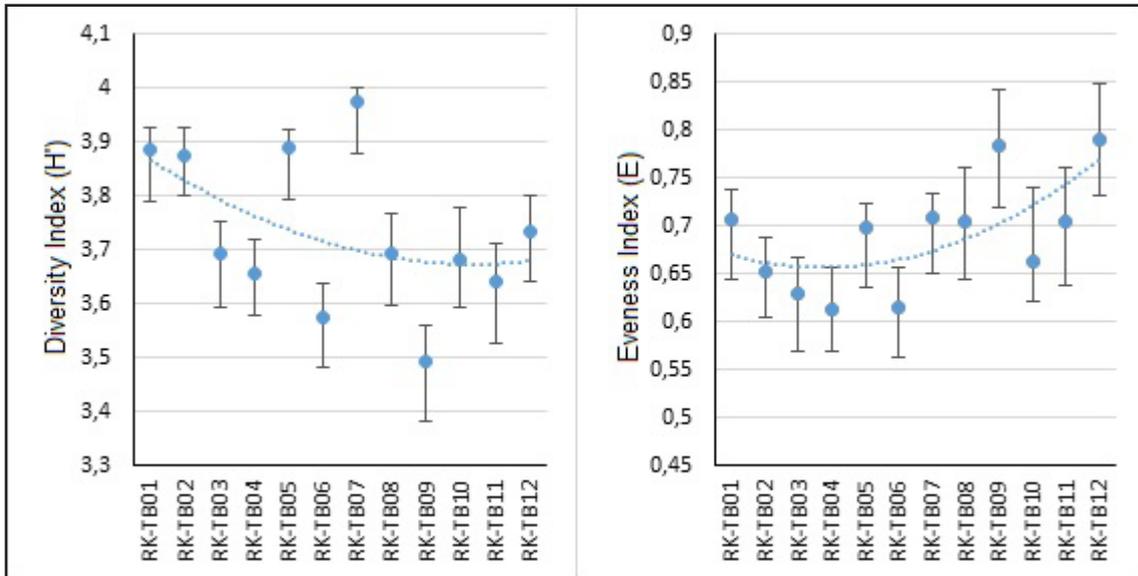


Figure 22. Diversity and evenness index between transects in PT. TBOT region

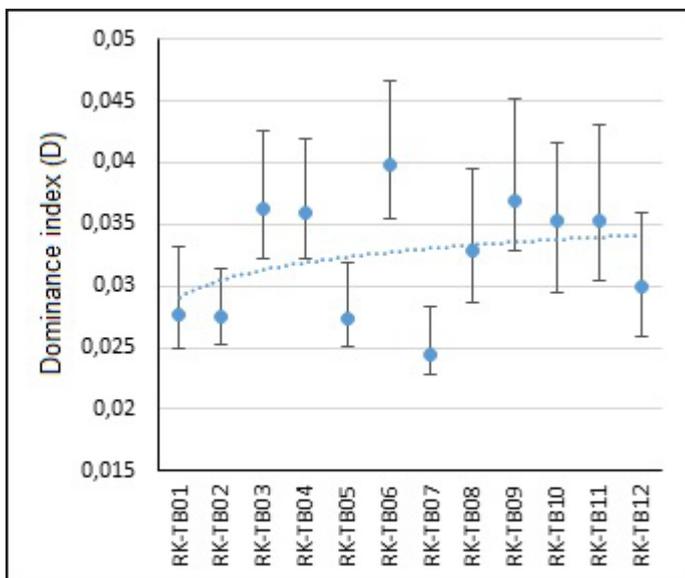


Figure 23. Dominance index between transect in the PT. TBOT region

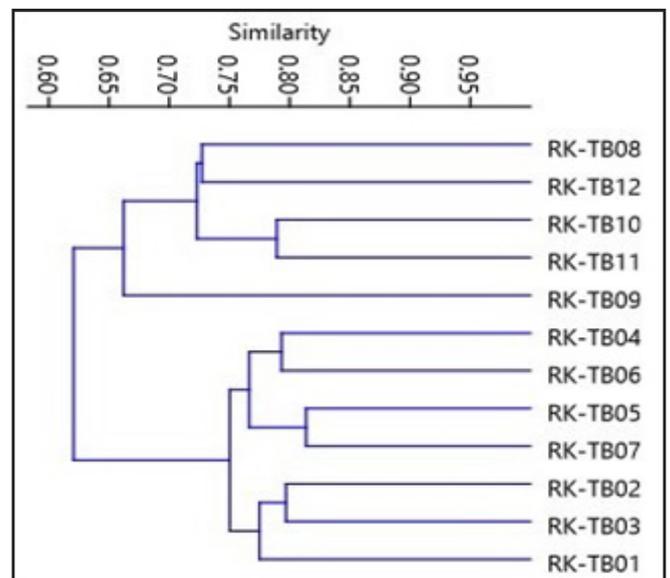


Figure 24. Dendrogram of species composition similarity between transect in the PT. TBOT region

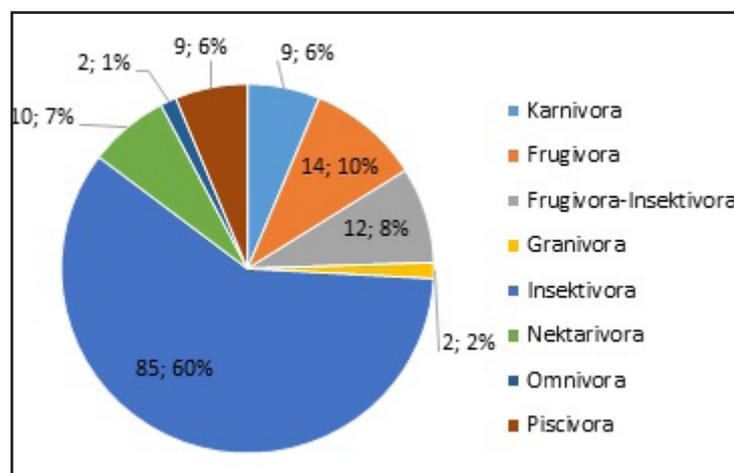


Figure 25. Proportion of number of species based on feeding guild in the PT. TBOT region

## f. Threats to bird in RER region.

The threats categorized into two; threats with indirect impact and threats with direct impact. In the survey area, threats with indirect impact are natural habitat destruction and the loss of big trees because of illegal logging. Meanwhile the direct impact is illegal hunting. The illegal hunting was executed by local community from the neighboring villages. Some species that are targeted for hunting are Blue-crowned hanging parrot (*Loriculus galgulus*), Blue-winged leafbird (*Chloropsis cochinchinensis*), Greater green leafbird (*Chloropsis sonnerati*), Lesser green leafbird (*Chloropsis cyanopogon*), and White-rumped shama (*Copsychus malabaricus*).

## 3.2 DISCUSSION

### a. Comparison of bird diversity in Peat Swamp Ecosystems

There have been researches about bird diversity in peat swamp forest areas especially in Kalimantan and Sumatra (Gaither, 1994; Fujita et al., 2012; Posa & Marques, 2012; Sheldon et al., 2014). Most of the results of the researches elaborate that the bird diversity in peat swamp forest has a lower value compared to bird diversity in other lowland forest areas. The bird diversity comparison that has been performed by Gaither (1994) in Gunung Palung National Park, Kalimantan showed that bird diversity in peat swamp forest is significantly lower than lowland dipterocarp forest.

A slightly different result is shown through survey that was done in RER region. 193 species of bird that was found in RER region (180 residents and 13 migrants) are still classified as the same bird species number that were found in Bukit Tigapuluh lowland dipterocarp forest with 193 bird species (Danielsen & Heegaard, 2011). Number of species of bird found in RER region includes 30% from the total of 635 bird species that exist in Sumatra and 12% from the total of 1,598 bird species that exist in Indonesia (Sukmantoro et al., 2007).

When compared with other peat swamp forests such as Bukit Batu, Riau, and Merang-Kepayang, South Sumatra, the bird species richness in RER region is different and quite higher. Bukit Batu peat swamp forest region has become a habitat for 172 species and 156 species in Merang-Kepayang region (Iqbal & Setijono, 2011; Fujita et al., 2012). The bird species richness in RER region shows a higher tendency from the increasing rarefaction curve result. It is assumed that the species that was not detected yet is a species with very low abundance (rare) hence the probability of sighting is very small or whether the species is elusive, which will move immediately once it detects disturbance (Young, 1998).

A difference in vegetation structure, habitat heterogeneity, food availability, and habitat destruction are assumed to have caused difference in bird species richness at several comparable areas including the RER region (Iqbal & Setijono, 2011; Fujita et al., 2012). A specific preference by certain bird species can also enable differences of bird species richness between those areas (Blake & Loiselle, 2001). This is at least observed from the presence of some species that require specific habitat that can be found in some compared areas but are not present in all RER region, such as Helmeted hornbill (*Rhinoplax vigil*), Ruddy kingfisher (*Halcyon coromanda*), Crested fireback (*Lophura ignita*), White-crowned forktail (*Enicurus leschenaulii*), and Chesnut-capped thrush (*Zoothera interpres*). Even so, difference on survey effort factor can also be assumed to influence difference on number of bird species richness that was found between regions.

Bird that inhabits canopy layer is a dominant group in RER region (20 families). Families of cuckoos, woodpeckers, hornbills, cuckoo-shrikes, doves, and owls are the main component of the group. The next dominant group is bird that inhabits understory layer (17 families). Family cuckoos has a higher species proportion that was caused by species addition that came from migrant species such as Indian cuckoo (*Cuculus micropterus*) and Common cuckoo (*Cuculus canorus*).

The main component of understory layer bird groups comes from babblers, sunbirds, flowerpeckers,

flycatchers, kingfishers, and warblers. Species that are included in family babblers are species that inhabit the surface or near the soil surface between shrubs and understory layer of trees (MacKinnon et al., 2010). In the meantime, almost all survey areas have the characteristic of high shrub vegetation which supports the life of groups of babblers and other understory layer bird species (Modena et al., 2013). When observed from its abundance, the understory layer bird group has a much higher abundance compared to the group that inhabits canopy layer. That condition indicates how important the lower vegetation structure and heterogeneity are to dominant bird group in RER region.

Gaither (1994) stated that peat swamp forest is crucial for the ecology of understory layer bird community in South East Asia region. This was based on his research that revealed a high abundance of understory layer bird at peat swamp forest if compared to dipterocarp forest in Gunung Palung National Park, West Kalimantan. Besides, the existence of some understory layer bird species that are specialists to peat swamp forest has increase the importance value of the area. Scarlet-breasted flowerpecker (*Prionochilus thoracicus*) and Grey-breasted babbler (*Malacopteron albogulare*) are specialists that were found in peat swamp forest of Gunung Palung National Park and were also found in RER region.

Other than the specialist species, 13 understory layer bird species are species that are categorized as NT (near threatened) such as Fluffy-backed tit-babbler (*Macronous ptilosus*), Sooty-capped babbler (*Malacopteron affine*), Rufous-crowned babbler (*Malacopteron magnum*), Black-throated babbler (*Stachyris nigricollis*), and Mangrove pitta (*Pitta megarhyncha*). Two species of understory layer also have the status of vulnerable (VU) such as Black partridge (*Melanoperdix nigra*) and Crestless fireback (*Lophura erythrophthalma*).

Based on its conservation status, RER region has become a habitat for 3 (1.55%) bird species that are included on CITES appendix I and 25 (13%) bird species in appendix II. Bird species that are included in appendix I are Great hornbill (*Buceros bicornis*), White-winged duck (*Cairina scutulata*), and Milky stork (*Mycteria cinerea*). Some bird species that are included in appendix II are Wallace's hawk-eagle (*Spizaetus nannus*), Oriental hobby (*Falco severus*), Long-tailed parakeet (*Psittacula longicauda*), Blue-crowned hanging parrot (*Loriculus galgulus*), Brown wood owl (*Strix leptogrammica*), Wrinkled hornbill (*Aceros corrugatus*), Wreathed hornbill (*Rhyticeros undulatus*), Rhinoceros hornbill (*Buceros rhinoceros*), and Common hill myna (*Gracula religiosa*).

