Fauna & Flora International's Indonesia Programme

THE DIVERSITY OF MAMMALS IN PT GLOBAL ALAM NUSANTARA (PT GAN) RIAU ECOSYSTEM RESTORATION

REPORT 2021

THE DIVERSITY OF MAMMALS IN PT GLOBAL ALAM NUSANTARA (PT GAN) RIAU ECOSYSTEM RESTORATION

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OVERVIEW

An extensive mammal survey was conducted in *Restorasi Ekosistem Riau* (RER) concession of PT Global Alam Nusantara (PT GAN) between March and August 2021. This survey is a continuation and completion of mammal surveys initiated in 2015 that aimed to provide reliable biodiversity baseline data in the 130,095 ha RER program area located on the Kampar Peninsula. Data collection using a combination of direct observations along transects and trapping with harp traps (non-volant mammals) and tomahawk live traps (small mammals). Additionally, this report integrates the results of the 2015 camera trap survey to complete the data. The Order Carnivora was the most dominant group observed. Twenty-nine mammal species were identified in PT GAN, including the Pen-tailed tree shrew *(Ptilocercus lowii)*, which is a new distributional record indicating a possible range extension, and the Sumatran porcupine *(Hystrix sumatrae);* first-time identification within the RER. This study succeeded in making the first echolocation recordings of two bat species that can be used as a reference for future acoustic monitoring.

I. INTRODUCTION

1.1 Background

Peat swamp forest is a unique and fragile ecosystem that is under threat from human disturbance. Peat swamp forests in Indonesia are located in Sumatra, Kalimantan, Papua and Sulawesi. Previously, the largest area of peatland forests in Indonesia was in Sumatra, with an area of 7,151,887 hectares. However, due to forest conversion from plantation development, illegal logging, encroaching agriculture and forest fires, Sumatra has experienced a 78% loss of peatland forest, compared to Kalimantan and Papua (Purba 2014). Today, Riau Province has the largest peatland area (4,004,434 ha) in Sumatra and about 671,125 ha in the Kampar Peninsula (Tropenbos International Indonesia Program 2011). The Kampar Peninsula contains the largest remaining block of peatland forest in Riau, highlighting its importance for biodiversity conservation, providing habitat for the Sumatran tiger and other globally threatened species, as well as being designated an Important Bird Area (IBA) by BirdLife International. The Kampar Peninsula also provides important ecosystem services such as carbon storage (2.14-2.68 billion tonnes $CO2_e$), the preservation of water resources and flood control (Tropenbos International Indonesia Program 2011).

The Riau Ecosystem Restoration (RER) program was formed by APRIL Group in 2013, with an area of 150,694 hectares. RER's focus is the protection, restoration and conservation of peat swamp forest ecosystems on the Kampar Peninsula and Padang Island, as part of the Ministry of Environment and Forestry's program to protect and restore 2.6 million hectares of degraded production forest (IUPHHK-RE). RER consists of five concessions located on two landscapes in Riau Province: The Kampar Peninsula (130,095 ha) and Pulau Padang (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-Indonesia Program (FFI-IP) in designing the framework, policies, and management plans relating to the Community, Climate and Biodiversity (CCB) assessment. This mammal survey in PT GAN is a continuation from previous biodiversity surveys conducted in 2015 by FFI-IP in three other RER concessions on Kampar Peninsula. This initiative will ensure that ecosystem services from the peat swamp forest remain available to people, especially those communities that live within this landscape.

Biodiversity is an important component of the peat swamp forest ecosystem on Kampar Peninsula. Restoration and conservation management efforts require data on biodiversity as a reference for formulating management strategies and conservation plans. Therefore, it is essential to study the diversity of fauna and flora in the PT GAN area.

Knowledge of the presence of wildlife, especially mammals, serves as a measure of the health of the landscape as mammals play a vital role within the ecosystem as important members of the food chain, as predators, seed dispersers, pollinators of several types of plants, insect and pest control, and other ecological functions (Suyanto 2001).

1.2 Objective

This report provides baseline data to RER management for developing long-term management and monitoring plans for the RER area, according to HCV concept and with the following objectives:

1. To identify and describe the current state of mammal diversity and any potential threats to it.

II. METHODS

2.1 Study Area

PT GAN is part of the Riau Ecosystem Restoration (RER) program area, located within the Kampar Peninsula landscape. The predominate ecosystem in the concession is peat swamp forest which is classified based on the type of vegetation that includes (Figure 1): (1) 12,840 ha of mixed peat swamp forests with uneven canopy heights and various condition classes (highly degraded, degraded and undisturbed), (2) 23,549 ha of peat swamp forests with low canopy (low pole forest), and (3) 98 ha of riparian forest. Riparian forest is mainly located along the Serkap River, which flows through the eastern edge of PT GAN (Tropenbos International Indonesia Program 2011). The dominant tree species in the concession are Meranti (*Shorea teysmanniana*), Bintangur (*Calophyllum ferrugineum*), with shrubs such as Mengkuang (*Pandanus andersonii*).

