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DIVERSITY OF AVIFAUNA IN PT GLOBAL ALAM NUSANTARA (PT GAN) Riau Ecosystem Restoration (RER)

REPORT 2021

DIVERSITY OF AVIFAUNA IN GLOBAL ALAM NUSANTARA (PT GAN) RIAU ECOSYSTEM RESTOTARTION

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OVERVIEW

An extensive avifauna survey was conducted in Global Alam Nusantara (PT GAN) between March-July 2021. This survey is a continuation and completion of avifauna surveys initiated in 2015 that aimed to provide reliable baseline biodiversity data in the 130,095 ha *Restorasi Ekosistem Riau* (RER) program area located on the Kampar Peninsula. The avifauna survey aimed to identify and describe the current state of avifauna diversity and its threats. Data collection used the point count and the Visual Encounter Survey (VES) methods on 12 transects spread across the concession area of Global Alam Nusantara (GAN) detected 96 species belonging to 34 families. Twelve of these species are globally threatened, including the blue-winged leafbird (*Chloropis cochincinensis*), short-toed coucal (*Centropus rectunguis*), hook-billed bulbul (*Setornis criniger*) and several other species. Habitat complexity and food availability are thought to be factors that influence the differences in diversity of the area. Variations in the composition of the understory layer may influence the diversity of avifauna groups that inhabit the lower canopy, so that these groups become dominant throughout the GAN area. In addition, the survey revealed an additional species for the Kampar Peninsula Bird List the Rufous-chested flycatcher (*Ficedula dumetoria*). The presence of specialist peat swamp species such as the hook-billed bulbul and the scarlet-breasted flowerpecker (*Prionochilus thoracicus*) illustrates the uniqueness of the Kampar Peninsula peat swamp forest and reinforces its status as an Important Bird Area (IBA) requiring focused conservation efforts in Sumatra.

I INTRODUCTION

1.1 Background

Peat swamp forest is a unique and fragile ecosystem, which is under threat from human disturbance, and provides wetland habitat for specially adapted fauna and flora. Peat swamps are transition zones between lowland mineral soil and marine ecosystems that provide ecosystem services that include timber and non-timber forest products, fishery products, water supply and flood mitigation, carbon storage and biodiversity. Within Sumatra, Riau province has the largest peatland area of 4,004,434 ha. The Kampar Peninsula contains the largest remaining peat swamp forest in Sumatra, almost all of which consists of tropical peat swamp forest with an area of 671,125 ha (Tropenbos International Indonesia Program, 2010). In the past the forest area on the Kampar Peninsula has experienced degradation from past forest conversion to plantations, illegal logging, encroaching agriculture and forest fires. These threats highlight the need to protect, restore and conserve peat swamp forest.

The Riau Ecosystem Restoration (RER) program was formed by APRIL Group in 2013 with an area of about 150,000 hectares. RER's focus is the protection, restoration and conservation of peat swamp forest ecosystems on the Kampar Peninsula and Padang Island, working under the Ministry of Environment and Forestry's program to protect and restore 2.6 million hectares of degraded production forest (IUPHHK-RE). The RER locations are spread over two landscapes in Riau province: the Kampar Peninsula (130,095 ha) and Padang Island (20,599 ha). One of the concessions located on the Kampar Peninsula is PT Global Alam Nusantara (PT GAN), with an area of 36,524 ha. Since 2013, RER has been collaborating with FFI's IP in designing the framework, policies, and management plans relating to the Community, Climate and Biodiversity (CCB) assessment. This avifauna assessment in PT GAN is a continuation from previous biodiversity surveys conducted in 2015 by FFI's IP in three other RER concessions. This initiative will ensure that ecosystem services from peat swamp forest remain available to people, especially communities that live within this landscape.

The peat swamp forest on the Kampar Peninsula is an important area for biodiversity conservation. However, because of its low nutrient content, peat swamp forests have traditionally been considered to be habitat with low biodiversity. Many recent studies however, have revealed that peat forests contain a very high level of diversity, in both flora and fauna (Purba, et al., 2014). The Kampar Peninsula is important habitat for the Sumatran tiger and several other endangered mammal species and is an Important Bird Area (IBA), hosting several endangered avifauna species by IUCN status, whose distribution is highly dependent on peat swamp forest (BirdLife International, 2016). Several avifauna species are indicators of environmental quality, such as the birds of prey or waterbirds and their presence can be used as reference for area management

practices. As most avifauna can fly and are highly mobile, movement across the landscape is not limited. Therefore, absence of a once-present species can indicate disruption or degradation of the habitat. Avifauna species occupy a variety of habitats, making them ideal species to observe and monitor (Birdlife International, 2013). The data collected from this survey will be used to complete a comprehensive basic understanding of the plant and animal communities that exist within the RER. The methods used during this survey are the same as those used in three previous RER restoration concession surveys in 2015.

1.2 Objective

This report provides baseline data to RER management for developing a long-term management plan for PT GAN and the RER area, according to HCV concepts and with the following objectives:

1. To identify and describe the current condition of avifauna diversity as well as any potential threats to it.

2. Provide recommendations for continued monitoring, protection and management of avifauna on the Kampar Peninsula.

II METHODS

2.1 Study Site

The Kampar Peninsula has an area of 6,711 km^2, located in the eastern part of Riau Province and is geographically located between 101° 50'-103° 07' East longitude and 0°10'-1°14' North latitude. The Kampar Peninsula is located in two regencies: Siak Regency (38%) and Pelalawan Regency (62%) with the RER fully located within Pelalawan Regency. To the west it is bordered by dry, mineral soils, to the east by the Long Strait, to the north by the Siak River and to the south by the Kampar River. PT GAN is dominated by low pole forest on the peat dome and a combination of mixed peat swamp and riparian forest near the Serkap River, some of which was degraded by past commercial logging (Figure 1).