Besides that, a large number is seen from bird species that are protected by Constitutions (UU) No. 5 year 1990 and Government Regulation (PP) No. 7 year 1999, there are as much as 46 species or 23.8% from the total of sighted bird in RER region. The large proportion number of protected species based on IUCN, CITES, and Regulation of Republic of Indonesia depicts the importance of RER region in conservation of protected bird species in Kampar Peninsula in general.

## **b. Bird diversity**

Diversity is varied and significantly different between concession areas except for those in PT. GCN and PT. TBOT. The high diversity index in PT. GCN and PT. TBOT generally shows that bird community is quite varied and the number of individuals of each species is almost spread evenly, or in other words, there are no species that are very dominant in the region (Swastikaningrum et al., 2012; Bibi & Ali, 2013). On the other hand, low diversity on PT. SMN region is suspected to be caused by dominance of one or some species. This can be seen by the highest dominance index in PT. SMN when compared to the other two regions (Figure 9).

Diversity is determined by the number of species and the individual number evenness between species. The higher number of species and the higher the individual number evenness are, the bird diversity will be higher, and vice versa (Krebs, 1985). A different but not significant diversity index between PT. GCN area and PT. TBOT areas is caused by high number of species and high individual number evenness on both regions compared to area of PT. SMN. The high amount of number of species found in PT. TBOT area can be influenced by factors of habitat structure and complexity in that region.

The result from microhabitat measurements (Table 1) indicates that PT. TBOT region generally have taller

trees, similar percentage for 5-15 m and > 15 m height, and followed by higher percentages for liana plants. That condition made an impact to a higher habitat complexity in PT. TBOT region compared to other regions. A more complex habitat will generally provide more resources and niche availability so it will be able to support more bird species (Diaz et al., 2005; Soka et al., 2013).

The presence of migrant species is also assumed to contribute to bird community diversity and dynamics in RER region (Blake & Loiselle, 2001). Generally, migrant species covers South East Asia region, especially Indonesia from September to January. The peak of migration starts happening at the beginning of October until December (Alerstam & Christie, 1993; Berthold, 2001). In the meantime, survey on PT. TBOT region was performed from November to December, which is the best season of migratory bird being sighted.

The diversity index on PT. GCN region is not significantly different with PT. TBOT and also with species number of bird that is higher than PT. SMN region. The numerous amount of species in that region can be influenced by the area location which is directly adjacent with edge of forest area which will trigger the edge effect (Sisk & Battin, 2002; Batáry et al., 2014). As the result, there is a mixture between forest interior bird species and bird species that can adapt to open areas or habitats that are converted by human activity.

On PT. GCN and PT. SMN regions there are less bird species sighted compared to PT. TBOT region. The difference is assumed to be influenced by factor of understory layer component plant composition variation on each region. The understory layer component plant composition for PT. GCN and PT. SMN regions is commonly *Rassau (Pandanus helicopus)*. A more variable plant composition may provide more food resources, shelters, able to attract more insects, and a more variable area for food resources (Diaz et al., 2005; Azman et al., 2011). That is why the less number of species in PT. GCN and PT. SMN compared to PT. TBOT is assumed to be caused by a simpler understory layer plant composition and that there are less niche available for bird species, especially for group of understory layer bird.

PT. SMN region has a lower and significantly different diversity index compared to regions of PT. GCN and PT. TBOT. The condition is influenced by the high dominance index that indicates a presence of one or some very dominating species in the region. The relative abundance achieved (Table 4) shows that Cream-vented bulbul (*Pycnonotus simplex*) is abundant in all concession areas, but the value is highest in PT. SMN region. The high relative abundance of Cream-vented bulbul (*Pycnonotus simplex*) is generally caused by the habitat preference and the larger food niche, so it can adapt well in all three concession areas (Peh & Ong, 2001).

Besides, based on site observation, there are many forest gaps in PT. SMN region. For some bird species, the presence of forest gaps means a loss habitat as food source and shelter from predators, especially for terrestrial inhabitant bird such as Black partridge (*Melanoperdix nigra*), Red junglefowl (*Gallus gallus*), and Crestless fireback (*Lophura erythrophthalma*) along with understory layer inhabitant bird species (Thiollay, 1997). But for Cream-vented bulbul (*Pycnonotus simplex*) and some canopy layer inhabitant species, the gap is used as a place to search food such as insects that can be found in open areas (Thiollay, 1997; MacKinnon et al., 2010).

Other than that, Long-tailed parakeet (*Psittacula longicauda*) is often found in the number of dozens to be utilizing forest gaps as roosting site. In some records it is also stated that Long-tailed parakeet are often sighted to visit and use degraded forest and decaying trees (Posa & Marqques, 2012; Sheldon et al., 2014). This condition will cause a relative high abundance of Long-tailed parakeet in SMN region.

Low diversity and abundance of bird in PT. SMN region is assumed to be caused by the fact that most of the region is a part of a peat dome. Peat dome is generally characterized with very low nutrient input from mineral soil or runoff from the surrounding area. It effects the region to be usually oligotrophic with high water acidity (<pH 4) (Göltenboth, 2006; Posa et al., 2011). Oligotrophic condition will affect the environmental primary productivity to be low which will indirectly causes deficit of resources for bird community in the region (Begon et al., 2006). Posa et al. (2011) even predicted that high abundance and diversity of wild animals only happen in mixed peat swamp forest that is located in the edge of peat dome.

## **Composition and Evenness of Bird Species**

Based on the composition evenness dendrogram of bird species (Figure 10), regions between concessions are estimated to have a quite high bird species composition (>77%, Table 5) with the highest evenness on SMN and TBOT regions. This indicates that most of the species have similar ecology roles within three different concession areas. The landscape continuity between those three concession areas is assumed to have caused most bird species can exploit RER regions as a whole (low species turnover) (Blake & Loiselle, 2001).

The composition evenness dendrogram of bird shows quite a difference between bird species composition in PT. GCN area when compared to PT. SMN and PT. TBOT. Bird species that can only be found in GCN region are mostly the species that adapt to open and modified habitats. For example Yellow-vented bulbul (*Pycnonotus goiavier*), Yellow-bellied prinia (*Prinia flaviventris*), Black drongo (*Dicrurus macrocercus*), Olive-backed sunbird (*Cynniris jugularis*), Silver-rumped spinetail (*Rhaphidura leucopygialis*), Asian palm swift (*Cypsiurus balasiensis*), House swift (*Apus nipalensis*), Cinnamon-headed green pigeon (*Treron fulvicollis*), White-breasted waterhen (*Amaurornis phoenicurus*), and Yellow-bellied bulbul (*Criniger phaeocephalus*) (MacKinnon et al., 2010). Even so, there are some species from forest interior that can only be found in this area, they are Buffy fish owl (*Ketupa ketupu*), Orange-breasted trogon (*Harpactes oreskios*), Rufous woodpecker (*Micropternus brachyurus*), Grey-headed babbler (*Stachyris poliocephala*), Brown-backed flowerpecker (*Dicaeum everetti*), and Yellow-vented flowerpecker (*Dicaeum chrysorrheum*). The presence of those species also strengthened the assumption that there is a skirt effect on GCN region.

## **The Bird Density**

Based on the estimation of bird density (Figure 11), there is no significant difference between bird density in PT. GCN, PT. SMN, and PT. TBOT regions. But there seem to be the tendency of lower bird density in SMN and GCN regions compared to TBOT region. According to Nelson (1996), the habitat structure and complexity can influence bird density. This is related to the increase of resources on a more complex habitat. Based on the measurement of habitat structure on every concession areas, it is shown that PT. TBOT region has a higher habitat complexity. This is assumed to be supporting a higher bird density in PT. TBOT.

The variation of fruiting season is specifically influencing the abundance and density of birds in a habitat (Anggraini et al., 2000; Soka et al., 2013). The survey for PT. TBOT was performed starting in November until December. In the bird survey in RER region, data collection was not done to know the fruiting season of the region, but it is assumed that the fruiting season begins in November. This is based on the encounter with increasing frequency of fruiting trees since November. A high rainfall from mid-November in RER region can also support the flowering and fruiting process in the region (Bibi & Ali, 2013).

The lowest bird density in PT. SMN region is assumed to be influenced by the presence of peat dome on the area. The peat dome is characterized with oligotrophic condition that causes the habitat productivity to be low. This affects to a low bird abundance and density since there are less resources that can be used (Begon et al., 2006; Posa et al., 2011). Besides, strong influence from El Nino that occurred through September to October in Indonesia has impacted on fire at some regions (Antara News, 2015; Kompas Cyber Media, 2015). This has caused the forest area on PT. SMN concession region to be covered with smog during the scheduled survey between September to October. The condition is quite affecting the presence of bird and the detection of bird by the observer in survey area, which finally influences the bird density estimation and makes some species to be dominant, hence causing a high level of dominance in SMN area.

## **Feeding Guilds**

Forest physical structure condition is very influential to the bird community within, including the influence to bird community composition based on type and food seeking methods (feeding guild), so feeding guild can be used as an indicator of forest ecological condition (Holmes et al., 1979; O'Connell et al., 2000). Based on the obtained identified feeding guild, it is known that insectivores are the main group component of bird

community in RER region, whether it is seen from the number of species or its abundance.

Insectivore is a type that usually abundant in forest area (Blake & Loiselle, 2001; Modena et al., 2013). Most of the insectivore bird types has a very small size, known to be very dependent to forest habitat and relatively sensitive to habitat destruction (Modena et al., 2013; Li et al., 2013). So indirectly, the presence and the abundance of insectivore species reflect proper forest rehabilitation in RER region.

One of the insectivore family that can be used as indicator is woodpeckers (Angelstam & Mikusiński, 1994). Most of the species of woodpeckers is very dependent to forest and dead trees that can only be found in the forest landscape. So the presence of some woodpecker species can reflect natural dynamics that is happening in the forest and can detect an occurring anthropogenic disturbance. (Mikusiński et al., 2001). From the total of 23 species from the family woodpeckers in Sumatra (Sukmantoro et al., 2007), 11 species (48%) of them can be found in RER region. The number is relatively higher compared to the number of woodpeckers that was found in other peat swamp forest such as in peat swamp forest of Merang Kepayang (8 species) and Bukit Batu (10 species) (Iqbal & Setijono, 2011; Fujita et al., 2012).

The next main feeding guild in RER region is frugivore. Family of bird is composed of doves, parrots, flowerpeckers, and hornbills. The presence of frugivore bird indicates the availability of fruit trees in RER region that is important for forest regeneration and indicating RER area as feeding ground for frugivore birds (Blake & Loiselle, 2001; Meijaard et al., 2006). The presence of frugivore bird from family hornbills is considered to be crucially important in RER region because the species of Hornbill is considered as an indicator of a success forest regeneration and as an indicator of reserves for tree biodiversity (Meijaard et al., 2006). Not less than six species from nine Hornbills that existed in Sumatra (Sukmantoro et al., 2007) can be found in RER region. Some examples of tree species that can be used by hornbill are *Myristica lowii*, *Tetramerista glabra*, *Ficus sundaica*, *Polyalthia glauca*, *Syzygium* spp., *Santiria laevigata*, *Aglaia rubiginosa*, *Palaquium* sp., and *Calophyllum lanigerum*. Those trees species are generally characterized with a tall trunk with fleshy encapsulated fruit, with seeds, and with high concentration of sugar (Meijaard et al., 2006).

### c. Important Species and Their Threats

Table 2 shows threatened and protected bird species that can be found in RER region. Bird species such as Great hornbill, Wallace's hawk-eagle, Bonaparte's nightjar, Short-toed coucal, Lesser adjutant, Crestless fireback, Black partridge, Hook-billed bulbul, White-winged duck, Milky stork, and Storm stork are considered as important because they are categorized as near threatened to endangered and/or included in appendix I CITES.

Great hornbill and Wallace's hawk-eagle are species with wide exploration range and inhabit forest habitats that are characterized with the presence of big trees. Even so, the records of Wallace's hawk-eagle have shown that the species are able to tolerate habitats that have been degraded a bit (BirdLife International, 2016). Great hornbill is detected in all concession regions and is observed to be very associated to the presence of big trees.