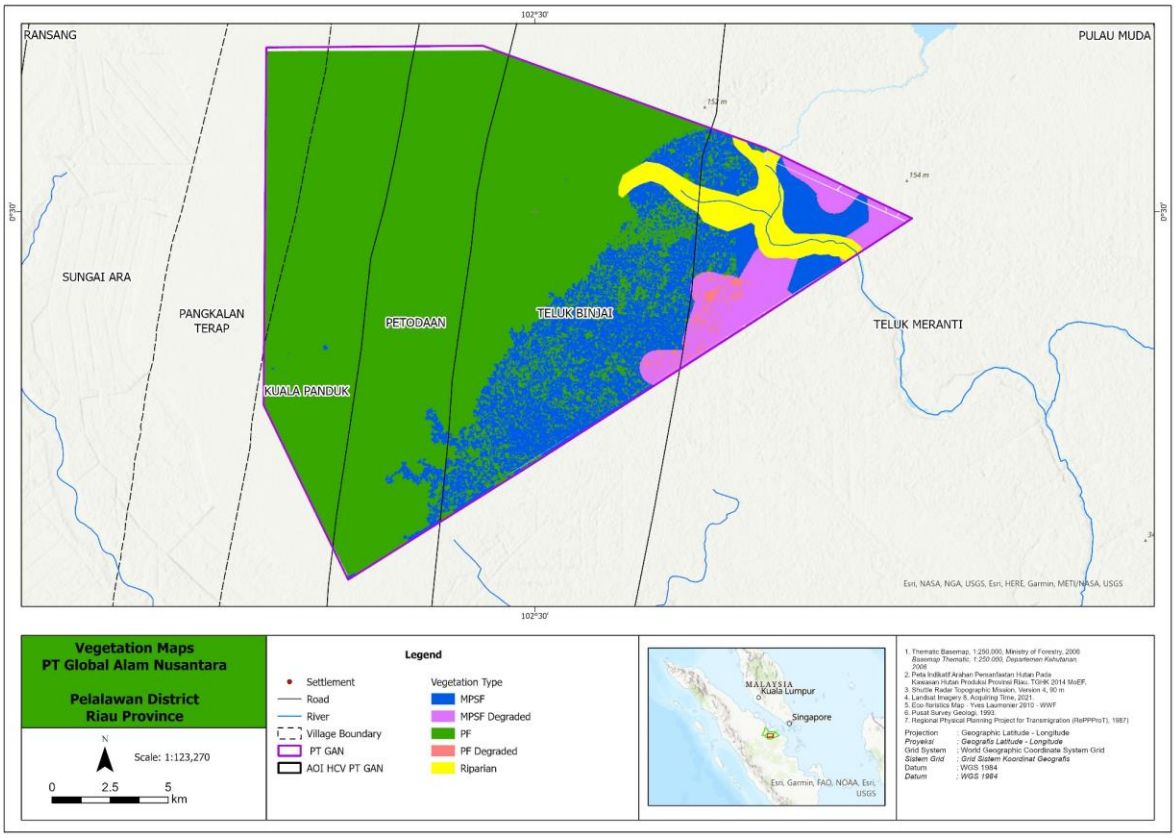

Figure 1. Forest cover condition in PT GAN.

The peat swamp forest ecosystem of Kampar Peninsula is an important habitat for globally threatened fauna and flora. There are several endangered flora species with high economic value, including: ramin (*Gonystylus* sp.), dipterocarps (*Shorea* spp.), durian (*Durio* sp.), kempas (*Kompassia malacensis*) and punak (*Tetramerista glabra*). Critically endangered and other threatened mammals include the Sumatran tiger (*Panthera tigris sumatrae*), pangolin (*Manis javanica*), and sun bear (*Ursus malayanus*) while hornbills, raptors, and reptiles (false gharial (*Tomistoma schlegelii*) and painted terrapin (*Batagur borneoensis*)) can also be found in this area (Tropenbos International Indonesia Program 2011).