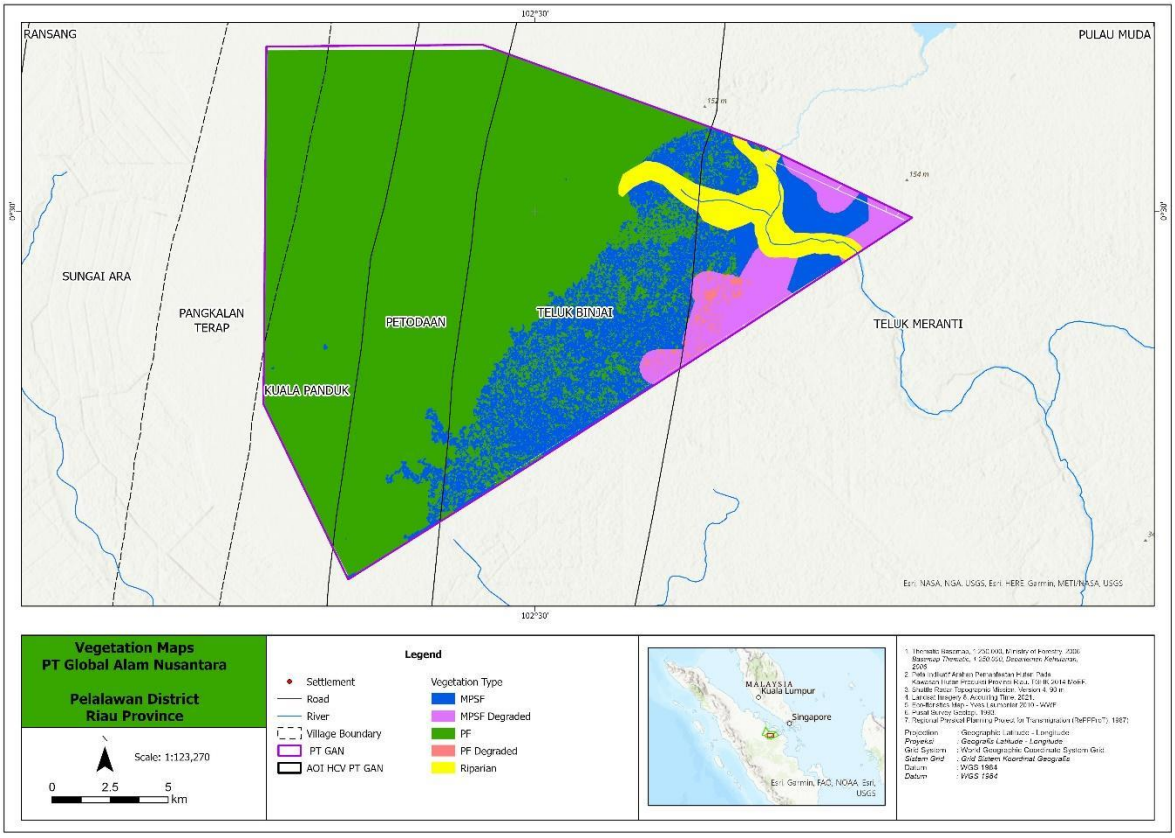


Figure 1. Vegetation cover in PT GAN on the Kampar Peninsula.

A series of surveys, along 12 transects, were carried out in PT GAN from March–July 2021 (Figure 2). Three of the transects (RK_GA08, RK_GA10 dan RK_GA11) were located near the Serkap and Sianyir rivers and were inundated with water (60–70 cm). All other transects were dry, with forest litter depth ranging from 2–7cm. Relative-humidity, temperature, and canopy cover in all transects were 98.8%, 25–28^{o}C, and 57–97%, respectively. Besides several dominant tree species, such as *Shorea*

teysmaniana, Calophyllum calaba, Campnosperma cariaceum, Tristaniopsis merguensis, Ormosia sumatrana and *Ilex hypoglauca*, other common floras were "mengkuang" (*Pandanus andersonii*), "rasau" (*P. helicopus*), and pitcher plant (*Nepenthes ampullaria*)

The Riau Ecosystem Restoration (RER) area is located in the center of the Kampar Peninsula with topography ranging from 2-16 m ASL. Relative humidity ranges from 81-84% with an annual average of about 82%, and annual rainfall ranges from 1,949-2,951 mm/year, typical for a wet tropical climate. The average monthly air temperature ranges from 26.1-27.5^{o} C, with an annual average of 26.7^{o} C (PT GCN, 2012).

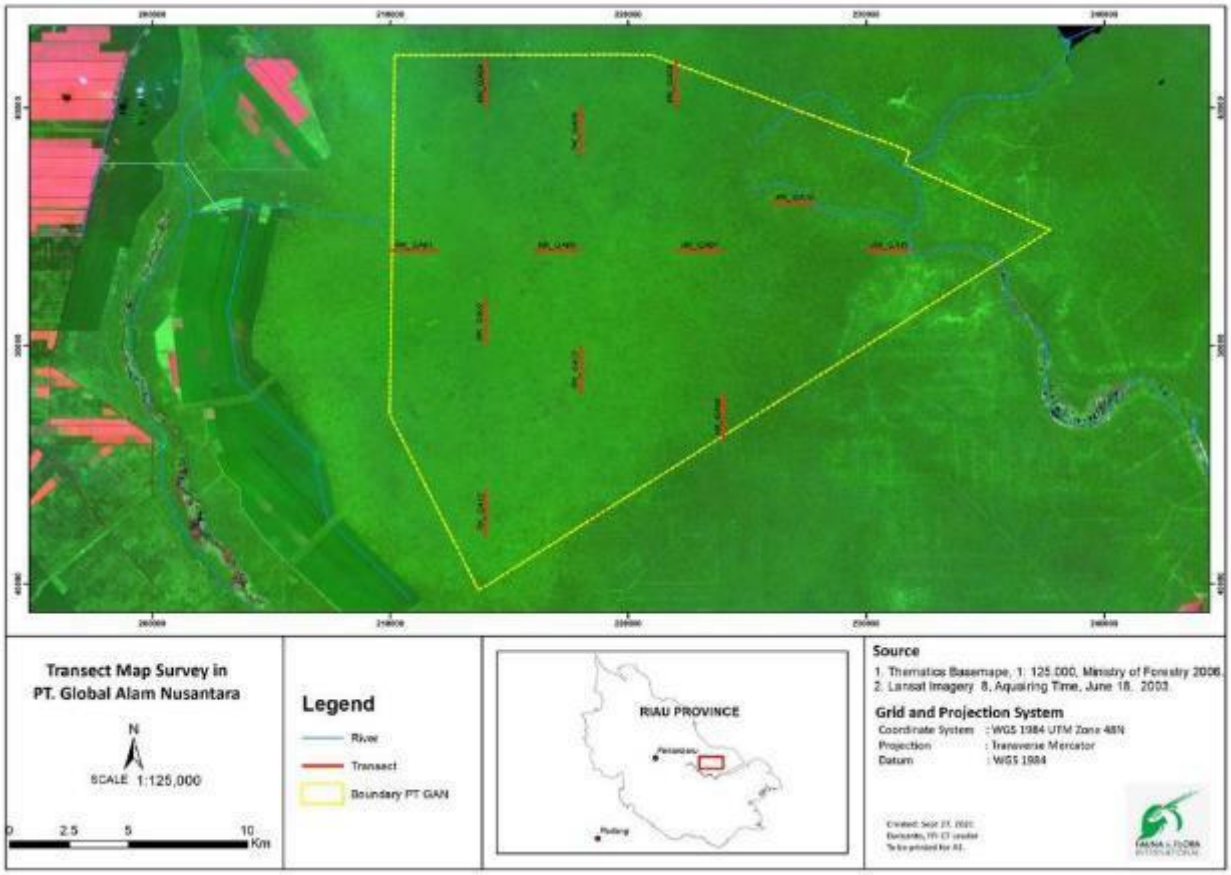


Figure 2. Location of twelve transects within PT GAN concession on the Kampar Peninsula.

This survey occurred in PT Global Alam Nusantara (36,524.78 ha) which is one of four concessions in the *Restorasi Ekosistem Riau* (RER) program on Kampar Peninsula. PT GAN is in the west of the RER area, and is bordered by acacia plantation concessions in the west, an ecosystem services concession (PT Putra Riau Perkasa) to the north; while in the east and south it is bordered by RER concessions PT TBOT and PT SMN. The Serkap River provides the only river access into the PT GAN concession. Additional access is via the Madakuro / Harapan Jaya acacia fiber plantation concessions via canals and walking 5+km. As a result, the risk of anthropogenic disturbance in PT GAN is minimal. The majority (23,549 ha or 65%) of PT GAN is a primary peat dome forest dominated by low pole trees in the western 2/3 of the concession. The dominant tree species in PT GAN is Terentang (*Campnosperma* sp), Meranti (*Shorea* sp), Bintangur (*Chalopylum* sp), and Mengkuang (*Pandanus* sp). The remainder of PT GAN in the eastern 1/3 of the concession is mixed peat swamp forest (12,840 ha), in which 4,021 ha is degraded due to past drainage, intensive logging and possibly impacts from past forest fires. There is also 98 ha of riparian forest near the Serkap River.

2.2 Data Collection

Avifauna data was collected using the Point Count and Visual Encounter Survey (VES) methods and acoustic data was collected using passive acoustic monitoring methods. and secondary data from camera trap survey.

2.2.1 Point Count

The point count method was carried out on 12 transects and in each transect the observer placed six count-points, with 200 meters between points and an observation diameter of 50 meters for 36 days effective. Observations at each point were carried out for 20 minutes, with observations in the morning between 0600-1000, and in the afternoon between 1530-1830. The data recorded were species name, number of individuals, distance from observers and animal behaviour when observed. The micro-habitat data was recorded at each count point which included the tree height, percent of forest floor (ground cover), the percentage occurrence of several plants (such as lianas, macaranga, shrubs, palms, gingers, bamboo and grass), distance from water sources, slope, number of dead trees, and thickness of moss and leaf litter.