The highest Great hornbill sighting frequency (18 sightings) occurred in PT. TBOT region, especially on transects that are the furthest from skirt area (RK-TB04, RK-TB05, RK-TB06, RK-TB07, and RK-TB12). Three sightings happened in PT. GCN region, and only two sightings took place in PT. SMN region. Meanwhile, the Wallace's hawk-eagle is only detected on PT. GCN (4 sightings) and PT. SMN (2 sightings). However, in the area of PT. GCN also found the nest of one of Wallace's Hawk individuals indicating that region is quite important as a breeding ground. The main threat to both Great hornbill and Wallace's hawk-eagle are the loss of habitat and big trees to find food and to nest due to illegal logging and land conversion (BirdLife International, 2016).

Bonaparte's nightjar, Short-toed coucal, Crestless fireback, Black partridge, and Hook-billed bulbul, are threatened species because of extreme specialization to lowland forest that is undergoing degradation, fragmentation, and loss of habitat due to land conversion. Most of them, with a dense and small size

population, inhabit primary forest, secondary forest, and forests that are slightly degraded but still had dense canopy layer. Hook-billed bulbul, is specifically recorded to be specialized on peat swamp forest habitat, and tend to avoid primary forest (MacKinnon et al., 2010; ARKive, 2016; BirdLife International, 2016). Based on the number of sightings, it is recorded that the highest sightings happened in PT. TBOT region (Table 9) that is suspected to be caused by a more supportive vegetation condition and a lower habitat destruction level. Posa et al. (2012) mentioned that the species distribution record for Black Partridge is still very limited especially in Sumatra, the latest records came more from Kalimantan. This is also similar with Bonaparte's nightjar, this species has been recorded more in Sumatra in Way Kambas National Park, Lampung (Cleere, 2016). In that case, the existence of Black partridge and Bonaparte's nightjar in RER region has become the latest distribution records of the species in Sumatra (McGowan & Kirwan, 2016).

Table 9. Number of sightings of lowland specialist species on every RER concession region.

Local Name	Scientific Name	Σ Detection in PT. GCN	Σ Detection in PT. SMN	Σ Detection in PT. TBOT
Bonaparte's Nightjar	<i>Caprimulgus concretus</i>	1	1	
Short-toed Coucal	<i>Centropus rectunguis</i>		9	34
Crestless Fireback	<i>Lophura erythrophthalma</i>		1	2
Black Partridge	<i>Melanoperdix nigra</i>	1	1	14
Hook-billed Bulbul	<i>Setornis criniger</i>	12	22	75

The main threat to those five lowland specialist species is the missing forest habitat, fragmentation, and forest degradation, especially the peat lowland forest. The other threat is hunting for food that gives more impact to terrestrial and large-size species, such as Crestless fireback and Black partridge (BirdLife International, 2016). It is confirmed by result of discussion with local community that accompanied us during data collection on the field, that Crestless fireback and Black partridge are being hunted for food. This habit is especially done by their partner who is a bird hunter during the time to find a bird in the surrounding of RER region.

White-winged duck, Lesser adjutant, Milky stork, and Storm stork inhabit natural lowland forest and/or a slightly disturbed forest, wetland, or aquatic habitat, mangrove habitat, and riparian habitat that are in adjacent to forest, its population density becomes very low and fragmented (MacKinnon et al., 2010; BirdLife International, 2016; Elliott et al., 2016). White-winged duck commonly inhabits aquatic habitats that are without current or weak current in the forest or areas that are in adjacent with the forest, including peat swamp forest. Those species make nests in big holes of trees in riparian habitat (Carboneras & Kirwan, 2016).

The sighting of White-winged duck in RER region only occurred in PT. GCN region where they have been observed 3 times (2-3 individuals on each sightings) only in canals, the canal of Puskopol are and the canal that is next to transect RK\_GC06. High level of human activity and habitat disturbance on those areas had caused the existence of White-winged duck in RER region to be threatened.

Lesser adjutant and Milky stork nest on big trees with dense canopy in riparian habitat and/or mangrove habitat (BirdLife International, 2016; Elliott & Garcia, 2016). Their presence in the RER region was only detected several times in Serkap River before the cross over and in the left corner of Serkap River. The Milky stork presence was only identified through camera trap that was installed in PT. TBOT region. Similar to Lesser adjutant and Milky stork, Storm stork is assumed to have strong association with the existence of Serkap River riparian habitat, which is mostly adjacent to PT. TBOT region. The presence of that detection had caused the riparian habitat of Serkap River to be crucial as a habitat for those threatened species.

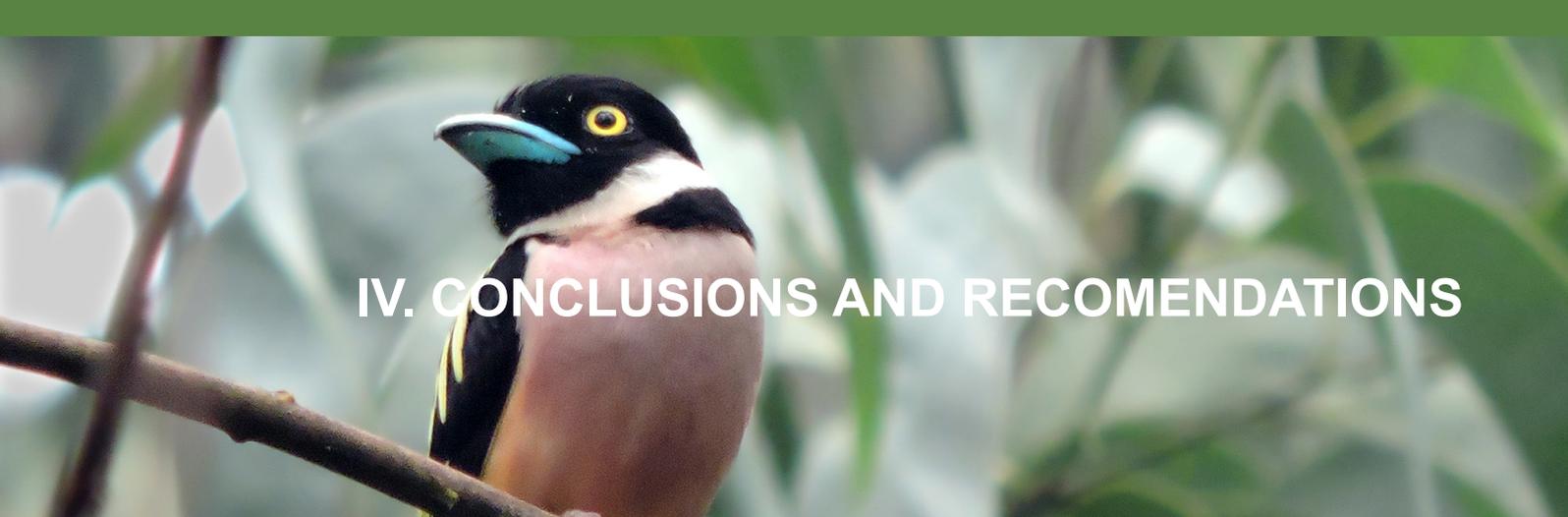
The main threat for those four aquatic species is the loss of ground to search for food and nesting area because of land conversion, degradation of riparian habitat, and forest fires (Carboneras & Kirwan, 2016; Elliott et al., 2016; Elliott & Garcia, 2016). Threats such as hunting for food and retrieving eggs and chicks had direct impacts to the species population in RER region. Considering that local community also uses

Serkap River to fish, which will increase the potential of a direct threat to bird.

Generally, the threat of bird hunting from its natural habitat in RER region is still considered as a big threat, especially for species that are categorized in CITES (appendix I and II). The 'belle' species that are mostly hunted for pets for the sound included such as Blue-winged leafbird (*Chloropsis cochinchinensis*), Greater-green leafbird (*Chloropsis sonnerati*), Lesser-green leafbird (*Chloropsis cyanopogon*), Oriental magpie-robin (*Copsychus saularis*), White-rumped shama (*Copsychus malabaricus*), Rufous-tailed shama (*Copsychus pyrrhophygus*) and Blue-crowned hanging parrot (*Loriculus galgulus*). All of those species are included in the CITES Appendix II category. But based on the discussion with some companions during data collection on the field which have conducted illegal hunting, those targets can be very opportunistic. If they found some species that are considered morphologically attractive, those species will also become the hunting target. Bird from family trogons (Scarlet-rumped trogon, Red-naped trogon, and Orange-breasted trogon) and pittas (Javan banded pitta and Hooded pitta) are usually hunted because of their beautiful morphology. Each time hunters enter RER region to find birds for a week, each person would be able to get dozens of bird individuals from several species. Entry access for bird hunters are through Puskopol guard posts of PT. GCN, Serkap River, and Sangar River.

Other than those important bird, there are still many bird species that live in RER region, especially species that are not in the IUCN category, CITES, or being protected by the Indonesian Republic Government Regulation. On the other hand, it is those species that have the potential of being largely hunted since there is no regulation or rules to protect them. In that way, there need to be conservation to all species because every bird whether they are large in size or small in size, each of them has functions and roles in nature in order to create a balanced ecology. If the existence of those bird is disturbed the balance will also be disturbed.

The migrant bird is also an important group that needs to receive attention. The presence of Common cuckoo (*Cuculus canorus*) in RER region, is a new record in Sumatra and Indonesia. That species was last recorded in West Java (Payne & Christie, 2016). Besides the carnivorous migrant bird species (hawks, eagle, kites and falcons) are also interesting species that need to be observed and learned on.



## IV. CONCLUSIONS AND RECOMENDATIONS

### 4.1 CONCLUSIONS

1. A total of 193 bird species were recorded in the RER areas. This record is 30% of the total (635 bird species) known bird species of all varied habitats in Sumatra. This figure is greater than that the total found in the bird survey which was conducted in 2015 in Bukit Batu-Giam Siak Kecil-Riau, and Merang-Kepayang region - South Sumatra province.
2. Based on the abundance, bird that inhabit understory layer are groups which dominated across all RER regions. All plant composition in ground cover influence the presence of bird that inhabit canopy layer.
3. Several important findings of birds in RER such as the globally threatened species (i.e. storm stork, milky stork, lesser adjutant, white-winged duck, wallace's hawk-eagle, crestless fireback and black partridge), the existence of Black partridge and Bonaparte's nightjar is a new record of distribution in Sumatra region and a detection of 13 migrant species. This indicates that RER is one of main route of migratory bird that come to Indonesia. One of migrant species, Common cuckoo (*Caculus canorus*) is the first record of this species in Sumatra.
4. The loss of habitat, forest degradation, and fragmentation are the main threats for bird in RER. The activity of illegal poaching for avifauna, whether to be pets or to be consumed, is another threat for the species existence in RER region.

### 4.2 RECOMENDATIONS

Based on the study of latest presence and composition of bird species in RER region, some recommendation of management plans and actions are elaborated as follows:

1. RER should do an awareness campaign for APRIL employees and local people, with the goal of improving the understanding of bird conservation in the wild.
2. RER could develop several sign boards about bird banning for hunting which need to be installed on RER region, especially in locations which suspected to be the main accesses by the local community.
3. RER should reduce on the opening of new footpaths in every concession areas that can influence a change of understory layer vegetation structure. This is related to maintenance of understory layer that becomes the main habitat for a lot of bird species in RER region, especially for most threatened species. The usage of existing footpaths can be treated as bird monitoring routes.
4. RER could conduct a bird monitoring for its richness and diversity at each concession area of RER at least once in every two years by collecting data of species and number of individuals so the information

of diversity change trend and bird population can be obtained.

5. RER should increase the capacity building for their staffs and RER rangers especially for identifying bird species. The process can be achieved by training and complying field tools that may support bird monitoring, such as camping equipment, field identification guide book, and binoculars.
6. RER could initiate a follow up research about the threatened species such as Storm stork, Milky stork, Lesser adjutant, White-winged duck, Wallace's hawk eagle, Crestless fireback, Black partridge, and Bonaparte's nightjar. Part of that is a monitoring for migratory birds in the RER areas during the migration seasons (October-December and March-April annually).
7. RER could developed either into a research subjects or into a limited tourism (birdwatching tourism) for the existence of endangered, rare, and and migrant birds. PT. GCN region might have an option for having a research area and birdwatching tourism.