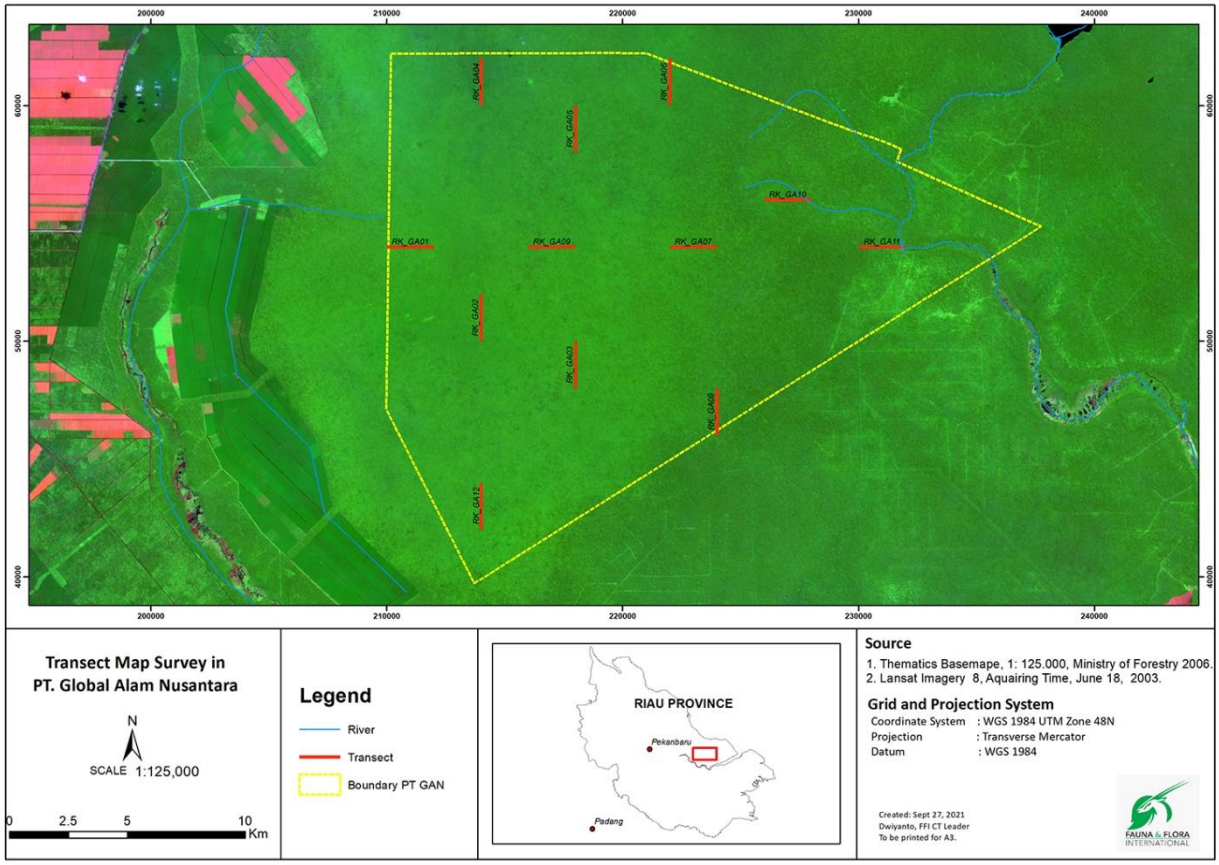

Figure 2. Distribution of transects in PT GAN.

The survey was conducted along 12 transects (Figure 2) from March to August 2021, with an effective survey time of 36 days. Transects were oriented in a North-South or East-West direction, each approximately 2-km long. Transects RK_GA10, RK_GA11, and RK_GA08 were located along the riverbank, with parts of the latter two being flooded by up to 70 cm of water during the survey. In contrast, transects RK_GA01 and RK_GA12 were approximately 4 km from the *Acacia crassicarpa* plantation.

2.2 Data Collection

Locations for the total length of 12 transects each has 2-km in length, were chosen by random sampling, stratified by peat forest type (see above). Once mapped, two main observation methods were applied:

1. Active observation
2. Live trapping

2.2.1 Line Transect

Transect lines were walked and any mammal signs were recorded (Varman & Sukumar, 1995). Observations were conducted from 06:00-12:00 and 17:00–22:00. During the observation period, both direct sightings of mammals and observation of their spoor (animal tracks, scratches, scent and droppings) were recorded, including species name, coordinate and distance from transect line. In the case of trapped animals, appropriate morphometrics (size) were recorded. Any mammals observed outside the transects were recorded using the reconnaissance walk method (Walsh and White 1999).

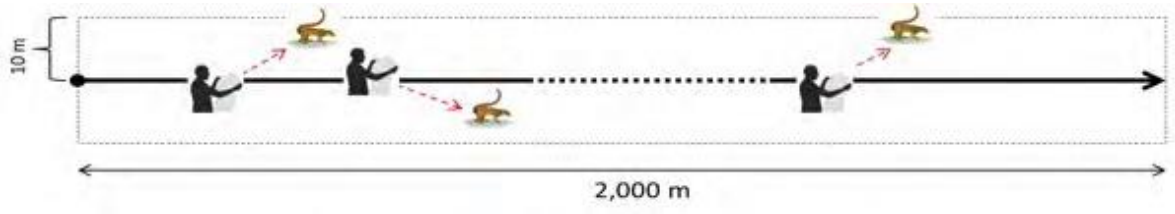

Figure 3. Line transect illustration.

2.2.2 Traps

Mammals that are difficult to observe directly were collected using traps; tomahawk live traps for rodents (Muridae), harp traps for bats (Chiroptera), and camera traps for elusive terrestrial mammals.

Live Trap

Live traps are targeted to capture small mammals from the rodent group (Muridae) and were installed along each observation transect at a distance between traps of up to 30 meters. Each trap was baited with a mixture of peanut butter, durian fruit

essence and grilled salted fish, which was replaced every 24 hours. Trapped individuals were measured (e.g. the total length (nose to tip of tail), tail length, hind foot length).

Figure 4. Live trap instalment.

Harp Trap

Harp traps are for the capture of insectivorous bats (Microchiroptera) that inhabit the lower forest canopy. Two sets of harp trap were placed for two nights on each transect, at a minimum distance of 500 meters between traps, and captured bats were measured (lengths of forearm, body, tail, ears, nostrils, and tragus (Suyanto 2001)).

Figure 5. Harp trap instalment.

In addition to body measurements, the reference recordings of echolocation calls was made using an Echo Meter Touch 2 ("EMT2 | Wildlife Acoustics"). This device records ultrasonic sounds with frequencies ranging from 10 kHz to 192 kHz, the threshold frequency for bats, and displayed as spectrograms.

Camera Traps

The survey was conducted from September 2020 to February 2021, with 91 camera trap stations. Camera traps were set up in each 2x2km grid cell, covering an area of 300 km^2. In each grid cell, one camera station was selected based on the possibility of getting pictures of wildlife and the camera mounted on a tree at a height of 40-50 cm. The distance between each camera trap was at least 1 km, to maintain independence of animal detections, and cameras were either set to take a single image or to record video[1]. The results from Camera Traps are documented in a separate technical report and have been integrated in this report to allow more insight into elusive mammals such as wildcat, civet, pangolin, etc.

[1] Avriandy, R., Dwiyanto, Permana, J., & Wibowo, J. S. (2022) Wildlife inventory from camera-trapping in PT Global Alam Nusantara, Restorasi Ekosistem Riau. Fauna & Flora International, Indonesia Programme.