2.2.2 Visual Encounter Survey (VES) The VES method records bird species that were identified through visual or vocal detection by the observer that occur outside of the point count interval. The species name, time of observation and number of individuals were recorded.

2.2.3 Passive Acoustic Monitoring

Meanwhile, passive acoustic monitoring involves placement of the audiomoth recording device and sound recorder at each count point along the transect, programmed to actively record for 2x24 hour periods with a total of 24 days of

recording. The data found from the point count method was used as a reference in data analysis.

2.2.4 Identification and Naming Convention

Identification of each species observed was referenced by "Birds of the Indonesian Archipelago Greater Sundas and Wallacea" (Eaton et al., 2021) and the "Field Guide Series for Birds in Sumatra, Java, Bali and Kalimantan" (MacKinnon et al., 2010). The English language and scientific naming refers to the "Birdlife International-Birdlife Datazone". Avifauna's protection status follows the IUCN Redlist of Threatened Species, CITES and government regulations of the Republic of Indonesia. Avifauna ecological characteristics such as migration, endemic, and restricted distribution are also used to determine the conservation value of avifauna. For guild feeding (avifauna feeding pattern), refers to "Birds of the World – The Cornell Lab of Ornithology" (https://birdsoftheworld.org).

2.3 Data Analysis

2.3.1 Shannon-Wiener Diversity Index

This diversity index is one of the quantification methods to quantify the diversity of biota in a habitat. This index assumes that individuals are randomly sampled from a large independent population and that the species obtained sufficiently represent the species present in a habitat (Bibi & Ali, 2013). Generally, the value of diversity is described from 1.5-3.5, where the higher the value, the higher the diversity (Magurran, 2004). Shannon-Wiener Diversity Index calculated using the following formula:

$$H' = -\sum_{i=1}^{n} pi.\ln pi$$

Explanation: H' = Shannon-Wiener Diversity Index
pi = Abundance species – I (pi=ni/N)
ni = Total individual species - i
N = Total all individual species

2.3.2 Pielou's Evenness Index and Simpson's Dominance

Diversity in a habitat is influenced by two factors, namely the number of species and the evenness of the number of individuals between species (Magurran, 2004). So, in addition to the diversity index, it is also necessary to analyse the evenness of species. The number of individuals between species is declared evenly if the value is 1 or close to 1, otherwise the number of individuals is uneven (low evenness) if the value is close to 0 (Boyce, 2005). Evenness is calculated using an evenness index as follows:

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

Explanation: E = Pielou's Evenness Index
H' = Shannon-Wiener Diversity Index
S = Number of species found

Dominance was calculated using the Simpson dominance index (D), designed to determine the presence of dominant species in a habitat. A dominance index value of 1, or close to 1, indicates the presence of a dominant species; where there is no dominant species, D will be closer to 0 (Boyce, 2005). The formula for calculating the Simpson dominance index is as follows.

$$D = \sum \frac{ni^2}{N} \quad \text{atau} \quad D = \sum \left(\frac{n_i[n_1 - 1]}{N[N-1]} \right)$$

Explanation D = Simpson dominance index
ni = Total individual species – i

2.3.3 Rarefaction

Rarefaction is used to determine the increase in the number of new species in each sample and estimate the number of species that may be found in an area. Rarefaction analysis was carried out using the EstimateS 9 statistical software. The results of the analysis will produce an increase in species curve which is equipped with extrapolation of the number of species that may not have been found in a sampling area (Magurran, 2004).

2.3.4 Distance Sampling

Distance sampling is a method for determining densities of populations, per unit area. In the point count method, the distance data collected comes from the estimated distance between avifauna individuals observed from the central point of observation (radial distance), while the effort survey is determined based on the number of observations in the morning and afternoon. The analysis was carried out with Distance 6.0 software (Bibby, et al., 2000).

2.3.5 Cluster Analysis

Cluster analysis is used to determine the level of similarity in species composition between different habitats. The analysis was performed with PAST 3.07 software, using the Bray-Curtis Similarity Index. Avifauna presence/absence data, for each concession area, was used to obtain clusters of similarity in the composition of

avifauna species between concessions. An inter-transect analysis was also carried out to measure the similarity of avifauna composition between transects in each concession area, so that the group of avifauna species similarity between transects in the GAN area could be obtained.

III RESULTS AND DISCUSSION

3.1 Results

3.1.1 Habitat Structure

Based on the microhabitat data collected from each observation point, the PT GAN concession was dominated with trees with an average height of 23 m and a ground cover of around 36% (Table 1). These two parameters are comparatively less than observed in PT GCN, SMN and TBOT in 2015 indicating that GAN has a different habitat structure.

Table 1. Parameters of the habitat structure of each concession

Parameter	GAN (mean)	GCN (mean)	SMN (mean)	TBOT (mean)
Tallest tree (m)	23	29	30,1	33,3
Ground cover (%)	36	65	79,6	73,4
Plant with a height of 0-1,5 m (%)	35	60	66,9	57,1
Plant with a height of 1,5-5 m (%)	35	57	70,5	55,6
Plant with a height of 5-15 m (%)	48	38	35,2	55,9
Plant with a height of >15 m (%)	17	22	14,8	39,8
Small Liana (%)	12	12	8,2	19,6
Lianas (%)	13	5	4,8	10,9
Macaranga Tree (%)	0	0,2	1,4	2,1
Rotan (%)	1	3	1,9	5,9
Fern (%)	16	10	13,9	14,6
Distance with water resource	3	3	2,9	2,2
Log tree (number of individuals)	3	7	3,4	5,1
Dead tree (number of individuals)	2	3	1,8	1,4
Zingiberaceae (%)	21	0,4	0	0,2

Grass (%)	6	0	3,9	11,1
Moss (cm)	2	1	1,5	1,4
Litter (cm)	7	1,5	1,89	2,4

3.1.2 Avifauna Diversity at Global Alam Nusantara (GAN)

The survey recorded 3,206 individual birds belonging to 96 species of avifauna in 34 families or 31% of the total birds in the RER area (Restorasi Ekosistem Riau, 2020). Most species encountered were often heard rather than seen, as would be expected in dense vegetation and peat forest cover where animals are typically difficult to visually observe. Several additional species were also observed outside the survey area, especially along the Serkap river, and several bird species were also recorded during the camera-trap survey, carried out before this biodiversity survey. The conservation status of birds recorded in GAN is based on IUCN Red List categories: a total of 51 species are listed as least concern (LC), 21 as near threatened (NT), 8 as vulnerable VU and 2 as endangered (EN) (Table 2). The survey also recorded a new record for the Kampar Peninsula: the rufous-chested flycatcher (*Ficedula dumetoria*) which was not detected in past avifauna surveys including the 2015 FFI IP surveys in RER.

Table 2. Threatened avifauna species observed in PT GAN.

Scientific Name	English Name	Family	IUCN	CITES
Rhabdotorrhinus corrugatus	Wrinkled hornbill	Bucerotidae	EN	I
Chloropsis cochinchinensis	Blue-winged Leafbird	Chloropseidae	EN	-
Belocercus longicaudus	Long-taile Parakeet	Psittacidae	VU	-
Buceros rhinoceros	Rhinoceros hornbill	Bucerotidae	VU	II
Buceros bicornis	Great hornbill	Bucerotidae	VU	I
Rhyticeros undulatus	Wreathed hornbill	Bucerotidae	VU	II
Melanoperdix niger	Black partridge	Phasianidae	VU	-
Lophura erythrophthalma	Crestless fireback	Phasianidae	VU	-
Centropus rectunguis	Short-toed coucal	Cuculidae	VU	-

Setornis criniger	Hook-billed bulbul	Pycnonotidae	VU	-
Trichastoma rostratum	White-chested babbler	Pellorneidae	NT	-
Harpactes duvaucelii	Scarlet-rumped trogon	Trogonidae	NT	-
Trichixos pyrropygus	Rufous-tailed shama	Muscicapidae	NT	-
Calyptomena viridis	Green broadbill	Eurylaimidae	NT	-

With nine species present, the Cuculidae family has the highest proportion of species in the survey area. The families Pellorneidae, Bucerotidae, and Muscicapidae are the next largest families, with eight and six species, respectively (Figure 2).