## V. BIBLIOGRAPHY

- ALERSTAM, T. & CHRISTIE, D.A. (1993) *Bird Migration*. Cambridge University Press.
- ANGELSTAM, P. & MIKUSIŃSKI, G. (1994) Woodpecker assemblages in natural and managed boreal and hemiboreal forest—a review. In *Annales Zoologici Fennici* pp. 157–172. JSTOR.
- ANGGRAINI, K., KINNAIRD, M. & O'BRIEN, T. (2000) The effects of fruit availability and habitat disturbance on an assemblage of Sumatran hornbills. *Bird Conservation International*, 10, 189–202.
- ANTARA NEWS (2015) BMKG: El Nino menguat September-Oktober 2015. [Http://www.antaraneews.com/berita/514684/bmkg-el-nino-menguat-september-oktober-2015](http://www.antaraneews.com/berita/514684/bmkg-el-nino-menguat-september-oktober-2015) [accessed 25 February 2016].
- ARKIVE (2016) Crestless fireback (*Lophura erythrophthalma*). ARKive. [Http://www.arkive.org/crestless-fireback/lophura-erythrophthalma/](http://www.arkive.org/crestless-fireback/lophura-erythrophthalma/) [accessed 9 March 2016].
- AZMAN, N.M., LATIP, N.S.A., SAH, S.A.M., AKIL, M.A.M.M., SHAFIE, N.J. & KHAIRUDDIN, N.L. (2011) Avian diversity and feeding guilds in a secondary forest, an oil palm plantation and a paddy field in riparian areas of the Kerian River Basin, Perak, Malaysia. *Tropical life sciences research*, 22, 45.
- BATÁRY, P., FRONCZEK, S., NORMANN, C., SCHERBER, C. & TSCHARNTKE, T. (2014) How do edge effect and tree species diversity change bird diversity and avian nest survival in Germany's largest deciduous forest? *Forest Ecology and Management*, 319, 44–50.
- BEGON, M., TOWNSEND, C.R. & HARPER, J.L. (2006) *Ecology: from individuals to ecosystems* 4th ed. Blackwell Pub, Malden, MA.
- BERTHOLD, P. (2001) *Bird Migration: A General Survey*. Oxford University Press.
- BIBBY, C.J., MARSDEN, S., JONES, M. & EXPEDITION ADVISORY CENTRE (1998) *Expedition field techniques: Bird surveys*. Expedition Advisory Centre, London.
- BIBI, F. & ALI, Z. (2013) Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. *JAPS, Journal of Animal and Plant Sciences*, 23, 469–474.
- BIRDLIFE INTERNATIONAL (2016) IUCN Red List for birds. [Http://www.birdlife.org/](http://www.birdlife.org/) [accessed 9 March 2016].
- BLAKE, J.G. & LOISELLE, B.A. (2001) Bird assemblages in second-growth and old-growth forests, Costa Rica: perspectives from mist nets and point counts. *The Auk*, 118, 304–326.
- BOYCE, R.L. (2015) Life Under Your Feet: Measuring Soil Invertebrate Diversity. *Teaching Issues and Experiments in Ecology*, 3, 1–28.
- CARBONERAS, C. & KIRWAN, G.M. (2016) White-winged Duck (*Asarcornis scutulata*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona. [Http://www.hbw.com/species/white-winged-duck-asarcornis-scutulata](http://www.hbw.com/species/white-winged-duck-asarcornis-scutulata) [accessed 9 March 2016].
- CLEARY, K.A. (2007) Species richness, densities, habitat relationships, and conservation of the avian community of the high-altitude forests of Tonicapán, Guatemala.
- CLEERE, N. (2016) Bonaparte's Nightjar (*Caprimulgus concretus*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona. [Http://www.hbw.com/species/bonapartes-nightjar-caprimulgus-concretus](http://www.hbw.com/species/bonapartes-nightjar-caprimulgus-concretus) [accessed 9 March 2016].
- DANIELSEN, F. & HEEGAARD, M. (2011) The Birds of Bukit Tigapuluh, Southern Riau, Sumatra. *KUKILA*, 7, 99–120.

- DIÁZ, I., ARMESTO, J., REID, S., SIEVING, K. & WILLSON, M. (2005) Linking forest structure and composition: avian diversity in successional forests of Chilo Island, Chile. *Biological Conservation*, 123, 91–101.
- ELLIOTT, A. & GARCIA, E.F.J. (2016) Lesser Adjutant (*Leptoptilos javanicus*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona. [Http://www.hbw.com/species/lesser-adjutant-leptoptilos-javanicus](http://www.hbw.com/species/lesser-adjutant-leptoptilos-javanicus) [accessed 9 March 2016].
- ELLIOTT, A., KIRWAN, G.M. & GARCIA, E.F. (2016) Storm's Stork (*Ciconia stormi*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona. [Http://www.hbw.com/species/storms-stork-ciconia-stormi](http://www.hbw.com/species/storms-stork-ciconia-stormi) [accessed 9 March 2016].
- FUJITA, M.S., IRHAM, M., FITRIANA, Y.S., SAMEJIMA, H., WIJAMUKTI, S., HARYADI, D.S. & MUHAMMAD, A. (2012) Mammals and Birds in Bukit Batu Area of Giam Siak Kecil-Bukit Batu Biosphere Reserve, Riau, Indonesia. *Kyoto Working Papers on Area Studies: G-COE Series* 126, 128, 1–70.
- GAITHER, J.C. (1994) Understory avifauna of a Bornean peat swamp forest: Is it depauperate? *The Wilson Bulletin*, 381–390.
- GÖLTENBOTH, F. (ed) (2006) *Ecology of insular Southeast Asia: the Indonesian Archipelago* 1 ed. Elsevier, Amsterdam.
- HAMMER, Ø. (2015) PAST (Paleontological Statistics): Reference manual. Natural History Museum University of Oslo, Oslo.
- HOLMES, R.T., BONNEY, R.E. & PACALA, S.W. (1979) Guild Structure of the Hubbard Brook Bird Community: A Multivariate Approach. *Ecology*, 60, 512.
- IQBAL, M. & SETIJONO, D. (2011) Burung-burung di Hutan Rawa Gambut Merang-Kepayang dan Sekitarnya. Merang REDD Project, Palembang.
- KOMPAS CYBER MEDIA (2015) Kabut Asap di Riau Makin Memburuk. *KOMPAS.com*. [Http://regional.kompas.com/read/2015/09/27/10512981/Kabut.Asap.di.Riau.Makin.Memburuk](http://regional.kompas.com/read/2015/09/27/10512981/Kabut.Asap.di.Riau.Makin.Memburuk) [accessed 25 February 2016].
- KREBS, C.J. (1985) *Ecology: the experimental analysis of distribution and abundance*. Harper & Row.
- KRISTI, F. (2014) Restorasi Ekosistem Riau. *Fauna Flora International*. [Http://www.fauna-flora.org/initiatives/restorasi-ekosistem-riau/](http://www.fauna-flora.org/initiatives/restorasi-ekosistem-riau/) [accessed 15 February 2016].
- LI, S., ZOU, F., ZHANG, Q. & SHELDON, F.H. (2013) Species richness and guild composition in rubber plantations compared to secondary forest on Hainan Island, China. *Agroforestry Systems*, 87, 1117–1128.
- MACKINNON, J., PHILLIPPS, K. & BALEN, B. VAN (2010) Burung-burung di Sumatera, Jawa, Bali dan Kalimantan: (termasuk Sabah, Sarawak dan Brunei Darussalam). *Burung Indonesia*.
- MAGURRAN, A.E. (2014) *Measuring Biological Diversity*. John Wiley & Sons, Oxford.
- MANLEY, P.N., VAN HORNE, B., ROTH, J.K., ZIELINSKI, W.J., MCKENZIE, M.M., WELLER, T.J., ET AL. (2006) *Multiple species inventory and monitoring technical guide*. USDA Forest Service, Washington.
- MCGOWAN, P.J.K. & KIRWAN, G.M. (2016) Black Partridge (*Melanoperdix niger*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona. [Http://www.hbw.com/species/black-partridge-melanoperdix-niger](http://www.hbw.com/species/black-partridge-melanoperdix-niger) [accessed 9 March 2016].
- MEIJAARD, E., INGER, R.F. & CENTER FOR INTERNATIONAL FORESTRY RESEARCH (CIFOR) (BOGOR) (2006) Hutan pasca pemanenan: melindungi satwa liar dalam kegiatan hutan produksi di Kalimantan. CIFOR, Bogor.
- MIKUSIŃSKI, G., GROMADZKI, M. & CHYLARECKI, P. (2001) Woodpeckers as indicators of forest bird diversity. *Conservation biology*, 15, 208–217.
- MODENA, E. DE S., RODRIGUES, M. & DE SOUZA, A.L.T. (2013) Trophic structure and composition of an understory bird community in a succession gradient of Brazilian Atlantic forest. *Ornithologia*, 6, 78–88.
- NELSON, M. (1996) Bird populations density in thinned, unthinned and old lowland regrowth forest, East Gippsland, Victoria. *Emu*, 96.
- O'CONNELL, T.J., JACKSON, L.E. & BROOKS, R.P. (2000) Bird guilds as indicators of ecological condition in the central Appalachians. *Ecological Applications*, 10, 1706–1721.
- PAYNE, R. & CHRISTIE, D.A. (2016) Common Cuckoo (*Cuculus canorus*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E. (eds.). *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona. [Http://www.hbw.com/species/common-cuckoo-cuculus-canorus](http://www.hbw.com/species/common-cuckoo-cuculus-canorus) [accessed 9 March 2016].
- PEH, K.S.-H. & ONG, L. (2001) A preliminary radio-tracking study of the ranging behaviour of olive-winged bulbul (*Pycnonotus plumosus*) and cream-vented bulbul (*P. simplex*) in a lowland secondary forest in Singapore. *The*

Raffles Bulletin of Zoology, 50, 251–256.

- POSA, M.R.C. & MARQUES, D.A. (2012) Peat swamp forest birds of the Tuanan research station, Central Kalimantan, Indonesia, with notes on habitat specialists. *Forktail*, 28, 29–37.
- POSA, M.R.C., WIJEDASA, L.S. & CORLETT, R.T. (2011) Biodiversity and Conservation of Tropical Peat Swamp Forests. *BioScience*, 61, 49–57.
- PURBA, C.P.P., NANGGARA, S.G., RATRIYONO, M., APRIANI, I., ROSALINA, L., SARI, N.A. & MERIDIAN, A.H. (2014) Potret keadaan hutan Indonesia periode 2009 - 2013. Forest Watch Indonesia, Bogor.
- RESTORASI EKOSISTEM RIAU (2015) Restorasi Ekosistem Riau. [Http://www.rekoforest.org/id/tentang](http://www.rekoforest.org/id/tentang) [accessed 11 February 2016].
- SHELDON, F.H., DAVISON, G., WONG, A. & MOYLE, R.G. (2014) Birds in Peatswamp at Klias Forest Reserve and Environs, Sabah, Malaysian Borneo. *Occasional Papers of The Museum of Natural Science*, 83.
- SISK, T.D. & BATTIN, J. (2002) Habitat edges and avian ecology: geographic patterns and insights for western landscapes. *Studies in Avian Biology*, 25, 30–48.
- SOKA, G., MUNISHI, P.K. & MGINA, B. (2013) Species diversity and abundance of Avifauna in and around Hombolo Wetland in Central Tanzania. *International Journal of Biodiversity and Conservation*, 5, 782–790.
- SUKMANTORO, W., IRHAM, M., NOVARINO, W., HASUDUNGAN, F., KEMP, N. & MUCHTAR, M. (2007) Daftar Burung Indonesia no. 2. Indonesian Ornithologists' Union, Bogor.
- SWASTIKANINGRUM, H., HARIYANTO, S. & IRAWAN, B. (2012) Keanekaragaman Jenis Burung Pada berbagai Tipe Pemanfaatan Lahan di Kawasan Muara Kali Lamong, Perbatasan Surabaya - Gresik. *Berk. Penel. Hayati*, 17, 131–138.
- THIOLLAY, J. (1997) Disturbance, selective logging and bird diversity: a Neotropical forest study. *Biodiversity & Conservation*, 6, 1155–1173.
- TROPENBOS INTERNATIONAL INDONESIA PROGRAM (2010) Buku I: Data dan informasi dasar penilaian menyeluruh nilai konservasi tinggi Semenanjung Kampar.
- YOUNG, B.E. (1998) Diversity and Conservation of Understory Birds in the Tilarán Mountains, Costa Rica. *The Auk*, 115, 998–1016.