Figure 6. Camera trap instalment.

Preservation and Identification

For the identification of trapped animals, field identification guides were used, as described by Suyanto (2001, 2006), Prasetyo et al., (2011), and Phillipps (2016). Individuals that could not be identified in the field were euthanized and preserved for later identification. Specimen preservation used 70% alcohol injected into the nape of the animal. Specimens were labeled and positioned for identification (Barnett and Dutton 1995).

Conservation/protection status for each species-record was based on the IUCN Red List (International Union for Conservation of Nature and Natural Resources), CITES Appendices (Convention on International Trade in endangered Species of Wild Fauna and Flora), and the Government of Indonesia's species protection act No. 106, 2018.

2.3 Data Analysis

2.3.1 Community Analysis

The community analysis reported here used only data collected along the transects. All community analysis was conducted in "R" (R Development Core Team 2011) with

following packages; 'BiodiversityR', 'treemap', 'spadeR' and 'iNext' (Tennekes and Ellis 2017; Kindt and Kindt 2008; Chao et al. 2016; Hsieh, Ma, and Chao 2016).

Mammal Diversity

The diversity of mammals in each transect was also measured using the Shannon–Wiener Diversity Index (H'), which provides a summary of the combination of species richness, evenness, and the number or proportion of individuals of each species (Shannon and Weaver 1949). In ecological studies, this value usually falls in the range of 1.5 to 3.5, where the higher the value, the greater the species diversity, and the proportion is almost evenly distributed.

In addition to measuring the Shannon diversity index, the Simpson species evenness index was also used (Simpson 1949). The distribution of individuals between species is considered to be even if the value is close to 1. Otherwise, if the value is close to 0, no species dominates the community.

Species Accumulation Curve

This analysis is used to determine the relation of species richness with the increasing number of transects, producing a species accumulation curve to measure the effectiveness of the survey and an estimate of the number of species that may still be found in the survey (Magurran 2013). To adjust with species rarity or 'singletons' (species represented by exactly 1 individual in the reference sample), we use iChao-1 (Chao and Chiu 2016) which is more sensitive with singletons.

Cluster Analysis

The cluster analysis provides a comparison of community composition between transects. Transects with similar mammalian communities will tend to group together (cluster) with a certain level of similarity, whilst transects containing significantly different compositions will form separate groups.

The Jaccard Index was used to measure the degree of similarity; this index is constrained within the presence-absence. When the range of values between the transects is close to 0, then the two transects have similarities in term of species composition. On the other hand, if the value is close to 1, the two transects are less likely to have similarities (Kindt and Coe 2005). The distance between transects is not influenced by the differences in species abundance between samples.

2.3.2 Acoustic Analysis

Bats Echolocation Characteristic

The sounds of bat echolocation, recorded through the Echo Meter, were visualized as spectrograms that describes the pattern of sound frequency (y-axis) and intensity changes with time (x-axis) (Scott 2012). Echolocation parameters can then be used as a reference for identifying target species without the need for capture. Parameters that are often used are minimum frequency, maximum frequency, peak frequency, pulse duration, and the interval between pulses (Figure 7).

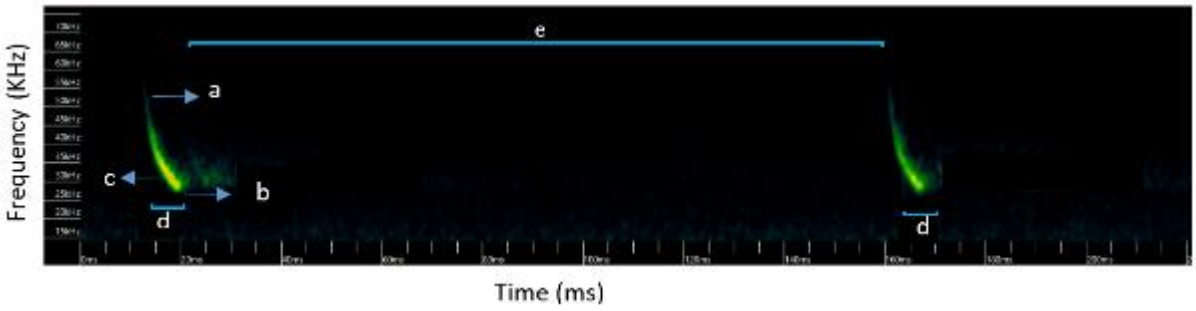

Figure 7. Spectrogram illustration with metric for echolocation structure. (a) Maximum Frequency (Fmax) (b) Minimum Frequency (Fmin) (c) Peak frequency (FME) (d) Duration (Dur) (e) Inter-pulse interval (IPI).

III. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Mammals Community

A total of 29 mammal species from eight orders and 20 families were identified in PT GAN using direct and secondary observations on line transects as well as camera traps from a separate survey. Based on the IUCN Red List, there are six Vulnerable (VU) species: clouded leopard (*Neofelis diardi*), sun bear (*Helarctos malayanus*), bearded pig (*Sus barbatus*), long-tailed monkey (*Macaca fascicularis*), pig-tailed macaque (*Macaca nemestrina*) and silvery lutung (*Trachypithecus cristatus*)); two Endangered (EN) species: agile gibbon (*Hyloabates agilis*) and Sunda slow loris (*Nycticebus coucang*); and two Critically Endangered (CR) species: Sumatran tiger (*Panthera tigris*) and Sunda pangolin (*Manis javanica*). In addition, there are 10 protected species based on Indonesian government regulation number 106 Year 2018 (Appendix 1).