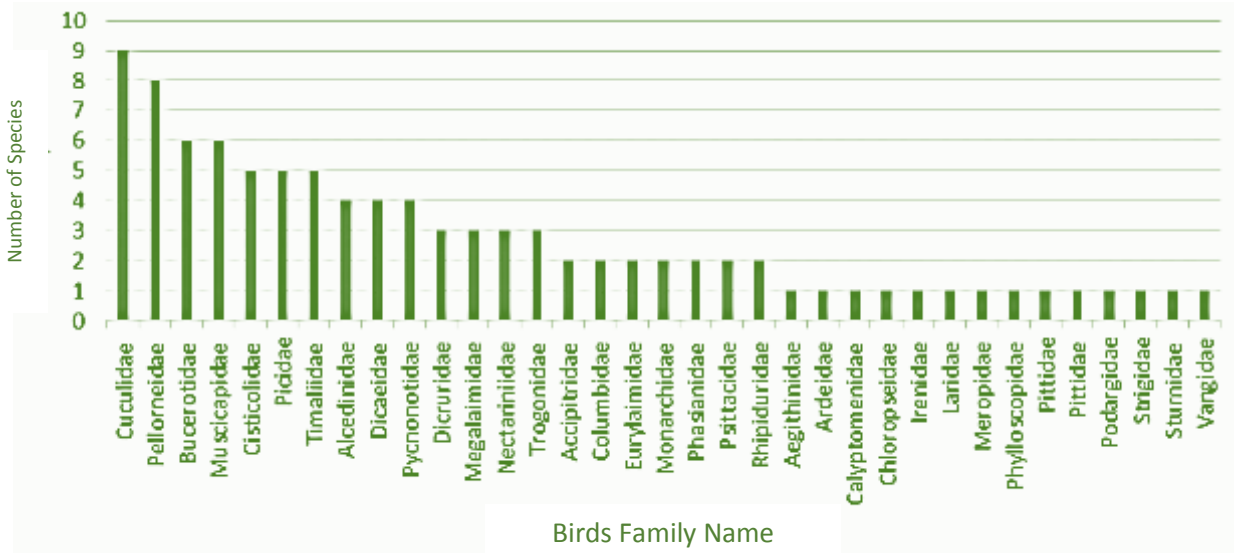


Figure 2. Distribution of 34 Avifauna Families in PT GAN on Kampar Peninsula.

Based on repeated observations and species lists (MacKinnon *et. al.,* 2010) a rarefaction curve shows the increase in the number of bird species encountered. In the 28th list, new species are still found (as indicated by the rising curve) and so there is still potential for an increase in the number of species found in the entire survey area.

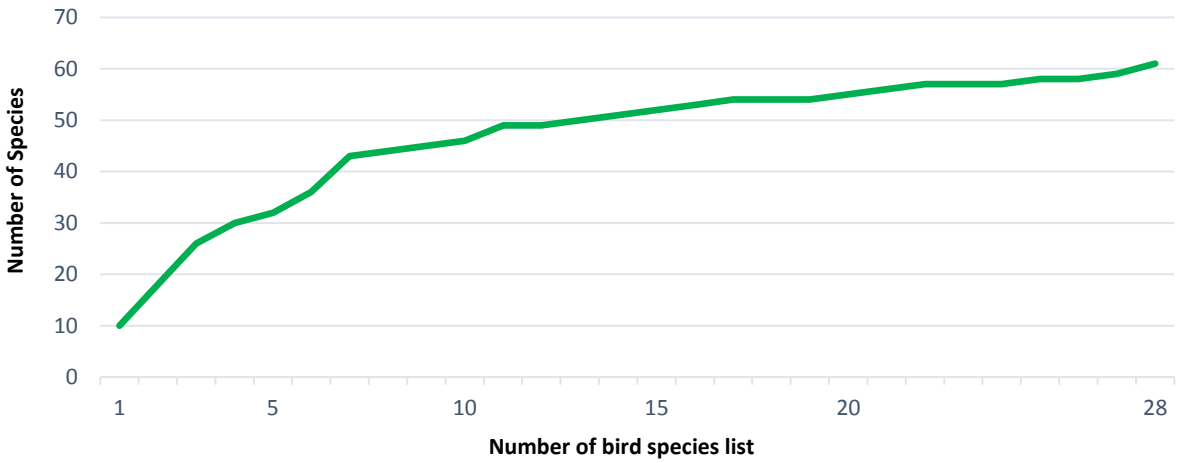


Figure 3. Rarefaction curve for PT GAN

3.1.3 Feeding Guild

Each bird species has different dietary needs, therefore birds seek suitable habitats that match and fulfil those needs. Observations showed that there were six types of feeding guilds in the survey area: carnivores, frugivores, insectivores, nectarivores, omnivores and piscivores. The dominant group was the insectivores (69%), while the smallest groups were the omnivores and nectarivores (each at 3%; Figure 4).

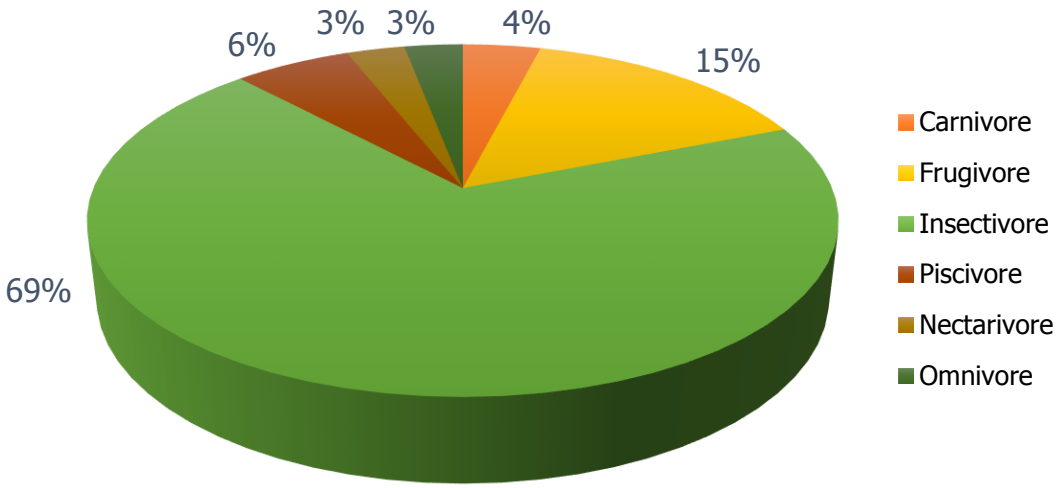


Figure 4. The proportion of species within each feeding guild in PT GAN.

3.1.4 Composition of Avifauna

The diversity index value (H') of avifauna in GAN is 3.5, meaning that the species diversity is high and the number of individuals (abundance) of all species is evenly distributed (Figure 5) in the study area without any single species dominating (dominance index D=0.04). Transects with high diversity and evenness indices were found in RK-GA10 and RK-GA11 (riparian forest), while the lowest diversity indexes were found in RK-GA06 and RK-GA05 transects (pole forest).