## VI. APPENDICES

**Appendix 1.** List of the bird species found in the RER (obtained through the point count and VES method)

No.	Family	Indonesian Name	Scientific Name	Guild	IUCN	CITES	GOI	Endemic	Migran	GCN	SMN	TBOT
1	Ardeidae	Cangak merah	<i>Ardea purpurea</i>	1								✓
2	Ardeidae	Cangak besar	<i>Ardea alba</i>	1			✓					✓
3	Ardeidae	Cangak besar	<i>Bubulcus ibis</i>	1			✓					✓
4	Ardeidae	Kokan laut	<i>Butorides striata</i>	1							✓	
5	Ardeidae	Bambangan hitam	<i>Ixobrychus flavicollis</i>	1							✓	
6	Ciconiidae	Bngau bluwok	<i>Mycteria cinerea</i>	1	EN	I	✓				✓	
7	Ciconiidae	Bangau tongtong	<i>Leptoptilos javanicus</i>	1	VU		✓				✓	
8	Accipitridae	Elang kelelawar	<i>Macheiramphus alcinus</i>	2		II	✓				✓	
9	Accipitridae	Elang bondol	<i>Haliastur indus</i>	2		II	✓				✓	
10	Accipitridae	Elang ular-bido	<i>Spilornis cheela</i>	2		II	✓			✓	✓	✓
11	Accipitridae	Elang-alap cina	<i>Accipiter soloensis</i>	2		II	✓		✓			✓
12	Accipitridae	Elang hitam	<i>Ictinaetus malayensis</i>	2		II	✓			✓	✓	
13	Accipitridae	Elang brontok	<i>Spizaetus cirrhatus</i>	2		II	✓			✓	✓	✓
14	Accipitridae	Elang wallace	<i>Spizaetus nanus</i>	2	VU	II	✓			✓	✓	
15	Falconidae	Alap-alap capung	<i>Microhierax fringillarius</i>	2		II	✓			✓	✓	

16	Falconidae	Alap-alap sapi	<i>Falco moluccensis</i>	2		II	✓				✓
17	Falconidae	Alap-alap macan	<i>Falco severus</i>	2		II	✓			✓	
18	Anatidae	Mentok rimba	<i>Cairina scutulata</i>	3	EN	I	✓		✓		
19	Phasianidae	Puyuh hitam	<i>Melanoperdix nigra</i>	4	VU					✓	✓
20	Phasianidae	Sempidan merah	<i>Lophura erythrophthalma</i>	5	VU					✓	✓
21	Phasianidae	Ayam-hutan merah	<i>Gallus gallus</i>	5						✓	
22	Turnicidae	Gemak loreng	<i>Turnix suscitator</i>	4						✓	
23	Rallidae	Kareo padi	<i>Amaurornis phoenicurus</i>	1					✓		
24	Scolopacidae	Trinil semak	<i>Tringa glareola</i>	6			✓		✓		✓
25	Laridae	Dara-laut sayap-putih	<i>Chlidonias leucopterus</i>	1			✓		✓		✓
26	Columbidae	Punai lengguak	<i>Treron curvirostra</i>	8					✓	✓	✓
27	Columbidae	Punai bakau	<i>Treron fulvicollis</i>	8	NT				✓		
28	Columbidae	Punai kecil	<i>Treron olax</i>	8					✓	✓	
29	Columbidae	Walik jambu	<i>Ptilinopus jambu</i>	8	NT					✓	✓
30	Columbidae	Pergam hijau	<i>Ducula aenea</i>	8							✓
31	Psittacidae	Betet ekor-panjang	<i>Psittacula longicauda</i>	8	NT	II			✓	✓	✓
32	Psittacidae	Nuri tanau	<i>Psittinus cyanurus</i>	8	NT	II			✓	✓	✓
33	Psittacidae	Serindit melayu	<i>Loriculus galgulus</i>	8		II			✓	✓	✓
34	Cuculidae	Kangkok india	<i>Cuculus micropterus</i>	6					✓		✓
35	Cuculidae	Kangkok erasia	<i>Cuculus canorus</i>	6					✓		✓
36	Cuculidae	Wiwik lurik	<i>Cacomantis sonneratii</i>	6					✓	✓	✓
37	Cuculidae	Wiwik kelabu	<i>Cacomantis merulinus</i>	6					✓	✓	✓
38	Cuculidae	Wiwik Uncuing	<i>Cacomantis sepulcralis</i>	6					✓	✓	
39	Cuculidae	Kedasi ungu	<i>Chrysococcyx xanthorhynchus</i>	6					✓	✓	✓
40	Cuculidae	Kedasi hitam	<i>Surniculus lugubris</i>	6					✓	✓	✓
41	Cuculidae	Kadalan beruang	<i>Rhopodytes diardi</i>	6	NT					✓	✓
42	Cuculidae	kadalan saweh	<i>Rhopodytes sumatranus</i>	6	NT				✓	✓	✓
43	Cuculidae	Kadalan kera	<i>Rhopodytes tristis</i>	6					✓		
44	Cuculidae	Kadalan selaya	<i>Rhinortha chlorophaeus</i>	6					✓	✓	✓
45	Cuculidae	Kadalan kembang	<i>Zanclostomus javanicus</i>	6					✓		✓

46	Cuculidae	Kadalan birah	<i>Rhamphococcyx curvirostris</i>	6						✓	✓	✓
47	Cuculidae	Bubut teragop	<i>Centropus rectunguis</i>	6	VU						✓	✓
48	Cuculidae	Bubut besa	<i>Centropus sinensis</i>	6						✓	✓	✓
49	Cuculidae	Bubut alang-alang	<i>Centropus bengalensis</i>	6								✓
50	Strigidae	Celepuk raja	<i>Otus brookii</i>	2		II						✓
51	Strigidae	Celepuk reban	<i>Otus lempiji</i>	2		II					✓	✓
52	Strigidae	Beluk jempuk	<i>Bubo sumatranus</i>	2		II					✓	✓
53	Strigidae	Beluk ketupa	<i>Ketupa ketupu</i>	2		II				✓		
54	Strigidae	Pungguk coklat	<i>Ninox scutulata</i>	2		II				✓		✓
55	Strigidae	Kukuk beluk	<i>Strix leptogrammica</i>	2		II				✓		✓
56	Podargidae	Paruh-kodok bintang	<i>Batrachostomus stellatus</i>	6	NT						✓	
57	Podargidae	paruh-kodok kepala-pucat	<i>Batrachostomus poliophus</i>	6	NT						✓	
58	Podargidae	Paruh-kodok jawa	<i>Batrachostomus javensis</i>	6								✓
59	Podargidae	Paruh-kodok tanduk	<i>Batrachostomus cornutus</i>	6							✓	
60	Caprimulgidae	Taktarau besar	<i>Eurostopodus macrotis</i>	6						✓		
61	Caprimulgidae	Cabak maling	<i>Caprimulgus macrurus</i>	6						✓	✓	
62	Caprimulgidae	Cabak kota	<i>Caprimulgus affinis</i>	6						✓		
63	Caprimulgidae	Cabak kolong	<i>Caprimulgus concretus</i>	6	VU					✓	✓	
64	Apodidae	Walet sarang-putih	<i>Collocalia fuciphagus</i>	6						✓	✓	✓
65	Apodidae	Walet sapi	<i>Collocalia esculenta</i>	6						✓	✓	✓
66	Apodidae	Kapinis-jarum kecil	<i>Rhaphidura leucopygialis</i>	6						✓		
67	Apodidae	Kapinis rumah	<i>Apus nipalensis</i>	6						✓		
68	Apodidae	Walet-palem asia	<i>Cypsiurus balasiensis</i>	6						✓		
69	Hemiprocnidae	Tepekong jambul	<i>Hemiprocne longipennis</i>	6						✓	✓	✓
70	Hemiprocnidae	Tepekong rangkang	<i>Hemiprocne comata</i>	6						✓	✓	✓
71	Trogonidae	Luntur kasumba	<i>Harpactes kasumba</i>	6	NT		✓					✓
72	Trogonidae	luntur diard	<i>Harpactes diardii</i>	6	NT		✓		✓	✓	✓	✓
73	Trogonidae	Luntur putir	<i>Harpactes duvaucelii</i>	6	NT		✓		✓	✓	✓	✓
74	Trogonidae	Luntur harimau	<i>Harpactes oreskios</i>	6			✓		✓			
75	Alcedinidae	Rajaudang meninting	<i>Alcedo meninting</i>	1			✓			✓		✓

76	Alcedinidae	Udang api	<i>Ceyx erithaca</i>	1			✓			✓	✓	✓
77	Alcedinidae	Udang punggung merah	<i>Ceyx rufidorsa</i>	1			✓			✓	✓	✓
78	Alcedinidae	Pekaka emas	<i>Pelargopsis capensis</i>	1			✓					✓
79	Alcedinidae	cekakak belukar	<i>Halcyon smyrnensis</i>	1			✓					✓
80	Meropidae	Kirik-irik laut	<i>Merops philippinus</i>	6							✓	✓
81	Coraciidae	Tiong lampu biasa	<i>Eurystomus orientalis</i>	6								✓
82	Bucerotidae	Enggang klihingan	<i>Anorrhinus galeritus</i>	8		II	✓			✓	✓	✓
83	Bucerotidae	Julang jambul-hitam	<i>Aceros corrugatus</i>	8	NT	II	✓			✓	✓	✓
84	Bucerotidae	Julang emas	<i>Rhyticeros undulatus</i>	8		II	✓			✓		
85	Bucerotidae	Kangkareng hitam	<i>Anthracoceros malayanus</i>	8	NT	II	✓			✓	✓	✓
86	Bucerotidae	Rangkong badak	<i>Buceros rhinoceros</i>	8	NT	II	✓			✓		✓
87	Bucerotidae	Rangkong papan	<i>Buceros bicornis</i>	8	NT	I	✓			✓	✓	✓
88	Capitonidae	Takur tutut	<i>Megalaima rafflesii</i>	7	NT					✓	✓	✓
89	Capitonidae	Takur tonggeret	<i>Megalaima australis</i>	7						✓	✓	✓
90	Capitonidae	Takur ampis	<i>Calorhamphus fuliginosus</i>	7						✓	✓	✓
91	Picidae	Tukik tikus	<i>Sasia abnormis</i>	6						✓	✓	✓
92	Picidae	Pelatuk kijang	<i>Micropternus brachyurus</i>	6						✓		
93	Picidae	Pelatuk sayap-merah	<i>Picus puniceus</i>	6						✓	✓	✓
94	Picidae	Pelatuk merah	<i>Picus miniaceus</i>	6						✓	✓	✓
95	Picidae	Pelatuk besi	<i>Dinopium javanense</i>	6						✓	✓	✓
96	Picidae	caladi batu	<i>Meiglyptes tristis</i>	6						✓	✓	✓
97	Picidae	Caladi badok	<i>Meiglyptes tukki</i>	6						✓	✓	✓
98	Picidae	Pelatuk ayam	<i>Dryocopus javensis</i>	6							✓	✓
99	Picidae	Caladi tilik	<i>Dendrocopos moluccensis</i>	6							✓	
100	Picidae	Caladi tikotok	<i>Hemicircus concretus</i>	6						✓	✓	✓
101	Picidae	Pelatuk kundang	<i>Reinwardtipicus validus</i>	6						✓	✓	✓
102	Eurylaimidae	Madi kelam	<i>Corydon sumatranus</i>	6						✓	✓	
103	Eurylaimidae	Sumpur-hujan rimba	<i>Eurylaimus javanicus</i>	6								✓
104	Eurylaimidae	Sempur-hujan darat	<i>Eurylaimus ochromalus</i>	6	NT					✓	✓	✓
105	Eurylaimidae	Madi-hijau kecil	<i>Calyptomena viridis</i>	6	NT					✓	✓	✓