Two additional mammal species were identified in PT GAN that were not previously observed in the 2015 surveys. These include the pen-tailed tree shrew (*Ptilocercus lowii)* found on transect number RK_GA06 and the Sumatran porcupine (*Hystrix sumatrae)* identified in camera trap grid cell RKGA_053.

Shannon-Wiener diversity index (H') in PT GAN is 1.94, and the Simpson evenness index is 0.76. The low diversity and high evenness index were because many of the mammals encountered along the line transect were dominated by the presence of sun bear. To some degree, differences in species abundance can be correlated to differences in ecological niche; for example, arboreal and nocturnal species, such as the small-toothed palm civet (*Arctogalidia trivirgata*), will be less readily observed on transects than purely terrestrial species.

3.1.2 New Record of *Ptilocercus lowii* in Riau

A pen-tailed tree shrew (*Ptilocercus lowii*) was observed in RK_GA06 on 18 March at 1930. We confirmed this encounter with one photograph by the teams in RK_GA06 (Figure 8). This species is easily identified by the plume like hair on the tip of the tail. The animal's back coloration is gray to light brownish with reflected yellow eye when pointed by a flashlight. We were unable to catch the animal since it was observed high on a tree branch. The second encountered on 28 July at 1525 was found while teams are getting ready for the night observation in RK_GA08. This species was not recorded during the 2015 surveys in other RER concession.

The pen-tailed tree shrew is found in peninsular Thailand, Malaysia, Sumatra, northern Borneo and nearby small islands, ranging from sea level to 2000 meters. This species

has been found in primary and secondary forests, rubber farms, and in houses near forest edges and usually observed at 1.5-2 meters off the ground on vines and branches (Payne et al 1985; Corbet and Hill 1992; Phillipps 2016). Currently, the IUCN assessment shows its Sumatra range as restricted to the Aceh region (Cassola 2021). These first verifiable records of pen-tailed tree shrew in PT GAN on Kampar Peninsula represents a possible range extension and a new record for the Kampar Peninsula. This species has very low detection rate and only observed coincidentally in this survey due to its small size, lives on the trees and active at night. Since all RER`s concessions had relatively similar habitat and almost had no barrier, it is likely this species inhabits other RER concessions.

Figure 8. Photograph of pen-tailed tree shrew (*Ptilocercus lowii*) in PT GAN.

3.1.3 Bats Echolocation Characteristic

In this study, only two species of echolocating bats were caught, the Lesser woolly horseshoe bat (*Rhinolopus sedulous*) and the Least woolly bat (*Kerivoula minuta*). The calls of each were upon release. The characteristics of the two species differ markedly from one another (Table 1), making future acoustic identification without capture a real possibility.

Table 1. Reference echolocation call parameter range measured manually in Kaleidoscope for two bat species in PT GAN.

Species	n	Fmax (Khz)	Fmin (Khz)	FME (Khz)	Dur (ms)	IPI (ms)
Rhinolophus sedulus	10	64-65	58-62	63 - 65	30-43	109-120
Kerivoula minuta	7	116-119	52-62	88-91	2 - 3	25-26

Structurally, these acoustic differences are clearly visible on the spectrograms (Figure 9). While *R. sedulus* has a constant frequency (CF) throughout the pulse, that of *K. minuta* is frequency modulated (FM), fluctuating throughout the pulse.

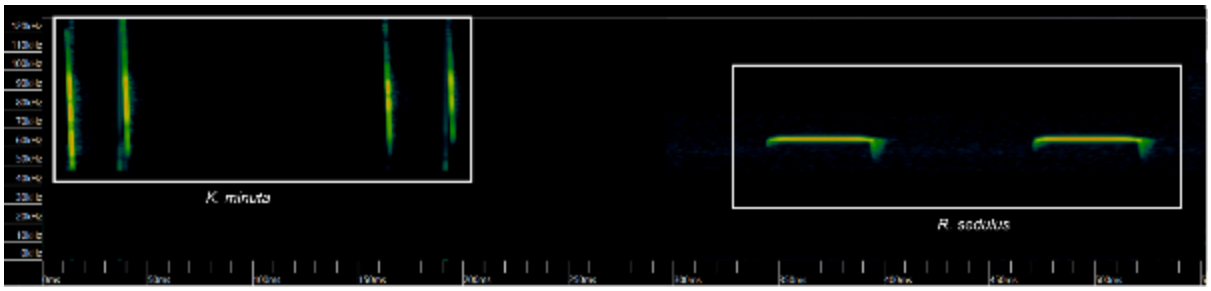

Figure 9. Spectrogram of echolocation calls of two bat species in PT GAN.

3.1.4 Threats to Mammals in PT GAN

Threats to mammals are categorized as either direct threats such as poaching or indirect threats to its habitat including illegal logging, forest conversion and forest fires. No direct or indirect threats were recorded during the survey period in PT GAN.

3.2 Discussions

3.2.1 Mammals Community

The distribution of species across the eight Orders and 20 families is visually represented (Figure 10), showing the Carnivora to be the most represented, in terms of number of species, followed by primates and rodents. The proportion of different species represented within an order indicates the level of detectability of the mammalian group in PT GAN. Generally, all mammal species, other than primates, are relatively difficult to observe, but since larger carnivores are mostly captured through camera traps deployed systematically across the entire concession, it is probable that detectability of carnivore species is higher than other mammal groups.