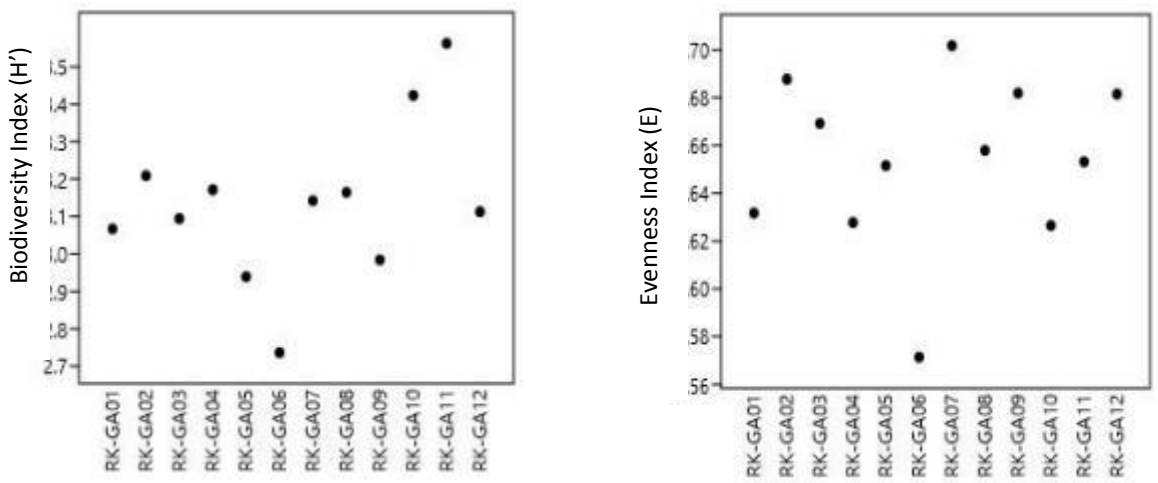


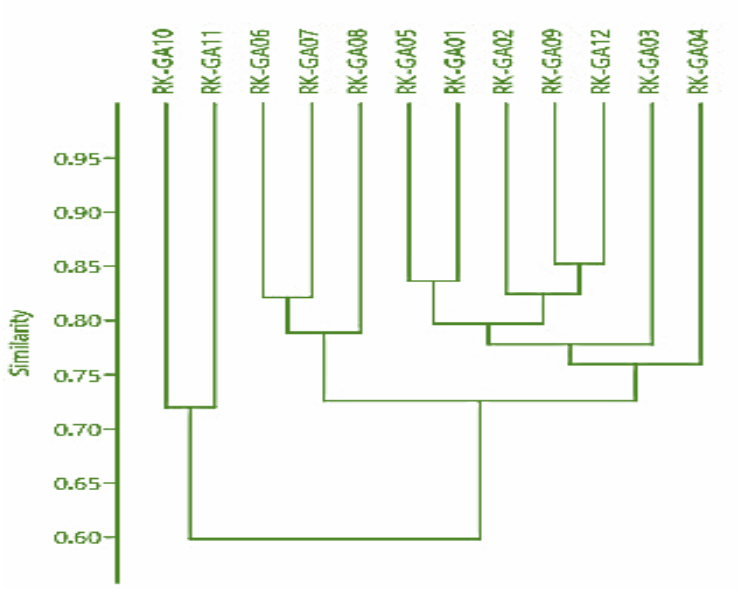
Figure 5. Diversity and Evenness of avifauna on 12 transects in PT GAN.

The dominance (D) index is highest for transect RK-GA06, while the RK-GA11 transect has the lowest dominance index (Figure 6).

Figure 6. Dominance index (D) for avifauna recorded on 12 transects in PT GAN.

The avifauna in GAN can be divided into 3 similarity groups (Figure 7). Group 1 is RKGA10 and RKGA11; Group 2 is RKGA06, RKGA07 and RKGA08; Group 3 is RKGA05, RKGA01, RKGA02, RKGA09, RKGA12, RKGA03 and RKGA04. Group 1 had the widest variety of avifauna composition as compared to Groups 2 and 3 containing a higher similarity level of 73%.

Figure 7. Similarity levels of avifauna found on 12 transects in PT GAN.



The groupings of avifauna are better understood when overlaying each transect with PT GAN's forest vegetation data (Figure 8). Transects in Group 1 are located in the riparian forest while Group 2 is in Mixed Peat Swamp Forest (MPSF) and Group 3 is in Pole Forest (PF). There were abundant large diameter trees in Group 1 transects where a variety of hornbills and several species of Columbidae family were found. These avifauna are not often found in the pole forest.

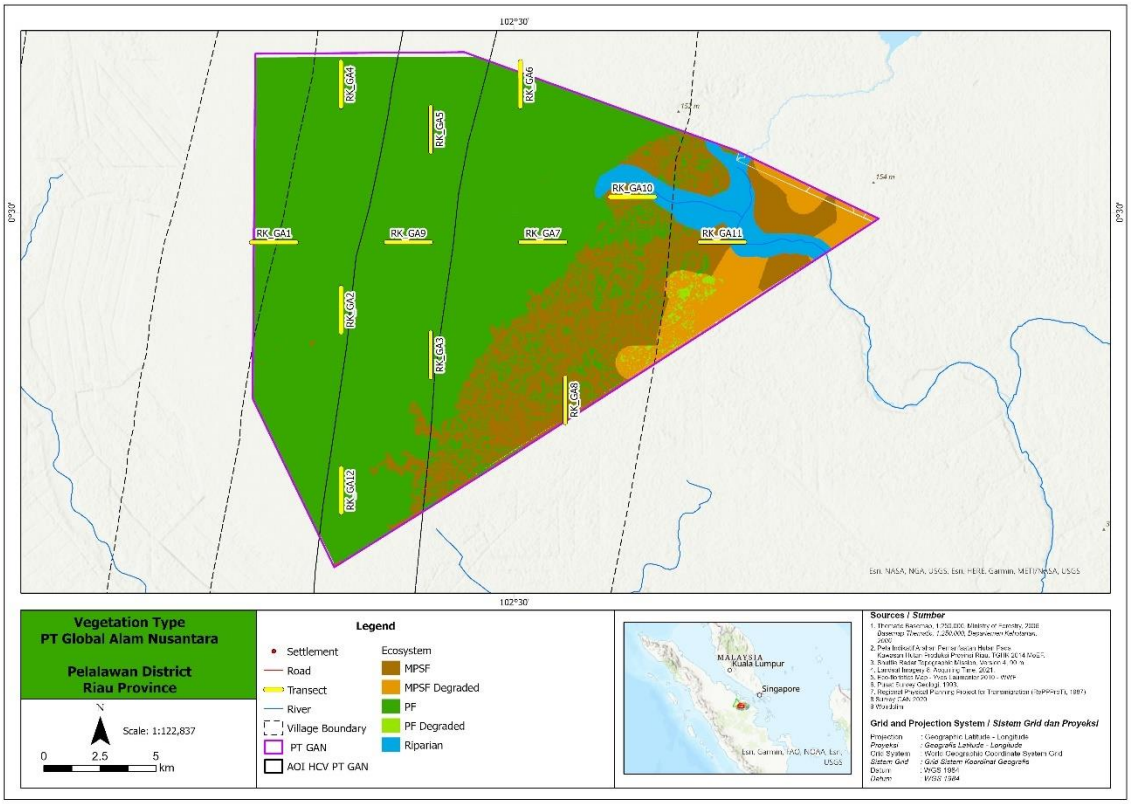


Figure 8. Avifauna transect overlayed with forest vegetation in PT GAN.