106	Pittidae	Paok bakau	<i>Pitta megarhyncha</i>	6	NT		✓					✓
107	Hirundinidae	Layang-layang api	<i>Hirundo rustica</i>	6					✓		✓	✓
108	Motacillidae	Kicuit kerbau	<i>Motacilla flava</i>	6					✓			✓
109	Campephagidae	Kepudang-sungu sumatera	<i>Coracina striata</i>	6								✓
110	Campephagidae	Kapasan kemiri	<i>Lalage nigra</i>	6							✓	
111	Campephagidae	Sepah tulin	<i>Pericrocotus igneus</i>	6	NT				✓	✓	✓	
112	Campephagidae	Sepah hutan	<i>Pericrocotus flammeus</i>	6							✓	✓
113	Campephagidae	Jinjing batu	<i>Hemipus hirundinaceus</i>	6					✓	✓	✓	
114	Campephagidae	Jinjing petulak	<i>Tephrodornis virgatus</i>	6					✓	✓	✓	
115	Aegithinidae	Cipoh kacat	<i>Aegithina tiphia</i>	6					✓			
116	Aegithinidae	Cipoh jantung	<i>Aegithina viridissima</i>	6	NT				✓	✓	✓	
117	Chloropseidae	Cica-daun besar	<i>Chloropsis sonnerati</i>	6					✓	✓	✓	
118	Chloropseidae	Cica-daun kecil	<i>Chloropsis cyanopogon</i>	6	NT				✓	✓	✓	
119	Chloropseidae	Cica-daun sayap-biru	<i>Chloropsis cochinchinensis</i>	6					✓	✓	✓	
120	Pycnonotidae	Cucak kuning	<i>Pycnonotus melanicterus</i>	7							✓	✓
121	Pycnonotidae	Merbah cerukcuk	<i>Pycnonotus goiavier</i>	7					✓			
122	Pycnonotidae	Merbah belukar	<i>Pycnonotus plumosus</i>	7					✓	✓	✓	
123	Pycnonotidae	Merbah corok-corok	<i>Pycnonotus simplex</i>	7					✓	✓	✓	
124	Pycnonotidae	Merbah mata-merah	<i>Pycnonotus brunneus</i>	7					✓	✓	✓	
125	Pycnonotidae	Merbah kaca mata	<i>Pycnonotus erythrophthalmos</i>	7					✓	✓		
126	Pycnonotidae	Empuloh ragum	<i>Criniger ochraceus</i>	7					✓			
127	Pycnonotidae	Empuloh irang	<i>Criniger phaeocephalus</i>	7					✓			
128	Pycnonotidae	Empuloh paruh-kait	<i>Setornis criniger</i>	7	VU				✓	✓	✓	
129	Pycnonotidae	Brinji mata-putih	<i>Iole olivacea</i>	7	NT				✓			
130	Pycnonotidae	Brinji rambut-tunggir	<i>Tricholestes criniger</i>	7					✓	✓	✓	
131	Irenidae	Kecembang gadung	<i>Irena puella</i>	6					✓	✓	✓	
132	Laniidae	Bentet loreng	<i>Lanius tigrinus</i>	6					✓			✓
133	Turdidae	Kucica kampung	<i>Copsychus saularis</i>	6							✓	
134	Turdidae	Kucica hutan	<i>Copsychus malabaricus</i>	6								✓
135	Turdidae	Kucica ekor-kuning	<i>Copsychus pyrropygus</i>	6					✓	✓	✓	

136	Timaliidae	Pelantung topi-hitam	<i>Pellorneum capistratum</i>	6						✓	✓	✓
137	Timaliidae	Pelanduk dada-putih	<i>Trichastoma rostratum</i>	6	NT					✓	✓	✓
138	Timaliidae	Pelanduk merah	<i>Trichastoma bicolor</i>	6	NT					✓	✓	✓
139	Timaliidae	Pelanduk ekor-pendek	<i>Malacocincla malaccense</i>	6						✓	✓	✓
140	Timaliidae	Pelanduk asia	<i>Malacocincla abboti</i>	6						✓	✓	✓
141	Timaliidae	Asi kumis	<i>Malacopteron magnirostre</i>	6						✓	✓	✓
142	Timaliidae	Asi topi-jelaga	<i>Malacopteron affine</i>	6	NT					✓		✓
143	Timaliidae	Asi topi-sisik	<i>Malacopteron cinereum</i>	6						✓	✓	✓
144	Timaliidae	Asi besar	<i>Malacopteron magnum</i>	6	NT					✓	✓	✓
145	Timaliidae	Asi dada-kelabu	<i>Malacopteron albogulare</i>	6	NT					✓	✓	✓
146	Timaliidae	Tepus kepala-kelabu	<i>Stachyris poliocephala</i>	6						✓		
147	Timaliidae	Tepus tunggir merah	<i>Stachyris maculata</i>	6	NT					✓	✓	✓
148	Timaliidae	Tepus kaban	<i>Stachyris nigricollis</i>	6	NT					✓	✓	✓
149	Timaliidae	Tepus merbah-sampah	<i>Stachyris erythroptera</i>	6						✓	✓	✓
150	Timaliidae	Ciung-air coreng	<i>Macronous gularis</i>	6						✓	✓	✓
151	Timaliidae	Ciung-air pongpong	<i>Macronous ptilosus</i>	6	NT					✓	✓	✓
152	Sylviidae	Perenjak rawa	<i>Prinia flaviventris</i>	6						✓		
153	Sylviidae	Cinenen semak	<i>Orthotomus atrogularis</i>	6						✓	✓	✓
154	Sylviidae	Cinenen merah	<i>Orthotomus sericeus</i>	6						✓	✓	✓
155	Sylviidae	Cinenen kellabu	<i>Orthotomus ruficeps</i>	6						✓	✓	✓
156	Sylviidae	Cikrak kutub	<i>Phylloscopus borealis</i>	6					✓		✓	✓
157	Muscicapidae	Sikatan dada-coklat	<i>Rhinomyias olivacea</i>	6							✓	✓
158	Muscicapidae	Sikatan dada-kelabu	<i>Rhinomyias umbratilis</i>	6	NT					✓	✓	✓
159	Muscicapidae	Sikatan sisi-gelap	<i>Muscicapa sibirica</i>	6					✓		✓	✓
160	Muscicapidae	Sikatan bubik	<i>Muscicapa dauurica</i>	6					✓		✓	✓
161	Muscicapidae	Sikatan emas	<i>Ficedula zanthopygia</i>	6					✓	✓	✓	✓
162	Muscicapidae	Sikatan melayu	<i>Cyornis turcosus</i>	6	NT					✓		✓
163	Acanthizidae	Remetuk laut	<i>Gerygone sulphurea</i>	6						✓	✓	✓
164	Platysteiridae	Philentoma sayap-merah	<i>Philentoma pyrropterum</i>	6							✓	✓
165	Monarchidae	Kehicap ranting	<i>Hypothymis azurea</i>	6						✓	✓	✓

166	Monarchidae	Seriwang asia	<i>Terpsiphone paradisi</i>	6							✓	✓
167	Rhipiduridae	Kipasan belang	<i>Rhipidura javanica</i>	6			✓			✓	✓	
168	Rhipiduridae	Kipasan mutiara	<i>Rhipidura perlata</i>	6						✓	✓	
169	Pachycephalidae	Kancilan bakau	<i>Pachycephala grisola</i>	6						✓	✓	✓
170	Dicaeidae	Pentis pelangi	<i>Prionochilus percussus</i>	8						✓	✓	✓
171	Dicaeidae	Pentis kumbang	<i>Prionochilus thoracicus</i>	8	NT					✓	✓	✓
172	Dicaeidae	Cabai tunggir-coklat	<i>Dicaeum everetti</i>	8	NT					✓		
173	Dicaeidae	Cabai rimba	<i>Dicaeum chrysorrheum</i>	8						✓		
174	Dicaeidae	Cabai bunga-api	<i>Dicaeum trigonostigma</i>	8						✓	✓	✓
175	Nectariniidae	Burung-madu polos	<i>Anthreptes simplex</i>	9			✓					✓
176	Nectariniidae	Burung-madu kelapa	<i>Anthreptes malacensis</i>	9			✓				✓	
177	Nectariniidae	Burung-madu belukar	<i>Anthreptes singalensis</i>	9			✓			✓	✓	✓
178	Nectariniidae	Barung-madu rimba	<i>Hypogramma hypogrammicum</i>	9			✓			✓	✓	✓
179	Nectariniidae	Burung-madu pengantin	<i>Leptocoma sperata</i>	9			✓			✓	✓	✓
180	Nectariniidae	Burung-madu bakau	<i>Leptocoma calcostetha</i>	9			✓					✓
181	Nectariniidae	Burung-madu sriganti	<i>Cinnyris jugularis</i>	9			✓			✓		✓
182	Nectariniidae	Burung-madu sepah raja	<i>Aethopyga siparaja</i>	9			✓			✓	✓	✓
183	Nectariniidae	Pinjantung kecil	<i>Arachnothera longirostra</i>	9			✓			✓	✓	✓
184	Nectariniidae	Pijantung tasmak	<i>Arachnothera flavigaster</i>	9			✓			✓	✓	✓
185	Nectariniidae	Pijantung dada-kelabu	<i>Arachnothera modesta</i>	9			✓			✓	✓	✓
186	Ploceidae	Burung-gereja erasia	<i>Passer montanus</i>	4								✓
187	Sturnidae	Tiong emas	<i>Gracula religiosa</i>	7		II	✓			✓	✓	✓
188	Oriolidae	Kepudang hutan	<i>Oriolus xanthonotus</i>	7	NT					✓	✓	✓
189	Oriolidae	kepudang kuduk hitam	<i>Oriolus chinensis</i>	7						✓		✓
190	Dicruridae	Srigunting gagak	<i>Dicrurus macrocercus</i>	6						✓		
191	Dicruridae	Srigunting keladi	<i>Dicrurus aeneus</i>	6								✓
192	Dicruridae	Srigunting batu	<i>Dicrurus paradiseus</i>	6						✓	✓	✓
193	Corvidae	Gagak hutan	<i>Corvus enca</i>	5						✓		✓
JUMLAH							46		12	132	134	143

Note:

1= Piscivore; 2= Carnivore; 3= Herbivore-insectivore; 4= Granivore; 5= Omnivore; 6= Insectivore; 7 =Frugivore-insectivore; 8= Frugivore; 9= Nectarivore.