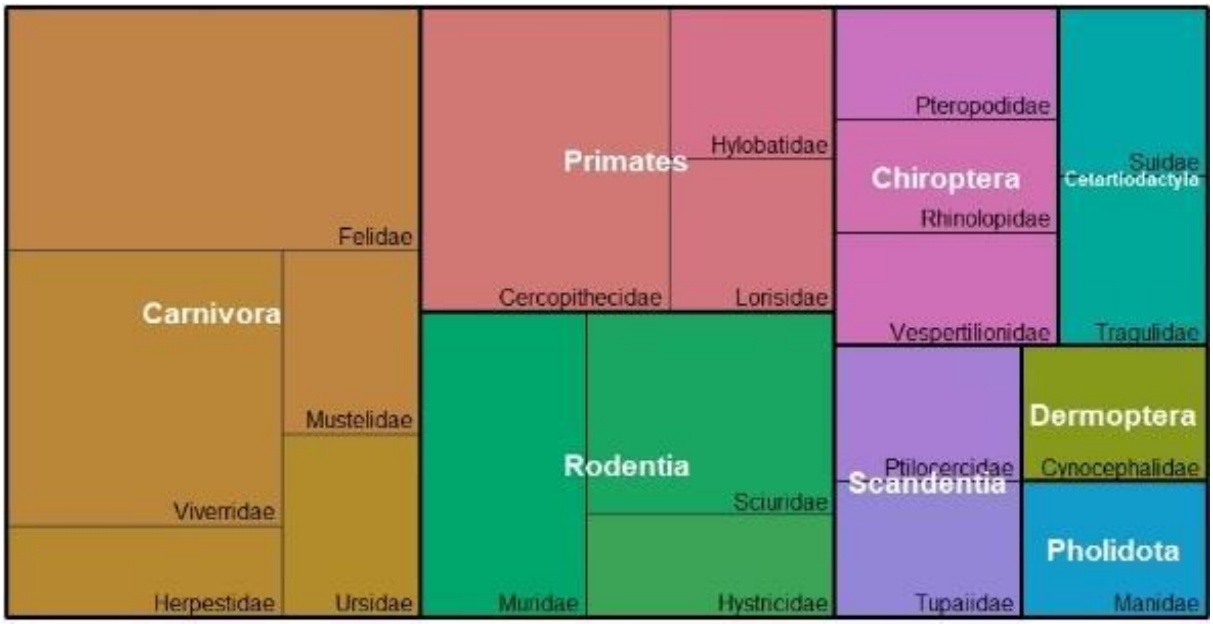

Figure 10. Comparison of mammal group composition in PT GAN.

Endangered and Protected Mammals

Only two of the 29 mammal species recorded are listed as Critically Endangered (CR) and, of these, the Sumatran tiger seems particularly scarce (captured twice on camera traps and four separate observations of pugmarks on transects). This is in keeping with current knowledge, whereby they tend to have lower densities in peat forests when compared to other forest types, especially in the Riau landscape (Wibisono et al., 2011). The pangolin (CR) had an even poorer encounter rate, with only one image recorded on camera traps near the Serkap River. The low encounters for pangolin are likely the result of traps placed slightly higher on trees that favor the capture of large mammals (i.e., Sumatran tiger and sun bear). Placement of the traps closer to the ground may have resulted in a higher capture rate for the pangolin.

Species listed as Endangered (EN) include the primates agile gibbon and Sunda slow loris. Whilst the agile gibbon was not recorded as a direct observation, its morning call was readily heard in almost all transects, particularly around the Serkap River. In this landscape, it plays an essential role in seed dispersal for several tree species, especially in the fig group (*Ficus spp*) (Kleiman, Geist, and McDade 2003). The Sunda slow loris was found mainly in the western and southern parts of PT GAN. As a nocturnal animal, all encounters were between 19:00-20:00. The slow loris nocturnal, arboreal, and solitary behavior all contributed to a relatively low encounter rate in PT GAN, which has a very dense canopy in some locations.

Vulnerable (VU) and nationally protected species recorded include the sun bear, clouded leopard and silvered langur. Three other species (long-tailed macaques, pig-tailed macaques, and bearded pigs) are listed globally as VU, but not in Sumatra. Sun bears were recorded on almost every transect and camera trap station, suggesting a high relative abundance in PT GAN, assumedly a product of their generalist diet and

lack of significant predators. The clouded leopard was found at five of the 91 camera trap stations, four of which were located near the Serkap river. Silvered langur was only recorded on one transect, near the Serkap River, in stark contrast to the more readily recorded macaque species. The silvered langur feeds exclusively on leaves and lives in small groups as compared to the macaques with much more varied diets and larger groups. There does seem to be, then, a tendency for ecological characteristics to play a role in detectability within the current survey.

Comparison of Species Richness

Previous surveys conducted in 2015 in RER adjacent concessions (PT TBOT, PT GCN, and PT SMN) resulted in comparative species richness values for mammal species of 48, 42, and 41, respectively (Alifianto, Sumantri, and Noerfahmy 2016).

The species accumulation curve (Figure 11) for PT GAN did not reach asymptote indicating that the species list presented in this study is not complete. Extrapolation of the curve, using iChao1, has the curve reaching asymptote at 33 species.