3.1.5 Threats to Avifauna

There were no direct threats to avifauna observed during the survey, but bird poaching was observed along the Serkap River in PT TBOT concession. As a precautionary approach, active forest protection patrols are essential to prevent and control bird poachers. In November 2020, a joint patrol/survey between FFI and BKSDA in SM Tasik Besar identified a fisherman's house which contained a bird cage containing the Purple-throated Sunbird (Ninja Hummingbird). This species often forages for nectar in Syzgium spp. trees that are frequently found along the Serkap River riverbanks.

3.2 Discussion

3.2.1 Avifauna Diversity

The PT GAN avifauna survey recorded a total of 96 species belonging to 34 families. This compares with 2015 records from three other concessions (Kristanto & Junaid, 2016) as follows; in PT GCN had 132 species, PT SMN with 134 species, and PT TBOT with 143 species. The lower number of records in this survey is thought to be due to differences in predominate vegetation structure, and food availability, some of the factors that affect species richness at the local level.

Vegetation is very important as a food source for various types of birds, providing food from stems, leaves, fruits, flowers, and nectar. Birds can be specialized to one type of food or be more generalist, feeding on a variety of different types (Widodo, 2015). Based on the measurement of microhabitat parameters, it was found that the vegetation cover of the GAN ground cover was 36%, which is much lower than the other three concessions (65.5%, 79.5%, and 73.4%), and probably contributes to the lower avifauna diversity. Similarly, the low pole forest type supports (fewer large trees >15m; mean = 17) which could explain the low number of large tree-dwelling species. And the factors of survey effort and observer bias are thought to have influenced the species findings at the time of the survey (Soka et al., 2013). Because for forest birds that have high movement, skill and experience are needed. It's different from just observing big birds like Eagles or Waterbirds.

Avifauna that inhabit the low-level (5m tall) canopy layer are the dominant group in GAN, with 19 families making up this group. Some of the dominant families include the Bucerotidae, Cuculidae, Columbidae and Picidae families. Then there are 11 families represented in the lower canopy (understory layer), the next dominant group, and include members of the Nectarinidae, Timaliidae, Dicaeidae, and Pellorneidae families.

The avifauna survey at GAN found new findings that had not previously been recorded, thus adding to the new list of bird species in the RER for the survey conducted by FFI, namely Common kingfisher (*Alcedo atthis*) and Rufous-chested Flycatcher (*Ficedula dumetoria*).

Based on the IUCN Red List, 10 species of avifauna were listed as globally threatened, increasing the number of listed birds in the RER to 16 species. This number includes Blue-winged Leafbird (*Chloropis cochincinensis*), Short-toed coucal (*Centropus rectunguis*), Hook-billed bulbul (*Setornis criniger*). This relatively large number of threatened species suggests that the RER area is an important site for threatened birds and should be maintained in its current condition as a peat swamp forest (Page dkk., 1999). The species curve shown above (section 3.1), suggests that, with further observations, the number of avifauna in the GAN area is likely to increase. It is suspected that the species that have not been detected are either present in very low abundances or are extremely shy, reducing the probability of being detected (Bibby dkk., 2000).

3.2.2 Avifauna Species Composition and Similarities

Species diversity increases with habitat complexity and considers both species richness and evenness. The latter point is an important component of the diversity index, indicating whether there is an even distribution of individuals among different species in a given area (Hill, 1973; Turchi dkk., 1995; Leinster dan Cobbold, 2012). As such, the value of the species evenness index is usually used as an indicator of the dominance of a species within a community. Meanwhile, the dominance index value

is used to describe the pattern of domination of one species over another in a community (Mawazin & Subiakto, 2013).

The evenness index value in the GAN concession is low, at 0.4, as is the dominance index, also at 0.4. This indicates that the distribution of bird species is even and there is no clear dominant species in the community. The closer the number is to one, the more likely is it that there is one, or several dominant species in the area (Heriyanto & Garsetiasih, 2007).

The species composition in dendrogram chart shows that the survey transects have a high degree of similarity, between them, in terms of the type of species recorded in each (>60%). The exceptions to this were transects RKGA10 and RKGA11, both of which contained species records that were not found in other transects; this included Rhinoceros hornbill (*Buceros rhinoceros*), Wreathed hornbill (*Rhyticeros undulates*), and Blue-tailed bee-eater (*Merops philippinus*). The key differences between these transects and all others were that they both included large trees (the preferred habitat feature for Bucerotidae species) and were close to the river (an important feature for Blue-tailed bee-eater). Certain birds, such as the Bucerotidae, require large diameter trees for activities such as playing, perching to nesting (Kemp & Boesman, 2020).

3.2.3 Avifauna Density

Based on the distance sampling analysis, it was found that the density of avifauna in the GAN area was 1,921 individuals/ha (Figure 9). With an effective radius of 16m, and a detection probability of 45%, this means that a radius of 16m is a very effective distance for bird watching in the GAN peat forest area. (Bibby dkk., 2000). A diverse habitat, with a variety of trees, poles, and shrubs, affects the density of avifauna in the GAN area. The diversity of habitat structures affects the richness of bird species that have different habitat preferences. The position of PT GAN, which is in a peat dome, results in very little vegetation diversity and this plays a role in the areas relative

lack of available of food sources. The availability of abundant feed in a habitat is one of the main factors for the presence of bird populations.

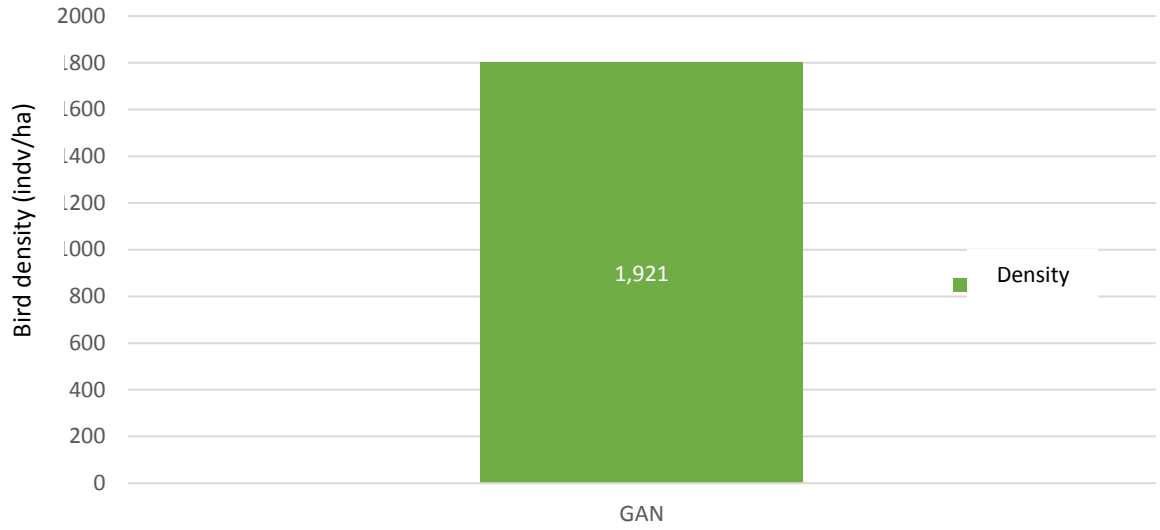


Figure 9. Avifauna density per hectare in PT GAN.

3.2.4 Feeding Guild

Birds prefer habitats that provide adequate and appropriate food and each type of bird has different food preferences (Darmawan, 2006). Of the total 96 species of bird observed in the current survey, six feeding groups were present: carnivore, frugivore, insectivore, nectarivore, omnivore and piscivore. The composition of these feeding groups reflects the type of food available in the GAN area, as has been found elsewhere (e.g., Blake 1983 & Fleming 1992).