**Appendix 2.** List of the bird species found in the Kampar Peninsula (species that are found both inside and outside the RER concession area)

No.	Family	Indonesian Name	Scientific Name	Guild	IUCN	CITES	GOI	Endemic	Migran	GCN	SMN	TBOT	APRIL Est.	CT
1	Ardeidae	Cangak merah	<i>Ardea purpurea</i>	1								✓	✓	
2	Ardeidae	Cangak besar	<i>Ardea alba</i>	1			✓					✓		
3	Ardeidae	Cangak besar	<i>Bubulcus ibis</i>	1			✓					✓		
4	Ardeidae	Kokan laut	<i>Butorides striata</i>	1							✓			
5	Ardeidae	Bambangan kuning	<i>Ixobrychus sinensis</i>	1									✓	
6	Ardeidae	Bambangan merah	<i>Ixobrychus cinnamomeus</i>	1									✓	
7	Ardeidae	Bambangan hitam	<i>Ixobrychus flavicollis</i>	1							✓			
8	Ciconiidae	Bngau bluwok	<i>Mycteria cinerea</i>	1	EN	I	✓				✓			
9	Ciconiidae	Bangau storm	<i>Ciconia stormi</i>	1	EN		✓							✓
10	Ciconiidae	Bangau tongtong	<i>Leptoptilos javanicus</i>	1	VU		✓				✓			
11	Accipitridae	Sikep madu-asia	<i>Pernis ptilorhynchus</i>	2		II	✓		✓				✓	
12	Accipitridae	Elang kelelawar	<i>Macheiramphus alcinus</i>	2		II	✓				✓			
13	Accipitridae	Elang tikus	<i>Elanus caeruleus</i>	2		II	✓						✓	
14	Accipitridae	Elang bondol	<i>Haliastur indus</i>	2		II	✓				✓			
15	Accipitridae	Elang-laut perut-putih	<i>Haliaeetus leucogaster</i>	2		II	✓						✓	
16	Accipitridae	Elang-ikan kecil	<i>Ichthyophaga ichthyaetus</i>	2	NT	II	✓						✓	
17	Accipitridae	Elang ular-bido	<i>Spilornis cheela</i>	2		II	✓			✓	✓	✓	✓	✓
18	Accipitridae	Elang-alap jambul	<i>Accipiter trivirgatus</i>	2		II	✓							✓
19	Accipitridae	Elang-alap cina	<i>Accipiter soloensis</i>	2		II	✓		✓			✓		
20	Accipitridae	Elang hitam	<i>Ictinaetus malayensis</i>	2		II	✓			✓	✓			
21	Accipitridae	Elang brontok	<i>Spizaetus cirrhatus</i>	2		II	✓			✓	✓	✓		✓
22	Accipitridae	Elang wallace	<i>Spizaetus nanus</i>	2	VU	II	✓			✓	✓			✓
23	Falconidae	Alap-alap capung	<i>Microhierax fringillarius</i>	2		II	✓			✓	✓			
24	Falconidae	Alap-alap sapi	<i>Falco moluccensis</i>	2		II	✓					✓		
25	Falconidae	Alap-alap macan	<i>Falco severus</i>	2		II	✓				✓			

26	Anatidae	Mentok rimba	Cairina scutulata	3	EN	I	✓			✓				
27	Phasianidae	Puyuh hitam	Melanoperdix nigra	5	VU						✓	✓		✓
28	Phasianidae	Puyuh sengayan	Rollulus rouroul	5	NT									✓
29	Phasianidae	Sempidan merah	Lophura erythrophthalma	5	VU						✓	✓		✓
30	Phasianidae	Ayam-hutan merah	Gallus gallus	5							✓			
31	Turnicidae	Gemak loreng	Turnix suscitator	5							✓			
32	Rallidae	Kareo padi	Amauornis phoenicurus	1						✓				
33	Scolopacidae	Trinil semak	Tringa glareola	6			✓		✓			✓		
34	Laridae	Dara-laut sayap-putih	Chlidonias leucopterus	1			✓		✓			✓		
35	Columbidae	Punai lengguak	Treron curvirostra	8						✓	✓	✓		
36	Columbidae	Punai bakau	Treron fulvicollis	8	NT					✓				
37	Columbidae	Punai kecil	Treron olax	8						✓	✓			
38	Columbidae	Walik jambu	Ptilinopus jambu	8	NT						✓	✓		
39	Columbidae	Pergam hijau	Ducula aenea	8								✓		
40	Columbidae	Tekukur biasa	Streptopelia chinensis	8									✓	
41	Columbidae	Perkutut jawa	Geopelia striata	8									✓	
42	Columbidae	Delimukan zamrud	Chalcophaps indica	8										✓
43	Psittacidae	Betet ekor-panjang	Psittacula longicauda	8	NT	II				✓	✓	✓		
44	Psittacidae	Nuri tanau	Psittinus cyanurus	8	NT	II				✓	✓	✓		
45	Psittacidae	Serindit melayu	Loriculus galgulus	8		II				✓	✓	✓		
46	Cuculidae	Kangkok india	Cuculus micropterus	6					✓			✓		
47	Cuculidae	Kangkok erasia	Cuculus canorus	6					✓		✓	✓		
48	Cuculidae	Wiwik lurik	Cacomantis sonneratii	6						✓	✓	✓		
49	Cuculidae	Wiwik kelabu	Cacomantis merulinus	6						✓	✓	✓		
50	Cuculidae	Wiwik Uncuing	Cacomantis sepulcralis	6						✓	✓			
51	Cuculidae	Kedasi ungu	Chrysococcyx xanthorhynchus	6						✓	✓	✓		
52	Cuculidae	Kedasi hitam	Surniculus lugubris	6						✓	✓	✓		
53	Cuculidae	Kadalan beruang	Rhopodytes diardi	6	NT							✓	✓	
54	Cuculidae	kadalan saweh	Rhopodytes sumatranus	6	NT					✓	✓	✓		
55	Cuculidae	Kadalan kera	Rhopodytes tristis	6										

56	Cuculidae	Kadalan selaya	Rhinorhiza chlorophaeus	6						✓	✓	✓		
57	Cuculidae	Kadalan kembang	Zanclostomus javanicus	6						✓		✓		
58	Cuculidae	Kadalan birah	Rhamphococcyx curvirostris	6						✓	✓	✓		
59	Cuculidae	Bubut teragop	Centropus rectunguis	6	VU						✓	✓		✓
60	Cuculidae	Bubut besa	Centropus sinensis	6						✓	✓	✓		✓
61	Cuculidae	Bubut alang-alang	Centropus bengalensis	6								✓		✓
62	Strigidae	Celepuk raja	Otus brokii	2		II						✓		
63	Strigidae	Celepuk reban	Otus lempiji	2		II						✓	✓	
64	Strigidae	Beluk jempuk	Bubo sumatranus	2		II						✓	✓	
65	Strigidae	Beluk ketupa	Ketupa ketupu	2		II				✓				✓
66	Strigidae	Pungguk coklat	Ninox scutulata	2		II				✓		✓		
67	Strigidae	Kukuk beluk	Strix leptogrammica	2		II				✓		✓		✓
68	Podargidae	Paruh-kodok bintang	Batrachostomus stellatus	6	NT							✓		
69	Podargidae	paruh-kodok kepala-pucat	Batrachostomus poliophus	6	NT							✓		
70	Podargidae	Paruh-kodok jawa	Batrachostomus javensis	6									✓	
71	Podargidae	Paruh-kodok tanduk	Batrachostomus cornutus	6								✓		
72	Caprimulgidae	Taktarau besar	Eurostopodus macrotis	6						✓				
73	Caprimulgidae	Cabak maling	Caprimulgus macrurus	6						✓	✓			✓
74	Caprimulgidae	Cabak kota	Caprimulgus affinis	6						✓				✓
75	Caprimulgidae	Cabak kolong	Caprimulgus concretus	6	VU					✓	✓			
76	Apodidae	Walet sarang-putih	Collocalia fuciphagus	6						✓	✓	✓	✓	
77	Apodidae	Walet sapi	Collocalia esculenta	6						✓	✓	✓	✓	
78	Apodidae	Kapinis-jarum kecil	Rhaphidura leucopygialis	6						✓				
79	Apodidae	Kapinis rumah	Apus nipalensis	6						✓				
80	Apodidae	Walet-palem asia	Cypsiurus balasiensis	6						✓				
81	Hemiprocidae	Tepekong jambul	Hemiprocne longipennis	6						✓	✓	✓		
82	Hemiprocidae	Tepekong rangkang	Hemiprocne comata	6						✓	✓	✓		
83	Trogonidae	Luntur kasumba	Harpactes kasumba	6	NT		✓						✓	
84	Trogonidae	luntur diard	Harpactes diardii	6	NT		✓			✓	✓	✓		
85	Trogonidae	Luntur putir	Harpactes duvaucelii	6	NT		✓			✓	✓	✓		

86	Trogonidae	Luntur harimau	Harpactes oreskios	6			✓			✓				
87	Alcedinidae	Rajaudang meninting	Alcedo meninting	1			✓			✓		✓		
88	Alcedinidae	Udang api	Ceyx erithaca	1			✓			✓	✓	✓		
89	Alcedinidae	Udang punggung merah	Ceyx rufidorsa	1			✓			✓	✓	✓		
90	Alcedinidae	Pekaka emas	Pelargopsis capensis	1			✓					✓		
91	Alcedinidae	cekakak belukar	Halcyon smyrnensis	1			✓					✓	✓	✓
92	Meropidae	Kirik-kirok laut	Merops philippinus	6							✓	✓	✓	
93	Coraciidae	Tiong lampu biasa	Eurystomus orientalis	6								✓		
94	Bucerotidae	Enggang klihingan	Anorrhinus galeritus	8		II	✓			✓	✓	✓		✓
95	Bucerotidae	Julang jambul-hitam	Aceros corrugatus	8	NT	II	✓			✓	✓	✓	✓	
96	Bucerotidae	Julang emas	Rhyticeros undulatus	8		II	✓			✓				
97	Bucerotidae	Kangkareng hitam	Anthracoceros malayanus	8	NT	II	✓			✓	✓	✓		
98	Bucerotidae	Rangkong badak	Buceros rhinoceros	8	NT	II	✓			✓		✓		
99	Bucerotidae	Rangkong papan	Buceros bicornis	8	NT	I	✓			✓	✓	✓		
100	Capitonidae	Takur tutut	Megalaima rafflesii	7	NT					✓	✓	✓		
101	Capitonidae	Takur tonggeret	Megalaima australis	7						✓	✓	✓		
102	Capitonidae	Takur ampis	Calorhamphus fuliginosus	7						✓	✓	✓		
103	Picidae	Tukik tikus	Sasia abnormis	6						✓	✓	✓		
104	Picidae	Pelatuk kijang	Micropternus brachyurus	6						✓				
105	Picidae	Pelatuk sayap-merah	Picus puniceus	6						✓	✓	✓		
106	Picidae	Pelatuk merah	Picus miniaceus	6						✓	✓	✓		
107	Picidae	Pelatuk besi	Dinopium javanense	6						✓	✓	✓		
108	Picidae	caladi batu	Meiglyptes tristis	6						✓	✓	✓		
109	Picidae	Caladi badok	Meiglyptes tukki	6						✓	✓	✓		
110	Picidae	Pelatuk ayam	Dryocopus javensis	6							✓	✓		
111	Picidae	Caladi tilik	Dendrocopos moluccensis	6							✓			
112	Picidae	Caladi tikotok	Hemicircus concretus	6						✓	✓	✓		
113	Picidae	Pelatuk kundang	Reinwardtipicus validus	6						✓	✓	✓		
114	Eurylaimidae	Madi kelam	Corydon sumatranus	6						✓	✓			
115	Eurylaimidae	Sumpur-hujan rimba	Eurylaimus javanicus	6								✓		