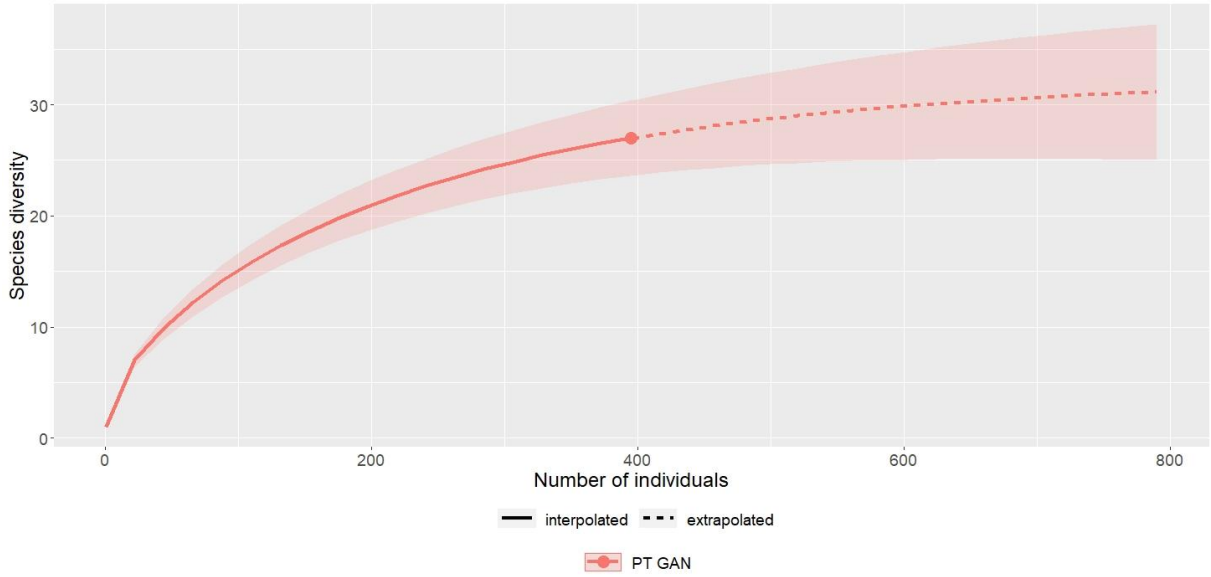

Figure 11. Species accumulation curve for PT GAN.

For further comparison, the peat swamp forest reserves Giam Siak Kecil Wildlife Reserve and the Berbak Sembilang National Park report 32 (Fujita et al. 2012) and 29 species (Perbatakusuma et al. 2012), respectively. In comparison to mineral soil forests, peat forests often have a lower species richness due to less efficient nutrient flows and productivity (Janzen 1974; Nishimua et al. 2007). This lack of productivity has implications for the number of wildlife that can be supported in peat forest areas. The diversity of plants in peat forest is less than half that found in dry, mineral soil forests. Additionally, peat forests support significantly fewer bat species and lower densities of several key terrestrial and arboreal vertebrates (Paoli et al. 2010).

Species Composition on Each Transect

The composition of species found in each transect (Table 2) shows that transect RK_GA07 (transition from Low pole forest to MPSF) had the highest number of species (nine). On the other hand, RK_GA09 (in Low pole forest) had the fewest number of species (three). The highest abundance of individuals occurred in RK_GA03 (Low pole forest), with 71 records. In contrast, transect RK_GA11 (Riparian forest) had only 12 encounters. The most frequently recorded species in all transects was the sun bear (*Helarctos malayanus*).

Table 2. Species richness and index in each transect in PT GAN.

Transect	GA 01	GA 02	GA 03	GA 04	GA 05	GA 06	GA 07	GA 08	GA 09	GA 10	GA 11	GA 12
Species	6	5	5	8	7	6	9	7	3	8	6	8
Individual	57	27	71	20	36	28	31	44	22	13	12	34
Shannon Index	1.27	1.14	1.36	1.75	1.63	1.4	1.82	1.32	0.82	2.03	1.47	1.63
Simpson Index	0.65	0.61	0.72	0.77	0.77	0.7	0.78	0.62	0.52	0.86	0.69	0.74

Figure 12 presents a dendrogram that illustrates the differences in species composition in each transect. The higher the value, the higher the difference between the transects; the lower the value, the more similar the transects. For example, the transects with the highest similarity are RK_GA06 and RK_GA02 with a dissimilarity index value of 0.39.

In this way, the dendrogram reveals two major groups: the first comprises just two transects, RK_GA10 and RK_GA11, both located adjacent to the Serkap River. The second group consists of all other transects located in the middle to the western part of the PT GAN where low pole forest in predominate.

The uniqueness of the two transects, RK_GA10 and RK_GA11, is also shown in the composition of other surveyed taxa, such as birds, herpetofauna, and plants, reported in other thematic reports in PT GAN. This difference in the species composition may be influenced by the riparian habitat conditions of the two transects that can support more species as compared to other areas in peat forests. As described in the methods, this cluster is constructed with Jaccard Index so that species that have larger abundances will not carry a larger weight in the analysis.

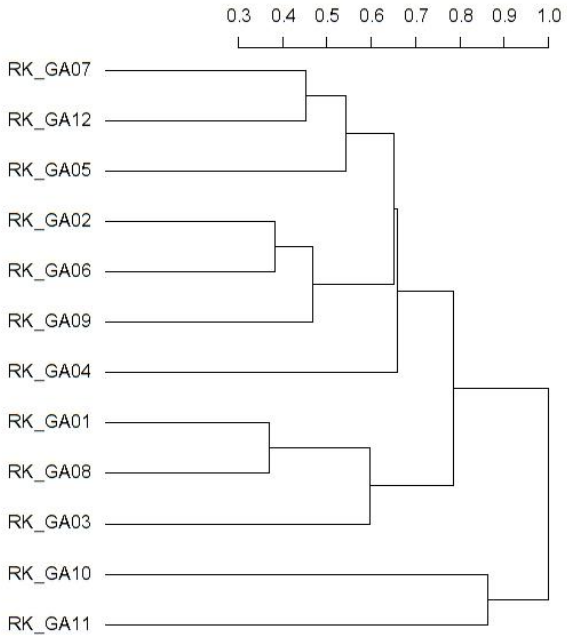

Figure 12. Comparative species diversity dendrogram.