The dominant feeding group in GAN is the insectivores (70%) and contains families such as Cuculidae, Pellorneidae, Monarchidae, Timaliidae and several others. The dominance of this group is common in peat forest bird communities, due to an abundance of insects that are available throughout the year; compared to fruit and nectar, they represent a stable food-source in peat swamp forest (Wong, 1986). In catching their prey, insectivore groups have various ways and adaptations, ranging from hunting while flying to pecking into trees (Morse, 1971). At a broader scale, insectivores are the most common and abundant species in tropical forests due to the abundance of insects when compared with more temperate areas (Blake & Loisille, 2001).

The frugivorous group was the second largest group in the survey area but, at 15%, their numbers are relatively few. Several groups of fruit-eating birds were found, including species from the Bucerotidae, Columbidae, Psittacidae, and Dicaeidae

families. During the survey it was very rare to find trees that were bearing fruit, despite taking place in the fruiting season. The seasonality of fruiting trees means that frugivorous birds tend to move into the area during limited times (Wong, 1986). According to Setiawan dkk. (2006) each type of tree in a community can create various environmental conditions and food availability that are specific to certain types of birds (their ecological niche). A higher diversity of such trees will create a more diverse range of ecological niches, allowing for a wide array of birds to share the same space. In addition, the presence of frugivores in a forest is very important for the distribution of seeds in that forest. As bird's are not able to digest the seeds of the fruit they eat, they are carried away in the stomach of the bird to be deposited elsewhere when the bird defecates (with the bird's faeces providing important fertilizer for the seed). Therefore, the presence of frugivorous in a forest is very important in the process of regenerating habitat (Kinnaird, 1998).

3.2.5 Important species and their threats

Avifauna species such as Great hornbill (*Buceros bicornis*), Short-toed coucal (*Centropus rectunguis*), Crestless fireback (*Lophura erythroptalma*), Black partridge (*Melanoperdix niger)*, and Hook-billed bulbul (*Setornis criniger*), are considered important because they are categorized as near threatened (NT) to endangered (EN) and/or included in CITES appendix I or II. During the survey, several migratory species, such *as* Chinese sparrowhawk (*Accipiter soloensis*) and White-winged tern (*Chlidonias leucopterus*), were also observed highlighting the areas importance for migratory birds. Chinese sparrowhawk is a resident of Taiwan that, in the winter (from late August to early October) migrates south to Indochina, and as far south as the Sundas (Orta & Kirwan, 2020). Species migrate from their place of origin to mountainous areas, swamps, coastal waters, wetlands and some other places usually to escape weather changes and to find other food sources (Howes dkk., 2003).

The peat swamp habitat in the GAN concession supports threatened and migratory species. In general, the threat to animals in the GAN area is low primarily because of its very isolated location and as evidenced by no observable direct threats to habitats (illegal logging and forest fires), or direct threats to animals (hunting or traps) during the survey. The low threat risk in the area also corroborates the information and experiences of RER employees. However, security at access points to enter the RER area must still be tightened and the establishment of a permanent guard post in PT GAN is recommended so that the risk of anthropogenic threats remains low.

IV CONCLUSIONS AND RECOMENDATION

4.1 Conclusions

1. With 96 species from 34 families PT GAN has a low diversity of birds as compared with the other three concessions in the RER on Kampar Peninsula.
2. Forest bush bird avifauna are the dominant group in the GAN area.
3. Ground cover vegetation affects the presence of avifauna inhabitants of the lower vegetation layer.
4. There is a new Kampar Peninsula species recorded in PT GAN, namely Rufous-chested flycatcher (*Ficedula dumetoria)*, thus adding to the list of avifauna species in the RER.
5. There are 12 globally threatened avifauna species in the GAN, this record adds to the total threatened avifauna in the RER area to 16 species.

4.2 Recommendations

Several recommendations for management plans and actions for PT GAN are:

1. There is a need to increase knowledge and awareness of local communities regarding the importance of natural habitats and the ecological role of avifauna through environmental-based education.
2. The need for information boards regarding the prohibition of hunting for avifauna to be installed in PT GAN, especially along the Serkap river which is the primary access route for forest users.
3. It is necessary to monitor the richness and diversity of avifauna in each RER concession. Monitoring of avifauna richness should be implemented at least once a month by recording all detected avifauna species. Monitoring of avifauna diversity should occur at least every two years by recording species and the number of individuals to obtain information on trends in changes in avifauna diversity and population.
4. Continue to build capacity of RER staff and rangers, with training in bird identification and monitoring methods, and the provision of field-monitoring equipment.
5. Establish a permanent Guard Post near the Serkap River helipad in PT GAN to improve security patrols, forest and wildlife monitoring frequency, and discourage illegal activities.
6. Maximize the use of existing trails in each RER concession as bird monitoring routes.
7. Identify research needs and tourism opportunities, focusing on the presence of endangered, rare and migratory birds.

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APPENDIX

Appendix 1. List of avifauna species found in GAN

No	Latin Name	English Name	Famili	IUCN	Guild	CITES	RI Law	Migrant
1	*Spilornis cheela*	Crested Serpent-eagle	Accipitridae	LC	Carnivore			√
2	*Accipiter soloensis*	Chinese Sparrowhawk	Accipitridae	LC	Carnivore		√	
3	*Aegithina viridissima*	Green Iora	Aegithinidae	NT	Insectivore			
4	*Alcedo atthis*	Common Kingfisher	Alcedinidae	LC	Piscivore			
5	*Alcedo meninting*	Blue-eared Kingfisher	Alcedinidae	LC	Piscivore	II		
6	*Ceyx erithaca*	Oriental Dwarf-kingfisher	Alcedinidae	LC	Piscivore			
7	*Todiramphus chloris*	Collared Kingfisher	Alcedinidae	LC	Piscivore			
8	*Ardea purpurea*	Purple Heron	Ardeidae	LC	Piscivore			
9	*Rhabdotorrhinus corrugatus*	Wrinkled Hornbill	Bucerotidae	EN	Frugivore	II	√	
10	*Anorrhinus galeritus*	Bushy-crested Hornbill	Bucerotidae	NT	Frugivore	II	√	
11	*Anthracoceros malayanus*	Black Hornbill	Bucerotidae	VU	Frugivore		√	
12	*Buceros bicornis*	Great Hornbill	Bucerotidae	VU	Frugivore		√	
13	*Buceros rhinoceros*	Rhinoceros Hornbill	Bucerotidae	VU	Frugivore		√	
14	*Rhyticeros undulatus*	Wreathed Hornbill	Bucerotidae	VU	Frugivore		√	
15	*Calyptomena viridis*	Green Broadbill	Calyptomenidae	NT	Insectivore			
16	*Chloropsis cochinchinensis*	Blue-winged Leafbird	Chloropseidae	EN	Insectivore		√	
17	*Orthotomus atrogularis*	Dark-necked Tailorbird	Cisticolidae	LC	Insectivore			
18	*Orthotomus ruficeps*	Ashy Tailorbird	Cisticolidae	LC	Insectivore			
19	*Orthotomus sericeus*	Rufous-tailed Tailorbird	Cisticolidae	LC	Insectivore			
20	*Prinia flaviventris*	Yellow-bellied Prinia	Cisticolidae	LC	Insectivore			
21	*Prinia familiaris*	Bar-winged Prinia	Cisticolidae	NT	Insectivore			
22	*Treron curvirostra*	Thick-billed Green-pigeon	Columbidae	LC	Frugivore			