116	Eurylaimidae	Sempur-hujan darat	Eurylaimus ochromalus	6	NT					✓	✓	✓		
117	Eurylaimidae	Madi-hijau kecil	Calyptomena viridis	6	NT					✓	✓	✓		
118	Pittidae	Paok pancawarna	Pitta guajana	6		II	✓							✓
119	Pittidae	Paok delima	Pitta granatina	6	NT		✓							✓
120	Pittidae	Paok hijau	Pitta sordida	6			✓							✓
121	Pittidae	Paok bakau	Pitta megarhyncha	6	NT		✓					✓		
122	Hirundinidae	Layang-layang api	Hirundo rustica	6					✓		✓	✓	✓	
123	Hirundinidae	Layang-layang batu	Hirundo tahitica	6									✓	
124	Motacillidae	Kicuit kerbau	Motacilla flava	6					✓			✓		
125	Motacillidae	Apung tanah	Anthus novaeseelandiae	6									✓	
126	Campephagidae	Kepudang-sungu sumatera	Coracina striata	6								✓		
127	Campephagidae	Kapasan kemiri	Lalage nigra	6							✓			
128	Campephagidae	Sepah tulin	Pericrocotus igneus	6	NT					✓	✓	✓		
129	Campephagidae	Sepah hutan	Pericrocotus flammeus	6							✓	✓		
130	Campephagidae	Jinjing batu	Hemipus hirundinaceus	6						✓	✓	✓		
131	Campephagidae	Jinjing petulak	Tephrodornis virgatus	6						✓	✓	✓		
132	Aegithinidae	Cipoh kacat	Aegithina tiphia	6										
133	Aegithinidae	Cipoh jantung	Aegithina viridissima	6	NT					✓	✓	✓		
134	Chloropseidae	Cica-daun besar	Chloropsis sonnerati	6						✓	✓	✓		
135	Chloropseidae	Cica-daun kecil	Chloropsis cyanopogon	6	NT					✓	✓	✓		
136	Chloropseidae	Cica-daun sayap-biru	Chloropsis cochinchinensis	6						✓	✓	✓		
137	Pycnonotidae	Cucak kuning	Pycnonotus melanicterus	7							✓	✓		
138	Pycnonotidae	Cucak kutilang	Pycnonotus aurigaster	7									✓	
139	Pycnonotidae	Merbah cerukcuk	Pycnonotus goiavier	7						✓				
140	Pycnonotidae	Merbah belukar	Pycnonotus plumosus	7						✓	✓	✓		
141	Pycnonotidae	Merbah corok-corok	Pycnonotus simplex	7						✓	✓	✓		
142	Pycnonotidae	Merbah mata-merah	Pycnonotus brunneus	7						✓	✓	✓		
143	Pycnonotidae	Merbah kaca mata	Pycnonotus erythrophthalmos	7						✓	✓			
144	Pycnonotidae	Empuloh ragum	Criniger ochraceus	7						✓				
145	Pycnonotidae	Empuloh irang	Criniger phaeocephalus	7						✓				

146	Pycnonotidae	Empuloh paruh-kait	Setornis criniger	7	VU					✓	✓	✓		
147	Pycnonotidae	Brinji mata-putih	Iole olivacea	7	NT					✓				
148	Pycnonotidae	Brinji rambut-tunggir	Tricholestes criniger	7						✓	✓	✓		
149	Irenidae	Kecembang gadung	Irena puella	6						✓	✓	✓		
150	Laniidae	Bentet loreng	Lanius tigrinus	6					✓			✓		
151	Laniidae	Bentet coklat	Lanius cristatus	6									✓	
152	Laniidae	Bentet kelabu	Lanius schach	6									✓	
153	Turdidae	Berkecet siberia	Luscinia cyane	6					✓					✓
154	Turdidae	Kucica kampung	Copsychus saularis	6							✓			
155	Turdidae	Kucica hutan	Copsychus malabaricus	6								✓		
156	Turdidae	Kucica ekor-kuning	Copsychus pyrropygus	6						✓	✓	✓		✓
157	Turdidae	Murai-batu arung	Monticola solitarius	6					✓				✓	
158	Timaliidae	Pelantung topi-hitam	Pellorneum capistratum	6						✓	✓	✓		✓
159	Timaliidae	Pelanduk dada-putih	Trichastoma rostratum	6	NT					✓	✓	✓		✓
160	Timaliidae	Pelanduk merah	Trichastoma bicolor	6	NT					✓	✓	✓		
161	Timaliidae	Pelanduk ekor-pendek	Malacocincla malaccense	6						✓	✓	✓		✓
162	Timaliidae	Pelanduk asia	Malacocincla abboti	6						✓	✓	✓		✓
163	Timaliidae	Asi kumis	Malacopteron magnirostre	6						✓	✓	✓		✓
164	Timaliidae	Asi topi-jelaga	Malacopteron affine	6	NT					✓		✓		
165	Timaliidae	Asi topi-sisik	Malacopteron cinereum	6						✓	✓	✓		
166	Timaliidae	Asi besar	Malacopteron magnum	6	NT					✓	✓	✓		
167	Timaliidae	Asi dada-kelabu	Malacopteron albogulare	6	NT					✓	✓	✓		
168	Timaliidae	Tepus kepala-kelabu	Stachyris poliocephala	6						✓				
169	Timaliidae	Tepus tunggir merah	Stachyris maculata	6	NT					✓	✓	✓		
170	Timaliidae	Tepus kaban	Stachyris nigricollis	6	NT					✓	✓	✓		
171	Timaliidae	Tepus merbah-sampah	Stachyris erythroptera	6						✓	✓	✓		
172	Timaliidae	Ciung-air coreng	Macronous gularis	6						✓	✓	✓		
173	Timaliidae	Ciung-air pongpong	Macronous ptilosus	6	NT					✓	✓	✓		
174	Sylviidae	Perenjak jawa	Prinia familiaris	6				✓					✓	
175	Sylviidae	Perenjak rawa	Prinia flaviventris	6						✓			✓	

176	Sylviidae	Cinenen semak	Orthotomus atrogularis	6						✓	✓	✓		
177	Sylviidae	Cinenen merah	Orthotomus sericeus	6						✓	✓	✓		
178	Sylviidae	Cinenen kellabu	Orthotomus ruficeps	6						✓	✓	✓		
179	Sylviidae	Cikrak kutub	Phylloscopus borealis	6					✓		✓	✓		
180	Muscicapidae	Sikatan dada-coklat	Rhinomyias olivacea	6							✓	✓		
181	Muscicapidae	Sikatan dada-kelabu	Rhinomyias umbratilis	6	NT					✓	✓	✓		
182	Muscicapidae	Sikatan sisi-gelap	Muscicapa sibirica	6					✓		✓	✓		
183	Muscicapidae	Sikatan bubuk	Muscicapa dauurica	6					✓		✓	✓		
184	Muscicapidae	Sikatan emas	Ficedula zanthopygia	6					✓	✓	✓	✓		
185	Muscicapidae	Sikatan melayu	Cyornis turcosus	6	NT					✓		✓		
186	Acanthizidae	Remetuk laut	Gerygone sulphurea	6						✓	✓	✓		
187	Platysteiridae	Philentoma sayap-merah	Philentoma pyrhopterum	6							✓	✓		
188	Monarchidae	Kehicap ranting	Hypothymis azurea	6						✓	✓	✓		
189	Monarchidae	Seriwang asia	Terpsiphone paradisi	6							✓	✓		
190	Rhipiduridae	Kipasan belang	Rhipidura javanica	6			✓			✓	✓			
191	Rhipiduridae	Kipasan mutiara	Rhipidura perlata	6						✓	✓			
192	Pachycephalidae	Kancilan bakau	Pachycephala grisola	6						✓	✓	✓		
193	Dicaeidae	Pentis pelangi	Prionochilus percussus	8						✓	✓	✓	✓	
194	Dicaeidae	Pentis kumbang	Prionochilus thoracicus	8	NT					✓	✓	✓		
195	Dicaeidae	Cabai tunggir-coklat	Dicaeum everetti	8	NT					✓				
196	Dicaeidae	Cabai rimba	Dicaeum chrysorrheum	8						✓				
197	Dicaeidae	Cabai bunga-api	Dicaeum trigonostigma	8						✓	✓	✓	✓	
198	Nectariniidae	Burung-madu polos	Anthreptes simplex	9			✓					✓		
199	Nectariniidae	Burung-madu kelapa	Anthreptes malacensis	9			✓				✓		✓	
200	Nectariniidae	Burung-madu belukar	Anthreptes singalensis	9			✓			✓	✓	✓		
201	Nectariniidae	Barung-madu rimba	Hypogramma hypogrammicum	9			✓			✓	✓	✓		
202	Nectariniidae	Burung-madu pengantin	Leptocoma sperata	9			✓			✓	✓	✓		
203	Nectariniidae	Burung-madu bakau	Leptocoma calcostetha	9			✓					✓		
204	Nectariniidae	Burung-madu sriganti	Cinnyris jugularis	9			✓			✓		✓		
205	Nectariniidae	Burung-madu sepah raja	Aethopyga siparaja	9			✓			✓	✓	✓		

206	Nectariniidae	Pinjantung kecil	Arachnothera longirostra	9			✓			✓	✓	✓		
207	Nectariniidae	Pijantung tasmak	Arachnothera flavigaster	9			✓			✓	✓	✓		
208	Nectariniidae	Pijantung dada-kelabu	Arachnothera modesta	9			✓			✓	✓	✓		
209	Estrildidae	Bondol rawa	Lonchura malacca	4									✓	
210	Estrildidae	Bondol haji	Lonchura maja	4									✓	
211	Ploceidae	Burung-gereja erasia	Passer montanus	4								✓	✓	
212	Sturnidae	perling kumbang	Aplonis panayensis	7									✓	
213	Sturnidae	Tiong emas	Gracula religiosa	7		II	✓			✓	✓	✓		
214	Oriolidae	Kepudang hutan	Oriolus xanthonotus	7	NT					✓	✓	✓		
215	Oriolidae	kepodang kuduk hitam	Oriolus chinensis	7						✓		✓		
216	Dicruridae	Srigunting gagak	Dicrurus macrocercus	6						✓				
217	Dicruridae	Srigunting keladi	Dicrurus aeneus	6								✓		
218	Dicruridae	Srigunting batu	Dicrurus paradiseus	6						✓	✓	✓		
219	Artamidae	Kekep babi	Artamus leucorhynchus	6									✓	
220	Corvidae	Gagak hutan	Corvus enca	5						✓		✓		
JUMLAH							55	1	15	130	134	143	34	26

Note:

1 = Piscivore; 2 = Carnivore; 3 = Herbivore-insectivore; 4 = Granivore; 5 = Omnivore; 6 = Insectivore; 7 = Frugivore-insectivore; 8 = Frugivore; 9 = Nectarivore.  
 APRIL Est. = APRIL Estate (Blok A, B, C, dan D); CT = Camera trap (bird detected by camera trap).

Appendix 3. Some of bird documentations in RER consession area



Great Hornbill (*Buceros bicornis*)



Wallace's Hawk-eagle (*Spizaetus nanus*)



Bonaparte's Nightjar (*Caprimulgus concretus*)

v



Lesser Adjutant (*Leptoptilos javanicus*)



Black Pettridge (*Melanoperdix nigra*)



Hook-billed Bulbul (*Setornis criniger*)



Chestnut-rumped Babbler (*Stachyris macula*)



Black-and-yellow Broadbill (*Eurylaimus ochromalus*)



Scarlet Trogon (*Harpactes duvaucelii*)



Diard's Trogon (*Harpactes diardii*)



Common Cuckoo (*Cuculus canorus*)



Red-naped Trogon (*Harpactes kasumba*)



Buff-necked Woodpecker (*Meygliptes tukki*)



Ferruginous Babbler (*Trichastoma bicolor*)



Long-tailed Parakeet (*Psittacula longicauda*)



Black-bellied Malkoha (*Rhopodytes diardi*)



Crestless fireback (*Lophura erythrophthalma*)



Chestnut-bellied Malkoha (*Rhopodytes sumatranus*)



Green Broadbill (*Calytomena viridis*)



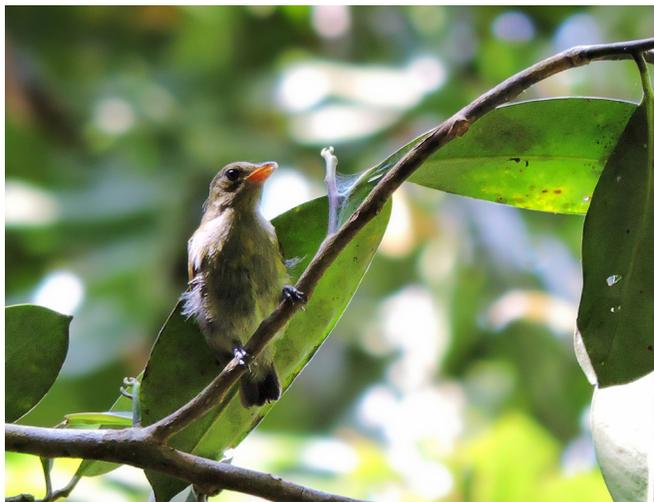
Jambu Fruit Dove (*Ptilinopus jambu*)



Green lora (*Aegithina viridissima*)



Dusky Broadbill (*Corydon sumatranus*)



Crimson-breasted Flowerpecker (*Prionochilus percussus*) - juvenile



Black-naped Monarch (*Hypothymis azurea*)