3.2.2 Echolocation Characteristic

Although the survey team only succeeded in obtaining the echolocation calls of two bat species, this technique is increasingly used for survey and monitoring bats (Walters et al. 2012). While echolocation surveys in the tropics are still in its infancy, it is effectively used for identifying species-specific characteristics in Europe with significantly fewer bat species. There is potential for non-invasive bat surveys to be carried out using equipment ("bat detectors") that can identify species based solely on their echolocation calls.

In the tropics, the biggest challenge to documenting the echolocation character of bats is the higher number of species and the similarity of call characteristics between species, compared to European countries. Besides that, tropical areas are more challenging to reach, and there is low community involvement in monitoring biodiversity, especially bats (Walters et al. 2013).

IV CONCLUSIONS AND RECOMMENDATION

4.1 Conclusion

1. The current survey suggests that PT GAN has a lower species richness than the previously surveyed (2015) RER concessions, though this may be a product of survey effort, as indicated by the species accumulation curve failing to reach asymptote.
2. PT GAN retains a high conservation value due to the presence of several globally threatened and critically endangered species.
3. There is a distinct community composition difference in the area surrounding the Serkap River, which is also observed in other taxa, indicating a distinct segregation of habitat types in the riparian area.
4. Records for the pen-tailed tree shrew (*Ptilocercus lowii*) represent a potential range extension for this species in Sumatra.

4.2 Recommendations

1. Conduct periodic and regular wildlife monitoring in the MPSF near the river branches to the west of Serkap River as the transects located in this area have higher diversity and relatively accessible by Security Rangers.
2. Conduct further investigation of the presence of *Ptiloercus lowii* and update the IUCN Red List.
3. Continue efforts to record bat echolocation calls as a reference for future identification and monitoring.

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APPENDICES

Appendix 1. List of 29 mammals identified in PT GAN.

Ordo	Family	Species Name	English Name	IUCN	Trend*	CITES	GOI**
Carnivora	Felidae	*Neofelis diardi*	Sunda Clouded leopard	VU	Decreasing	I	P
		Panthera tigris sumatrae	Sumatran tiger	CR	Decreasing	I	P
		Pardofelis marmorata	Marbled cat	NT	Decreasing	I	P
		Prionailurus bengalensis	Leopard cat	LC	Stable	II	P
	Herpestidae	*Herpestes brachyurus*	Short-tailed mongoose	NT	Decreasing	-	-
	Mustelidae	*Martes flavigula*	Yellow-throated marten	LC	Decreasing	-	-
	Ursidae	*Helarctos malayanus*	Sun bear	VU	Decreasing	I	P
	Viverridae	*Arctogalidia trivirgata*	Small-toothed palm civet	LC	Decreasing	-	-
		Hemigalus derbyanus	Banded civet	NT	Decreasing	-	-
		Viverra tangalunga	Malay civet	LC	Stable	-	-
Cetartiodactyla	Suidae	*Sus barbatus*	Bearded pig	VU	Decreasing	-	-
	Tragulidae	*Tragulus* sp	Mousedeer	-	-	-	P
Chiroptera	Rhinolopidae	*Rhinolophus sedulus*	Lesser woolly horseshoe bat	NT	Decreasing	-	-
	Pteropodidae	*Pteropus vampyrus*	Large flying-fox	NT	Decreasing	-	-
	Vespertilionidae	*Kerivoula minuta*	Least woolly bat	NT	Decreasing	-	-
Dermoptera	Cynocephalidae	*Galeopterus variegatus*	Sunda colugo	LC	Decreasing	-	-
Pholidota	Manidae	*Manis javanica*	Sunda pangolin	CR	Decreasing	I	P
Primates	Cercopithecidae	*Macaca fascicularis*	Long tailed macaque	VU	Decreasing	-	-
		Macaca nemestrina	Pig-tailed macaque	VU	Decreasing	-	-
		Trachypithecus cristatus	Silvered langur	VU	Decreasing	-	P
	Hylobatidae	*Hylobates agilis*	Agile gibbon	EN	Decreasing	I	P
	Lorisidae	*Nycticebus coucang*	Sunda slow loris	EN	Decreasing	I	P

Ordo	Family	Species Name	English Name	IUCN	Trend*	CITES	GOI**
Rodentia	Hystricidae	*Hystrix sumatrae****	Sumatran porcupine	LC	Stable	-	-
	Muridae	*Rattus sp*	Rat species	-	-	-	-
		Rattus exulans	Polynesian rat	LC	Stable	-	-
	Sciuridae	*Callosciurus sp*	Squirrel species	-	-	-	-
		Ratufa bicolor	Black giant squirrel	NT	Decreasing	II	-
Scandentia	Ptilocercidae	*Ptilocercus lowii****	Pen-tailed tree shrew	LC	Decreasing	-	-
	Tupaiidae	*Tupaia sp*	Tree shrew	-	-	-	-

*Based on global assessment by IUCN 2021

**GOI; Government of Indonesia, Ministry of Environment and Forestry regulation No.106, year 2018. P; Protected

*** New species for RER on Kampar Peninsula

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