No	Latin Name	English Name	Famili	IUCN	Guild	CITES	RI Law	Migrant
23	*Treron olax*	Little Green-pigeon	Columbidae	LC	Frugivore			
24	*Cacomantis merulinus*	Plaintive Cuckoo	Cuculidae	LC	Insectivore			
25	*Cacomantis sonneratii*	Banded Bay Cuckoo	Cuculidae	LC	Insectivore			
26	*Centropus sinensis*	Greater Coucal	Cuculidae	LC	Insectivore			
27	*Chrysococcyx xanthorhynchus*	Violet Cuckoo	Cuculidae	LC	Insectivore			
28	*Phaenicophaeus tristis*	Green-billed Malkoha	Cuculidae	LC	Insectivore			
29	*Rhinortha chlorophaea*	Raffles's Malkoha	Cuculidae	LC	Insectivore			
30	*Surniculus lugubris*	Square-tailed Drongo-cuckoo	Cuculidae	LC	Insectivore			
31	*Phaenicophaeus sumatranus*	Chestnut-bellied Malkoha	Cuculidae	NT	Insectivore			
32	*Centropus rectunguis*	Short-toed Coucal	Cuculidae	VU	Insectivore		√	
33	*Dicaeum chrysorrheum*	Yellow-vented Flowerpecker	Dicaeidae	LC	Frugivore			
34	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker	Dicaeidae	LC	Frugivore			
35	*Prionochilus percussus*	Crimson-breasted Flowerpecker	Dicaeidae	LC	Frugivore			
36	*Prionochilus thoracicus*	Scarlet-breasted Flowerpecker	Dicaeidae	NT	Frugivore			
37	*Dicrurus annectens*	Crow-billed Drongo	Dicruridae	LC	Insectivore			
38	*Dicrurus macrocercus*	Black Drongo	Dicruridae	LC	Insectivore			
39	*Dicrurus paradiseus*	Greater Racquet-tailed Drongo	Dicruridae	LC	Insectivore			
40	*Eurylaimus javanicus*	Javan Broadbill	Eurylaimidae	NT	Insectivore	II		
41	*Eurylaimus ochromalus*	Black-and-yellow Broadbill	Eurylaimidae	NT	Insectivore			
42	*Irena puella*	Asian Fairy-bluebird	Irenidae	LC	Insectivore			
43	*Chlidonias leucopterus*	White-winged Tern	Laridae	LC	Piscivore			√
44	*Caloramphus fuliginosus*	Bornean Brown Barbet	Megalaimidae	LC	Insectivore			
45	*Psilopogon australis*	Yellow-eared Barbet	Megalaimidae	LC	Insectivore			
46	*Psilopogon rafflesii*	Red-crowned Barbet	Megalaimidae	NT	Insectivore			
47	*Merops philippinus*	Blue-tailed Bee-eater	Meropidae	LC	Insectivore			
48	*Hypothymis azurea*	Black-naped Monarch	Monarchidae	LC	Insectivore			
49	*Terpsiphone affinis*	Oriental Paradise-flycatcher	Monarchidae	LC	Insectivore			

No	Latin Name	English Name	Famili	IUCN	Guild	CITES	RI Law	Migrant
50	*Cyornis olivaceus*	Fulvous-chested Jungle-flycatcher	Muscicapidae	LC	Insectivore			
51	*Ficedula dumetoria*	Rufous-chested Flycatcher	Muscicapidae	LC	Insectivore			
52	*Ficedula zanthopygia*	Yellow-rumped Flycatcher	Muscicapidae	LC	Insectivore			
53	*Cyornis turcosus*	Malay Blue-flycatcher	Muscicapidae	NT	Insectivore			
54	*Cyornis umbratilis*	Grey-chested Jungle-flycatcher	Muscicapidae	NT	Insectivore			
55	*Trichixos pyrropygus*	Rufous-tailed Shama	Muscicapidae	NT	Insectivore			
56	*Arachnothera longirostra*	Little Spiderhunter	Nectariniidae	LC	Nectarivore			
57	*Leptocoma calcostetha*	Copper-throated Sunbird	Nectariniidae	LC	Nectarivore			
58	*Leptocoma sperata*	Purple-throated Sunbird	Nectariniidae	LC	Nectarivore			
59	*Malacopteron cinereum*	Scaly-crowned Babbler	Pellorneidae	LC	Insectivore			
60	*Malacopteron magnirostre*	Moustached Babbler	Pellorneidae	LC	Insectivore			
61	*Pellorneum capistratum*	Rufous-browed Babbler	Pellorneidae	LC	Insectivore			
62	*Trichastoma bicolor*	Ferruginous Babbler	Pellorneidae	LC	Insectivore			
63	*Malacopteron affine*	Sooty-capped Babbler	Pellorneidae	NT	Insectivore			
64	*Malacopteron albogulare*	Grey-breasted Babbler	Pellorneidae	NT	Insectivore			
65	*Malacopteron magnum*	Rufous-crowned Babbler	Pellorneidae	NT	Insectivore			
66	*Trichastoma rostratum*	White-chested Babbler	Pellorneidae	NT	Insectivore			
67	*Lophura erythrophthalma*	Malay Crestless Fireback	Phasianidae	VU	Omnivore			
68	*Melanoperdix niger*	Black Partridge	Phasianidae	VU	Omnivore			
69	*Phylloscopus borealis*	Arctic Warbler	Phylloscopidae	LC	Insectivore			
70	*Meiglyptes tristis*	White-rumped Woodpecker	Picidae	EN	Insectivore			
71	*Chrysophlegma miniaceum*	Banded Woodpecker	Picidae	LC	Insectivore			
72	*Dinopium javanense*	Common Flameback	Picidae	LC	Insectivore			
73	*Micropternus brachyurus*	Rufous Woodpecker	Picidae	LC	Insectivore			
74	*Picus puniceus*	Crimson-winged Woodpecker	Picidae	LC	Insectivore			
75	*Erythropitta granatina*	Garnet Pitta	Pittidae	NT	Insectivore		√	
76	*Pitta moluccensis*	Blue-winged Pitta	Pittidae	LC	Insectivore		√	

No	Latin Name	English Name	Famili	IUCN	Guild	CITES	RI Law	Migrant
77	*Batrachostomus poliolophus*	Short-tailed Frogmouth	Podargidae	NT	Carnivore	I		
78	*Loriculus galgulus*	Blue-crowned Hanging-parrot	Psittacidae	LC	Frugivore		√	
79	*Belocercus longicaudus*	Long-tailed Parakeet	Psittacidae	VU	Frugivore	II	√	
80	*Ixidia erythropthalmos*	Spectacled Bulbul	Pycnonotidae	LC	Insectivore	II		
81	*Pycnonotus plumosus*	Olive-winged Bulbul	Pycnonotidae	LC	Insectivore			
82	*Pycnonotus simplex*	Cream-vented Bulbul	Pycnonotidae	LC	Insectivore			
83	*Setornis criniger*	Hook-billed Bulbul	Pycnonotidae	VU	Insectivore		√	
84	*Rhipidura javanica*	Sunda Pied Fantail	Rhipiduridae	LC	Insectivore	II	√	
85	*Rhipidura perlata*	Spotted Fantail	Rhipiduridae	LC	Insectivore			
86	*Bubo sumatranus*	Barred eagle-owl	Strigidae	LC	Carnivore	II		
87	*Gracula religiosa*	Common Hill Myna	Sturnidae	LC	Omnivore		√	
88	*Cyanoderma erythropterum*	Chestnut-winged Babbler	Timaliidae	LC	Insectivore			
89	*Mixornis gularis*	Pin-striped Tit-babbler	Timaliidae	LC	Insectivore			
90	*Macronus ptilosus*	Fluffy-backed Tit-babbler	Timaliidae	NT	Insectivore			
91	*Stachyris maculata*	Chestnut-rumped Babbler	Timaliidae	NT	Insectivore			
92	*Stachyris nigricollis*	Black-throated Babbler	Timaliidae	NT	Insectivore			
93	*Harpactes diardii*	Diard's Trogon	Trogonidae	NT	Insectivore		√	
94	*Harpactes duvaucelii*	Scarlet-rumped Trogon	Trogonidae	NT	Insectivore		√	
95	*Harpactes kasumba*	Red-naped Trogon	Trogonidae	NT	Insectivore		√	
96	*Philentoma pyrhoptera*	Rufous-winged Philentoma	Vangidae	LC	Insectivore			

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